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Simulation Research of Extension Control Based on Crane-Double Pendulum System

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Abstract

According to the existed structure and algorithm of extension controller, proposed an improved extension control algorithm based on the Optimal Control, which was named LQR-EC, and applied to a SIMO system—Crane-Double Pendulum System. And, using MATLAB simulation platform to study the effect of the LQR—EC Algorithm. The result shows that, the LQR-EC Algorithm not only has a simple theory, but also has rapid response and stability.

Keywords: Extension Control, Crane-Double Pendulum System, Simulation Research

Introduction

Extension Control, a concept and method of intelligent control, was established and developed on the basis of Extension Theory, which was originated from China. In the recent years, many experts and scholars have carried out the corresponding research of the structure and algorithm of Extension Controller, and have achieved certain results.

Crane-Double Pendulum System is a non-linear, multi-variables and complex system. It is an ideal model of testing various control theory. In this paper, for crane-double system proposed LQR-EC Algorithm, which is based on the existing EC Algorithm and Optimal Control Theory. The simulation research shows that the LQR-EC Algorithm can satisfy the purpose of improving the control effect, and steadying the system more quickly.

1. Proposed of Extension Control Method

In 1991, Wang Shine-yu, a Professor of East China University of Science and Technology, proposed a new concept and method of Intelligent Control, denominated Extension Control, which basic idea is to solve control problem form the aspect of information transformation. In other word, it is to transform the control information into the eligible value range by using dependent degree to tune the output modification factors. He is the opener of Extension Control. Based on this idea, they set up the structure of Extension Controller is shown in Fig.1.

Fig.1 shows the structure of extension controller, which adopts dual-layer structure including upper-layer extension controller and basic extension controller.

The basic extension controller consists of five parts: character selecting, character pattern identification, dependent degree identification, measure pattern identification and control algorithm. The basic extension controller is used for completing the main control function.

The upper-layer extension controller consists of database, repository, and manage of decision-making and information. Database and repository are used for saving the information of control process and expert knowledge respectively. As

the basic extension controller's consummate and supplement, this upper-layer controller is used to optimize the basic control, guarantee the good control effect, and reflect the transform of contradictory question, which is the extension control emphasized.

The extension control theory and method has provided the basis theory and method for people to solve the existent contradictory questions in the automatic control system such as stability, accuracy and speed.

In 1996, Pan Dong and Jin Yi-hui proposed a more complete structure of extension control, and improved the control algorithm. All of these enabled the extension controller can use a simple knowledge to self-study, consequently to achieve the better control effect. In 2005, Huang Ying and Yu Yong-quan proposed an improved extension control algorithm by adopting dependent degree and status distance, the basic extension controller's whole output of algorithm is as follows:

$$u(t)=\begin{cases} u(t-1), & K(s)>=0 \\ y(t)/k-p\cdot K(s)\cdot \mathrm{sgn}(e)+D(s)\cdot \mathrm{sgn}(e)\cdot g, & -1\le K(s)<0 \\ u_m, & K(s)<-1 \end{cases}$$

Where, $u(t)$ is the current output value, $u(t-1)$ is the previous control value, $y(t)$ is the current sampling value of control object, k is the static gain, $K(s)$ is the dependent degree of character status, $D(s)$ is the status distance, p is modification factor, $\mathrm{sgn}(e)$ is the symbol function of error e shown in the follows:

$$\mathrm{sgn}(e)=\begin{cases} 1, & e>0 \\ 0, & e=0 \\ -1, & e<0 \end{cases}$$

2. Modeled and analyzed of Crane-Double Pendulum System

In the actual production, it requests the crane to deliver the goods to the destination as soon as possible, and does not allow to present wide range of swinging in the process of moving. This requests the crane to maintain the two angles' steady, moreover the car itself must achieve the destination at last. All of these will be achieved through motor by the control of controller. The model of Crane-Double System is as shown in Fig.2.

Where, M is the crane's equivalent quality, m_1 is the upper-pendulum's equivalent quality, m_2 is the lower-pendulum's equivalent quality, x is the car's position, α is the angle 1, β is the angle 2, l_1 is the length of the upper-pendulum, l_2 is the length of the lower-pendulum, F is the pulling force of the car received.

Analyzed the model of crane-double pendulum system, and adopted $x=[x,\dot{x},\alpha,\dot{\alpha},\beta,\dot{\beta}]'$ as the system's feature vector. The vector expresses the car's position, car's response speed, the upper-pendulum's angle, the upper-pendulum's response angular speed, the lower-pendulum's angle, and the lower-pendulum's response angular speed respectively.

And from the analysis, we know that $x=\dot{x}=\alpha=\dot{\alpha}=\beta=\dot{\beta}=0$ is the system's balance point. First, doing linear processing of the system nearby the balance point, and then taking the actual parameters of crane-double pendulum system are as follows: motor's load $J=1\times10^{-4}kg\cdot m^2$, anti-electromotive force coefficient $Ke=0.4758V\cdot s$, armature resistance $Ra=13.5\Omega$, moment coefficient $Kt=0.0491kg\cdot m/A$, transmission round radius $r=0.02276m$, $m_1=0.3kg$, $m_2=0.5kg$, $M=0.4kg$, $l_1=0.205m$, $l_2=0.156m$.

Finally, we can obtain the state-space equation of the crane-double pendulum system is:

$$\begin{cases} \dot{x}=Ax+Bu \\ y=Cx+Du \end{cases}$$

Where, $A=\begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & -58.1558 & -13.3099 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -73.7445 & -112.7311 & 0 & 79.6748 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 73.7445 & 112.7311 & 0 & -247.1962 & 0 \end{bmatrix}$, $B=\begin{bmatrix} 0 \\ 9.4888 \\ 0 \\ 46.275 \\ 0 \\ -46.275 \end{bmatrix}$, $C=eye(6)$, $D=0$.

With the aid of the MATLAB software, analyzed the performance of system's mathematical model, we find that this crane-double pendulum system is able to be controlled and observed completely.

3. LQR-EC Algorithm

The crane-double pendulum system is a SIMO system, the input is a voltage value, which indicates the car's target location, 6 outputs correspond to the 6 condition quantities of the state space equation.

For this single-input and multi-outputs system, adopts error (e) and error differential ($\dot{e}$) as the characteristic quantity of extension control, which are shown as follows:

$$e=\sum_{i=1}^{3} k_i e_i \,,\ \dot{e}=\sum_{i=1}^{3} k_i \dot{e}_i$$

Where, e_i and $\dot{e}_i$ are the error and error differential which correspond the response of car's position, the upper-pendulum's angle and the lower-pendulum's angle respectively; k_i is the weighted factor, and its value range is $0<k_i<1$.

Assumed that the allowable value ranges of weighted error (e) and weighted error differential ($\dot{e}$) of control object are $[-e_{iom},\ e_{iom}]$ and $[-\dot{e}_{iom},\ \dot{e}_{iom}]$ respectively, the maximum extensible value ranges of weighted error (e) and weighted error differential ($\dot{e}$) of control object are $[-e_{im},\ e_{im}]$ and $[-\dot{e}_{im},\ \dot{e}_{im}]$ respectively. So the extension set about character status $S(e,\dot{e})$ of basic extension controller can be represented in Fig.3.

In Fig.3, assumed that character status of the original point is $S_0(0,0)$, and point $S(e,\dot{e})$ is a character status of a random point in the coordinate plane.

Here defines that the distance from a random point of the coordinate plane to the original point of the coordinate plane is called status distance, written as D_S .

Then from Fig.3 we can get the maximum status distance of classic domain and extension domain, together with the status distance of a random point of the coordinate plane can be represented by the following equations:

$$D_0=\sqrt{e_{iom}^2+\dot{e}_{iom}^2}\ ,\ D_m=\sqrt{e_{im}^2+\dot{e}_{im}^2}\ ,\ D_S=\sqrt{e_i^2+\dot{e}_i^2}$$

Now defines that $K(s)=\begin{cases} 1-\left|SS_0\right|/M_0, & S\in[Classic-domain] \\ (M_0-\left|SS_0\right|)/(M_{-1}-M_0), & S\notin[Classic-domain] \end{cases}$ is the character status

dependent degree of a random point $S(e,\dot{e})$ in the coordinate plane. Where $\left|SS_0\right|=\sqrt{K_1 e_i^2+K_2\dot{e}_i^2}$, and K_1 and K_2 are the modification factors which were decided by the character pattern of themselves.

The dependent degree $K(s)$ indicates the connection degree of character status $S(e,\dot{e})$ and extension set. And the measure pattern of system can be divided from analysis of $K(s)$.

For the extension controller mainly works in the scope of system's unstable and critical-stable stage, and the LQR algorithm has already could realize the preliminary control of the crane-double pendulum system, so output value of the improved LQR-EC algorithm of basic extension controller can be given as follows:

(1) Measure pattern M_1

The character status of measure pattern M_1 is in the classic domain, which is able to be controlled completely, written as $M_1=\{s|K(s)\geq 0\}$. So, we adopt linear quadratic optimal control algorithm in this measure pattern. The output of controller is:

$$u(t)=-Kx$$

Where $K=[K_1,K_2,...,K_n]$ is the feedback gain matrix obtained from the control of LQR, x is the feature vector of crane-double pendulum system.

(2)Measure pattern M_2

The character status of measure pattern M_2 is in the extension domain, written as $M_1=\{s|K(s)\geq 0\}$. So, we adopt the improved extension control algorithm in this measure pattern, named LQR-EC algorithm. The output of controller is:

$$u(t)=-Kx-K_{ci}\cdot K(s)\cdot \mathrm{sgn}(e)+D(s)\cdot g\cdot \mathrm{sgn}(e)$$

Where $K(s)$ is the dependent degree of character status S ; K_{ci} is the control parameter of the measure pattern M_{2i} ; $D(s)$ is the status distance; g is the modification factor, e is the weighted error; $\mathrm{sgn}(e)$ is the symbol function or weighted error e .

(3)Measure pattern M_3

The character status of measure pattern M_3 is in the no-domain, written as $M_3=\{s|K(s)<-1\}$, the output of controller adopts maximum value. The output of controller is:

$u(t)=u_m$

From the above analysis, the whole LQR-EC algorithm of basic extension controller is as follows:

$$u(t)=\begin{cases} -Kx, & K(s)>=0 \\ -Kx-K_{ci}\cdot K(s)\cdot \mathrm{sgn}(e)+D(s)\cdot g\cdot \mathrm{sgn}(e), & -1\le K(s)<0 \\ u_m, & K(s)<-1 \end{cases}$$

4. Simulation research of extension control

For the model of crane-double pendulum system which obtained from the second part, we using the linear feedback extension controller to simulate the system model by the help of the simulation tool of MATLAB.

The controller is designed to control the pendulums to swing when there is a step-input for the system, and the pendulums can return to the upright position finally. And at the same time, the car can arrive at the new target location. The LQR-EC algorithm is programmed by the S-function of MATLAB, with one output and seven inputs (the first six inputs are the motion states of system, and the seventh input is the car's target location).

The original state of system is $x(0)=0,\dot{x}(0)=0,\alpha(0)=1.2,\dot{\alpha}(0)=0,\beta(0)=-1.2,\dot{\beta}(0)=0$. And the angles of pendulums are expressed with the Arc measure. The target location of the car is $x=0.2$; the expectation state is $x(0)=0.2,\dot{x}(0)=0,\alpha(0)=0,\dot{\alpha}(0)=0,\beta(0)=0,\dot{\beta}(0)=0$.

The result of simulation research of the car and pendulums are shown in Fig4.

5. Conclusion

From the shown of Fig.4, we found that compared with LQR Algorithm, the LQR-EC Algorithm mainly works in the system of unstable and critical-stable stage. The improved extension control algorithm not only can achieve the ideal control effect, but the more importantly is that it can reduce the system's control time and cause the system to stabilize quickly.

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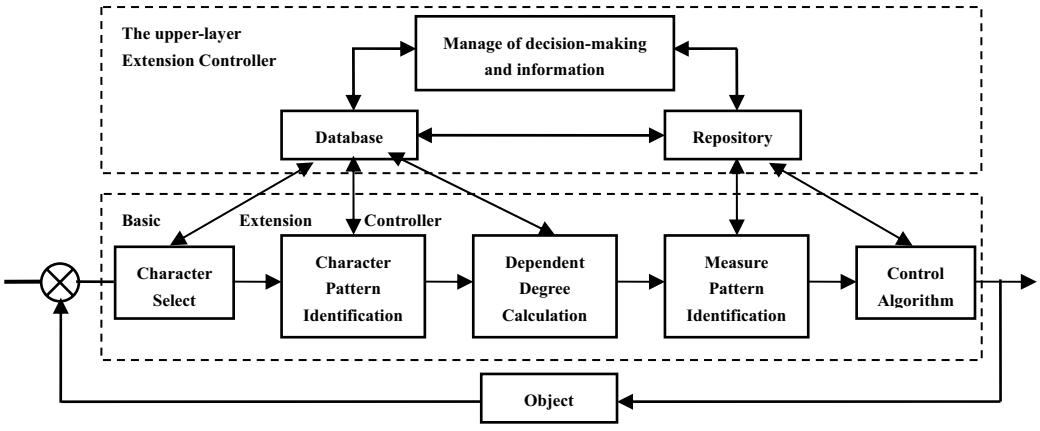


Figure 1. The structure of Extension Controller

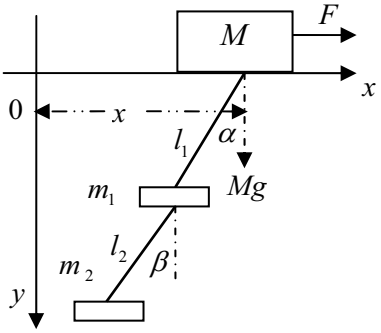


Figure 2. Model of Crane-Double System

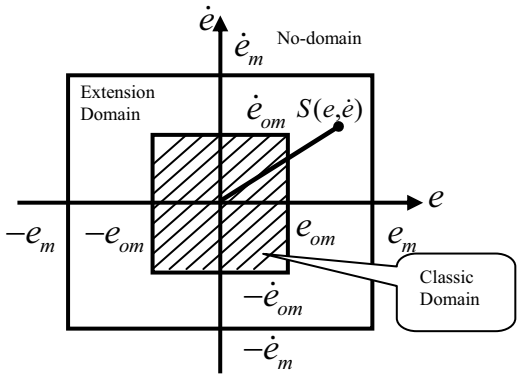
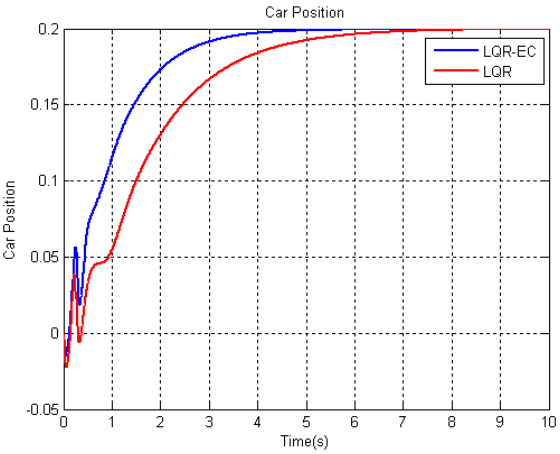
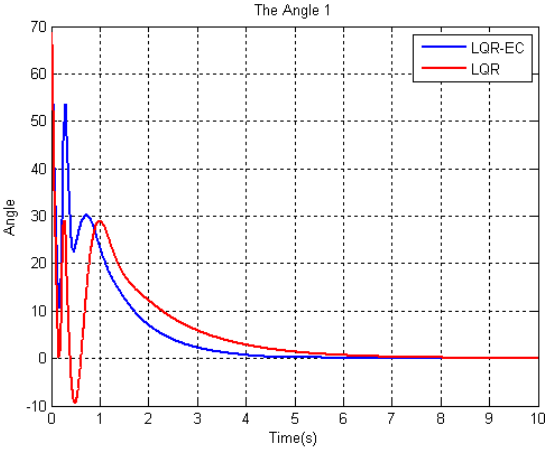


Figure 3. The extension set about character status $S(e,\dot{e})$



(1) response of car's position



(2) response of the upper-pendulum's angle

Figure 4. Response of the system

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An Analysis of Improving Memory Performance Based on EEG Alpha and Theta Oscillations

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Abstract

Evidence is presented that EEG oscillations in the alpha and theta band reflect memory performance in particular. Good performance is related to two types of EEG phenomena: a tonic increase in alpha but a decrease in theta power, and a large phasic decrease in alpha but increase in theta, depending on the type of memory demands. In a similar way as brain volume does, upper alpha power increases from early childhood to adulthood, whereas the opposite holds true for the late part of the lifespan. Alpha power is lowered and theta power enhanced in subjects with a variety of different neurological disorders. Furthermore, after sustained wakefulness and during the transition from waking to sleeping when the ability to respond to external stimuli ceases, upper alpha power decreases, whereas theta increases. Event-related changes indicate that the extent of upper alpha desynchronization is positively correlated with (semantic) long-term memory performance, whereas theta synchronization is positively correlated with the ability to encode new information.

Keywords: EEG, Alpha, Theta, Oscillation, Memory

1. Introduction

Scalp EEG signals are produced by partial synchronization of neuronal-scale field potentials across areas of cortex of centimetre-squared scale. Although once viewed by some as a form of brain 'noise', it appears increasingly probable that this synchronization optimizes relations between spike-mediated 'top-down' and 'bottom-up' communication, both within and between brain areas. This optimization might have particular importance during motivated anticipation of, and attention to, meaningful events and associations – and in response to their anticipated consequences (A. von Stein *et al.* 2000.)(P. Fries *et al. 2001.*)(E. Salinas and T.J. Sejnowski. 2001.). In a physiological sense, EEG power reflects the number of neurons that discharge synchronously.During the few years, alpha and theta oscillations have attracted considerable interest . It is the purpose of the present article to show that EEG power is indeed related to memory performance, but in a complex and partly non-linear way. Within the alpha frequency range EEG power is positively related to cognitive performance and brain maturity, whereas the opposite holds true for the theta frequency range. Alpha and theta reactivity as well as event-related changes in alpha and theta band power show yet another pattern of results. During actual task demands the extent of alpha power suppression is positively correlated with memory performance in particular, whereas again the opposite holds true for the theta band. The extent of theta synchronization is related to good performance.

2. Design and method

2.1 Subjects

A sample of 10 right handed students (5 males and 5 females) participated in the experiment. Their mean age was 23.5 years. Before participating in the experiment, subjects were asked about the hand they use in different tasks such as

handwriting, throwing a ball, etc. A subject was considered right-handed if he/she indicated to use the right hand for all of these different tasks.

2.2 Design

Subjects had to respond by pressing a ‘yes' response key if the letter or number of the frame was contained in the memory set, otherwise with ‘no'. Each subject was tested under all of the experimental conditions. Presentation sequence was counterbalanced between subjects.

2.3 Apparatus

EEG-signals were amplified by a 32-channel biosemi system (frequency response: 0.15 to 30Hz), subjected to an anti-aliasing filterbank (cut-off frequency: 30 Hz, 110 dB/octave) and were then converted to a digital format via a 32-channel A/D converter. Sampling rate was 256 Hz. During data acquisition, EEG signals were displayed online on a high resolution monitor and stored on disk.

2.4 Recordings

A set of 25 silver electrodes, attached with a glue paste to the scalp was used to record EEG-signals. Thirteen electrodes were placed according to the International Electrode (10–20) Placement-System, at F3, F4, Fz, C3, C4, Cz, T3, T4, P3, P4, Pz, O1 and O2. From the remaining twelve electrodes, 4 electrodes were placed over parieto-occipital areas (PO3, PO1, PO2, PO4), 4 electrodes were placed over centro-parietal areas (CP5, CP1, CP2, CP6), and 4 electrodes were placed over fronto-central areas (FC5, FC1, FC2, FC6). (Figure 1) In addition to the 25 electrodes described above, two ear lobe electrodes (termed A1 and A2), were attached to the left and right ear. The EOG was recorded from 2 pairs of leads in order to register horizontal and vertical eye movements.

3. Conclusion

3.1 Event-related changes in the alpha and theta band

Since the work of Berger it was suggested that visual (or other sensory) task demands and visual attention in particular are the primary factors that lead to a suppression of the alpha rhythm (W.J. Ray and H.W. Cole. 1985.). In using event-related desynchronization (ERD), a method introduced originally by Pfurtscheller and Aranibar (G. Pfurtscheller and A. Aranibar. 1977.), recent research has revealed a much more complex picture.

A typical example of an EEG epoch which is used for measuring event-related desynchronization (ERD) is shown in(Figure 2). During the first second of the epoch, which is called reference interval, the subject shows pronounced rhythmic alpha activity. Subjects run through many trials and, thus, the anticipation of the warning signal already causes alpha to desynchronize even before the warning signal actually appears. As spectral analysis shows, this attentional effect is reflected only in the lower alpha band. The subjects' task was to read a visually presented word and to make a semantic judgment by responding ‘yes' to a word denoting a living and ‘no' to a word denoting a non-living object. Before a word appeared a warning signal is presented. Subjects had to judge a total of 96 words. The basic principle for measuring ERD is that alpha shows a typical phasic change over the time course of a trial. After a response, the subject relaxes and awaits the presentation of the next stimulus. This state of relaxed but alert wakefulness is reflected by a pronounced alpha activity during the reference interval which precedes each trial. Even before the warning signal actually appears, the alpha rhythm becomes suppressed, because the subject anticipates the beginning of the next trial.

The measurement of ERD is done in several steps. First, the EEG is band pass filtered within defined frequency bands, the filtered data are squared and then averaged within consecutive time intervals (of e.g., 125 ms). Second, the obtained data are averaged over the number of epochs. Third, band power changes are expressed as the percentage of a decrease or increase in band power during a test as compared to a reference interval by using the following simple formula: ERD=((band power reference−band power test)/(band power reference))×100. Note that desynchronization is reflected by positive ERD values, whereas event-related synchronization (ERS) is reflected by negative ERD values (G. Pfurtscheller, A. Stancak, Jr. and C. Neuper. 1996.).

The appropriate selection of frequency bands is one of the most critical issues when using ERD or related measures such as changes in induced band power. Due to large interindividual differences of alpha frequency, large portions of alpha power may fall outside a fixed frequency window and invite misleading interpretations. In order to avoid these and related problems that arise with fixed frequency windows, we suggested to use alpha frequency $f(i)$, averaged over all leads, as an anchor point to adjust frequency bands individually for each subject. Then, four frequency bands with a width of 2 Hz can be defined in relation to $f(i)$ that cover the traditional theta and alpha frequency range from about 4–12 Hz (depending on the actual $f(i)$ for each subject). The frequency bands obtained by this method are termed: theta ($f(i)$-6 to $f(i)$-4); lower 1 alpha ($f(i)$-4 to $f(i)$-2); lower 2 alpha ($f(i)$-2 to $f(i)$) and upper alpha ($f(i)$ to $f(i)$+2). For each subject, ERD is calculated within these individually determined frequency bands. We have shown in several studies that fixed frequency bands blur the specific relationships between cognitive performance and ERD, we otherwise are able to observe (as an example, see Figure 3).where subjects did not know in advance that a recall test will be carried out later.

Data represent the time period of 1000 ms poststimulus after presentation onset of a word during encoding and are averaged over all recording sites. (A) Those words that can be remembered in a later recall task show a significantly larger task related increase in theta power (negative ERD values) during encoding as compared to words that cannot be remembered later. The respective differences in the three alpha bands are not significant. (B) In the theta band not only (negative) ERD (reflecting the percentage of an increase in power with respect to a reference interval) but also absolute power too is significantly larger for remembered words but only if frequency bands are adjusted individually (as for the ERD analysis) to IAF. (C) If instead fixed frequency windows are used, no significant differences can be observed.*3.2 3.2 The relationship between desynchronization, synchronization and absolute power*

As the results by Klimesch et al. (W. Klimesch, M. Doppelmayr, H. Russegger and T. Pachinger. 1996.)(W. Klimesch, M. Doppelmayr, T. Pachinger and H. Russegger. 1997.) have shown, the extent of theta synchronization and upper alpha desynchronization are related to episodic and semantic memory performance, respectively. Although these findings reveal very specific effects, they are in good agreement with the well known fact that the amount of alpha desynchronization generally is related to the relevance and/or difficulty of a task. The more demanding or relevant a task, the stronger the amount of alpha suppression or ERD (W. Klimesch, G. Pfurtscheller, W. Mohl and H. Schimke. 1990.). In a pure logical sense one would expect that the amount of desynchronization should depend on absolute power. Only if there is sufficient activity during a reference or resting interval would there be a possibility of a large extent of power suppression during task performance. A similar relationship may also be expected on the basis of physiological considerations. It would be quite plausible to assume that after a difficult task, a rebound of alpha activity takes place that lasts even into the reference interval of the next following trial (epoch). If this occurs trial after trial, the percentage of desynchronization (ERD) would clearly be linked to the power of the reference interval.

For all of the three alpha bands, the results clearly indicate that large band power in the reference interval is associated with a large amount of desynchronization (alpha suppression) during task performance. Most interestingly, the opposite holds true for the theta band. Here, small reference power is related to a large amount of synchronization or increase in power. Thus, the extent of alpha desynchronization and theta synchronization depend on the magnitude of absolute band power, but in opposite ways. With respect to the broad alpha band (7–14 Hz), similar findings were reported by Salenius et al. (S. Salenius, M. Kajola, W.L. Thompson, S. Kosslyn and R. Hari. 1995.). The interesting conclusion, thus, is that the reactivity in band power which reflects task performance can be predicted from the amount of absolute power as measured during a resting state.

With respect to the relationship between memory performance and absolute power, the reported findings allow us to make an important prediction. We would expect that good as compared to bad memory performers show significantly more power in the upper alpha but less power in the theta band. This result would be expected even when the EEG is measured during a resting phase. This hypothesis was clearly supported by two recent studies (F. Vogt, W. Klimesch and M. Doppelmayr. 1997.)(W. Klimesch, F. Vogt, M. 1998.), as the example shown in Figure 4 indicates. The ongoing EEG was analysed for 4 min and arbitrarily segmented in epochs of 4 s in order to achieve a frequency resolution of 0.25 Hz. Significant results (of *t*-tests between good and bad memory performers) are marked by one asterisk (for the 5%-level) or two vertically arranged asterisks (for the 1%-level). Good memory performers show significantly more upper alpha but less theta power. Similar results were found for all recording sites and even during resting sessions with eyes open and closed. Similar findings were reported by Jausovec (N. Jausovec. 1996.). He found that highly intelligent subjects have significantly more absolute power in the broad alpha frequency range (7.5–13 Hz) than less intelligent subjects.

3.3 General conclusions and physiological considerations

The most important conclusion is that the amount of EEG power in the theta and alpha frequency range is indeed related to memory performance in particular, if a double dissociation between absolute and event-related changes in alpha and theta power is taken into account. This double dissociation is characterized by the fact that during a resting state

(i) small theta power but large alpha power (particularly in the frequency range of the upper alpha band) indicates good performance, whereas the opposite holds true for event-related changes, where

(ii) a large increase in theta power (synchronization) but a large decrease in alpha power (desynchronization) reflect good memory performance in particular.

A comparison with findings about the hippocampal theta rhythm in animals reveals that in response to increasing encoding demands, hippocampal theta synchronizes in a small frequency window, just as the human theta (scalp) EEG does (for an extensive review of this issue see Ref. (W. Klimesch. 1996.)). Theta synchronization is due to an increase in the duration of multi-unit population bursts and to an increase in rhythmicity of these bursts which have the same frequency as theta. Convincing evidence for the hypothesis that theta synchronization is related to the encoding of new information comes from the fact that LTP is closely linked to the synchronous activity of the hippocampal theta rhythm:

– LTP can be best induced with stimulation patterns that mimic theta rhythm (J. Larson, D. Wong and G. Lynch. 1986.).

– LTP has been demonstrated in several brain regions, but it is most robust and, thus, has been studied most extensively in the hippocampus.

– The induction of LTP occurs primarily during the positive phase of the theta rhythm.

– The strength of the induced LTP increases linearly with increasing theta power.

– Pharmacological manipulations demonstrate that drugs which decrease theta activity also block learning, whereas drugs that promote the theta rhythm (and, thus, enhance the induction of LTP) also facilitate learning.

These findings support the view that hippocampal theta is important for the induction of LTP and is related to the encoding of new information in a similar way as LTP is. Consequently, we may assume that our results which suggest a close relationship between theta synchronization and the encoding of new information reflect theta activity that is induced into the cortex via cortico-hippocampal feedbackloops for a comprehensive review on this topic). Further evidence for this interpretation comes from an interesting study by Gevins et al. (A. Gevins, M.E. Smith, H. Leong, L. McEvoy, S. Whitfield, R. Du and G. Rush. 1998.), who used a new method to spatially sharpen the EEG with magnetic resonance imaging-based finite element deblurring. These authors found a frontal midline theta rhythm which increased with increasing memory load. Most interestingly, dipole models localized this signal to the region of the anterior cingulate cortex which is part of the Papez circuit and, thus, is linked with the hippocampal formation via complex feedback or ‘reentrant' loops.

It should be noted that there are two different types of theta synchronization. One type of synchronization is related to an increase in power within a narrow frequency band in the range of peak theta frequency. The second form of theta synchronization refers to irregular slow activity (ISA) which also is termed large irregular activity (LIA). Irregular slow activity dominates during slow wave sleep (SWS) and shows increased power outside the theta peak range. This type of synchronization is not related to the increased power of a dominant rhythm within a narrow frequency band, but rather to an increase in power over a broad range. It may be explained in terms of irregular oscillatory epochs of the type Buzsaki et al. (G. Buzsaki, Z. Horvath, R. Urioste, J. Hetke and K. Wise. 1992.) have described. These irregular oscillatory epochs which occur over a comparatively broad frequency range are not coupled to the ‘coordinating' force of the theta rhythm and are not related to the encoding of new information. It appears plausible to assume that the broad band increase in theta power reflects a state in which the ability to encode new information is reduced or even blocked whereas the narrow band synchronization during regular rhythmic theta activity reflects event-related theta synchronization that is closely linked to the encoding of new information (or ‘recoding' during REM).

In contrast to theta, the physiological mechanisms underlying alpha desynchronization appear more complex and at the first glance even paradoxical. Whereas alpha synchronization occurs during alert wakefulness, desynchronization reflects actual cognitive information processes. Alpha synchronization is a state in which millions of cortical neurons oscillate synchronously with the same phase and within a comparatively narrow frequency band. Desynchronization seems to imply that different oscillators within the alpha band are no longer coupled and start to oscillate with different frequencies. These different oscillators most likely reflect the synchronous activity of more local cortical or thalomocortical networks and are, thus, termed ‘local' or ‘functional' alphas. For each of the local alphas all neurons may still show a regular pattern of synchronous oscillation.

This basic EEG-phenomenon of large scale alpha synchronization (during mental inactivity) and desynchronization (during mental activity) which probably reflects a complex pattern of micro scale synchronization provides us with a preliminary but nonetheless important understanding of how information may be processed in the brain: Large scale alpha synchronization blocks information processing because very large populations of neurons oscillate with the same phase and frequency. In contrast, alpha desynchronization reflects actual cognitive processes because different neuronal networks start to oscillate at different frequencies and with different phases.

Research focusing on gamma oscillations in the visual cortex have shown that synchronous oscillatory discharge patterns reflect an elementary visual encoding process. These results, obtained with microelectrodes, are a good example of a microscale synchronization. With respect to the human scalp EEG, it is a matter of resolution, whether or not we may speak of synchronization or desynchronization. Even if the EEG desynchronizes, a large number of different networks may still show synchronous oscillations on a microscale level. In order to discriminate between these two different types of synchronization, the synchronous activity of large cortical areas reflecting mental inactivity is termed type 1 synchronization, whereas the regular synchronous oscillatory discharge pattern of selected and comparatively small cortical areas is termed type 2 synchronization. Type 1 synchronization, reflecting the summed activity of a large number of cell assemblies is a strong signal that can easily be recorded by macroelectrodes from the scalp. In contrast, the synchronous discharge of a small number of cell assemblies is a rather weak signal for the human scalp EEG. Thus, the behavior of the alpha rhythm can be explained by type 1 synchronization reflecting mental inactivity and type 2 synchronization reflecting mental activity. The behavior of the theta rhythm, on the other hand, can

be described by type 2 regular synchronization (reflecting mental activity) and by type 1 irregular synchronization (reflecting mental inactivity). The general conclusion, thus, is that regular type 2 synchronization is that oscillatory mode in all of the frequency bands that reflects actual information processing in the brain.

In an attempt to integrate results from memory research in divergent fields such as cognitive psychology, neuroanatomy and neurophysiology, Klimesch has suggested that type 2 synchronization, generated by thalamo-cortical and cortico-cortical feedback loops provides an ideal framework for describing spreading activation processes in semantic long-term memory. Thus, it may be assumed that type 2 synchronization as measured by (upper) alpha desynchronization reflects search and retrieval processes in semantic long-term memory which are induced into the cortex by thalomo-cortical feedback loops. For the theta band it is suggested that hippocampo-cortical pathways induce synchronous oscillations within a narrow frequency window of the theta peak into widely distributed assemblies in the cortex, thereby binding different parts of cell assemblies together. This binding process forms the basis for encoding new information. This interpretation also implies that cognitive performance is closely linked to type 2 synchronization in thalamo- and hippocampo-cortical networks.

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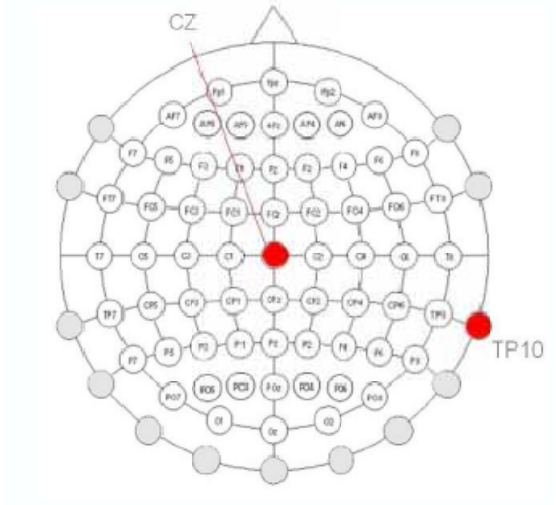

Figure 1. International Electrode Placement- System

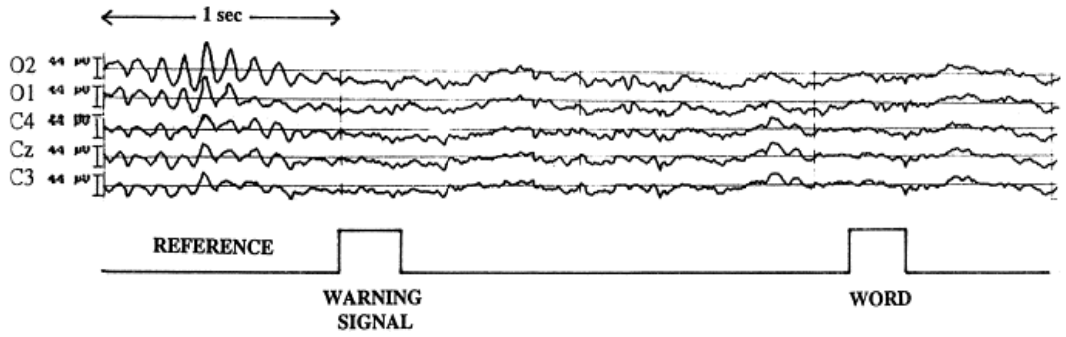

Figure 2. Typical example of an EEG epoch, showing the basic principle of alpha desynchronization.

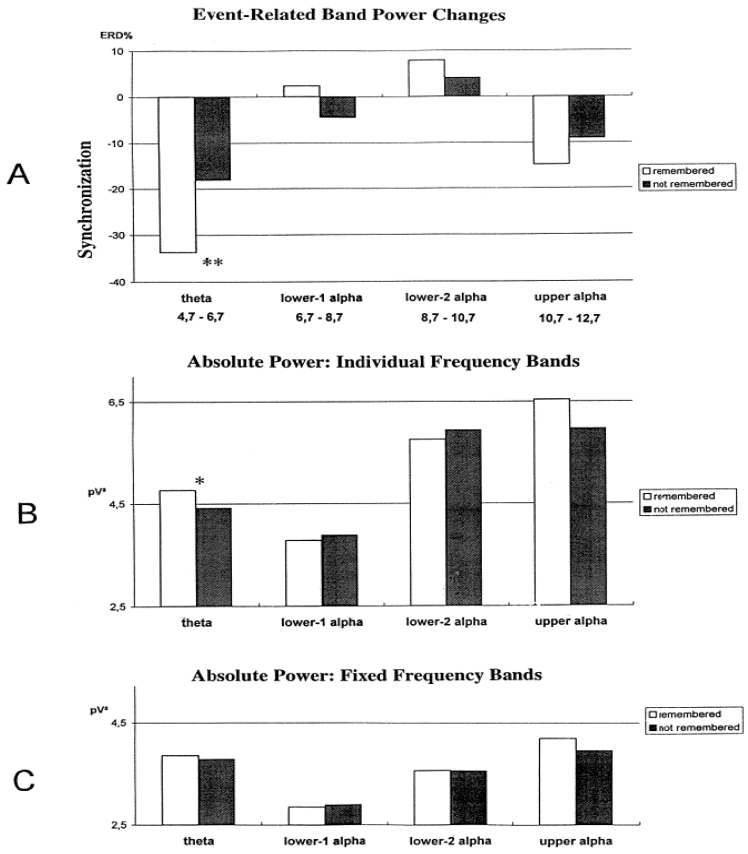

Figure 3. ERD during the encoding phase of an incidental memory task.

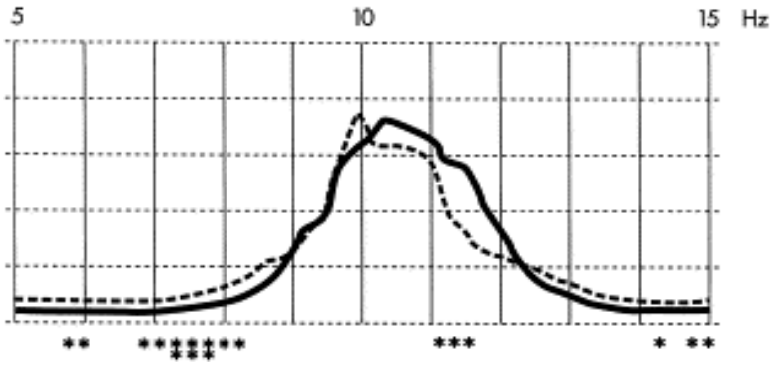

Figure 4. Normalized percent power for good and bad memory performers during memorizing words at O1.

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A Study on Query Optimization for Federated Database Systems

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Abstract

In this paper, we explore the design space for a query optimizer in this environment and demonstrate the need for decoupling various aspects of the optimization process. We present minimum-communication decoupled variants of various query optimization techniques, and discuss trade-offs in their performance in this scenario. We have implemented these techniques in the Cohera federated database system and our experimental results, somewhat surprisingly, indicate that a simple two-phase optimization scheme performs fairly well as long as the physical database design is known to the optimizer , though more aggressive algorithms are required otherwise.

Keywords: Query Optimization, Federated database, Optimization Quality, Two-phase

1. Introduction

The need for federated database services has increased dramatically in recent years. Within enterprises, IT infrastructures are often decentralized as a result of mergers, acquisitions, and specialized corporate applications, resulting in deployment of large federated databases. Perhaps more dramatically, the Internet has enabled new inter-enterprise ventures including Business-to-Business Net Markets (or Hubs) (L. Knight), whose business hinges on federating thou-sands of decentralized catalogs and other databases. These decouplings are often forced by administrative constraints, since federations typically span organizational boundaries; decoupling is also motivated by the need to scale the administration and performance of a system across thousands of sites. Federated query processors need to consider three basic decouplings:

Decoupling of Query Processing;

Decoupling of Cost Factors;

Decoupling of Cost Estimation.

In this paper, we consider a large space of federated query optimizer design alternatives and argue the need for taking into consideration the high “cost of costing” in this environment. Accordingly, we present minimum-communication decoupled variants of various well-known optimization techniques. We have implemented these algorithms in the Cohera federated database system (J. M. Hellerstein, M. Stonebraker, & R. Caccia. 2003.) and we present experimental results on a set of modified TPC-Hbenchmark queries.

Our experimental results, somewhat surprisingly, suggest that the simple technique of breaking the optimization process into two phases (W. Hong andM. Stonebraker. 2001.)—first finding the best query plan for a single machine and then scheduling it across the federation based on run time conditions — works very well in the presence of fluctuations in the loads on the underlying data sources and the communication costs, as long as the physical database design is known to the optimizer.

We also present a preliminary analysis explaining this surprising success of the two-phase optimizer for our cost model and experimental settings later in the paper (Section 4.3). Our analysis suggests that this behavior may not merely be a peculiarity of our experimental settings, but may hold true in general.

2. Architecture and Problem Definition

We base our system architecture on the Mariposa re-search system (A. Tomasic, R. Amouroux, P. Bonnet, O. Kapitskaia,H. Naacke, & L. Raschid. 2007.), which provides the decouplings discussed in the earlier section through the

use of an economic paradigm. The main idea behind the economic paradigm is to integrate the underlying data sources into a computational economy that captures the autonomous nature of various sites in the federation. A significant and controversial goal of Mariposa was to demonstrate the global efficiency of this economic paradigm, e.g., in terms of distributed load balancing. For our purposes here, controversies over economic policy are not relevant; the long-term adaptivity problem that Mariposa tried to solve is beyond the scope of this paper. The main benefit of the economic model for us is that it provides a fully decoupled costing API among sources. As a result, each site has local autonomy to determine the cost to be reported for an operation, and can take into account factors such as resource consumption, response time, accuracy and staleness of data, admin- istrative issues, and even supply and demand for specialized data processing.

For query optimization purposes, the most relevant parts of the system are the query optimizer in the middleware, and the bidders at the underlying sites (Figure 1). As in a centralized database system, the query optimizer could use a variety of different optimization algorithms, but the federated nature of the system requires that the cost estimates be made by the underlying data sources or in our case, by the bidders. The optimizer and the bidder communicate through use of two constructs: (1) Request for Bid (RFB) that the optimizer uses to request cost of an operation, and (2) Bid through which a bidder makes cost estimates.

2.1 The Federated Query Optimization Problem

The federated query optimization problem is to find an execution plan for a user-specified query that satisfies an optimization goal provided by the user; this goal may be a function of many variables, including response time, total execution cost, accuracy and staleness of the data. For simplicity, we concentrate on two of these factors, response time and total execution cost (measured in abstract cost units), though it is fairly easy to extend these to include other factors, assuming they can be easily estimated. Since we assume that the only information we have about the costs of operations is through the interface to the bidders, the optimization problem has to be restated as optimizing over the cost information exported by the bidders. Before describing the adaptations of the known query optimization algorithms to take into account the high cost of costing, we will discuss two important issues that affect the optimization cost in this framework significantly.

2.2 Simplifying Assumptions

To simplify the discussion in the rest of the paper, we will make the following assumptions :

.Accurate Statistics: We assume that statistics regarding the cardinalities and the selectivities are available. This information can be collected through standard protocols such as ODBC/JDBC that allow querying the host database about statistics, or by caching statistics from earlier query executions .

.Communication Costs: We assume that communication costs remain roughly constant for the duration of optimization and execution of the query, and that the optimizer can estimate the communication costs incurred in data transfer between any two sites involved in the query.

.No Pipelining Across Sites : We assume that there is no pipelining of data among query operators across sites. The main issue with pipelining across sites is that the pipelined operators tend to waste resources, especially space shared resources such as memory (M. N. Garofalakis & Y. E. Ioannidis. 2005.).

3. Adapting the Optimization Techniques

In this section, we discuss our adaptations of various well-known optimization techniques to take into account the high "cost of costing". Aside from minimizing the total communication cost, we also want to make sure that the plan space explored by the optimization algorithm remains the same as in the centralized version of the algorithm. In general, we will break all optimization algorithms into three steps:

Step 1: Choose subplans that require cost estimates and prepare the requests for bids.

Step 2: Send messages to the bidders requesting costs.

Step 3: Calculate the costs for plans/subplans. If possible, decide on an execution plan for the query, other wise, repeat steps 2 and 3.

Clearly we should try to minimize the number of repetitions of steps 2 and 3, since step 2 involves expensive communication.

3.1 Exhaustive with Exact Pruning

An optimizer may be able to save a considerable amount of computation by pruning away subplans that it knows will not be part of any optimal plan. A top-down approach is more suitable for this kind of pruning than the bottom-up dynamic programming approach we described above, though it is possible to incorporate pruning in that algorithm as well. Typically, these algorithms first find some plan for the query and then use the cost of this plan to prune away those subplans whose cost exceeds the cost of this plan.

The main problem with using this kind of pruning to reduce the total number of bid requests made by the optimizer is that it requires multiple rounds of messages between the optimizer and the data sources. The effectiveness of pruning will depend heavily on the number of rounds of messages and as such, we believe that exact pruning is not very useful in our framework..

3.2 Dynamic Programming with Heuristic Pruning

Since dynamic programming requires the costs for all the feasible joins, we can not reduce the number of bid requests without compromising the optimality of the technique. Heuristic pruning techniques such as Iterative Dynamic Programming (IDP) (D. Kossmann & K. Stocker. 2006.) can be used instead to prune sub-plans earlier so that the total number of cost estimates required is much less. The main idea behind this algorithm is to heuristically choose and fix a subplan for a portion of the query before the optimization process is fully finished.

We experiment with two variants of the iterative dynamicprogramming technique that are similar to the variants described in (D. Kossmann & K. Stocker. 2006.), except that the bid requests are batched together to minimize the number of rounds of messages:

IDP(k) : We adapt this algorithm as follows :

1) Enumerate all feasible k-way joins, i.e., all feasible joins that contain less than or equal to k base tables. K($\leq$n) is a parameter to the algorithm.

2) Find costs for these by contacting the data sources using a single round of communication.

3) Choose one subplan (and the corresponding k-way join) out of all the subplans for these k- way joins using an evaluation function and throw away all the other subplans.

4) If not finished yet, repeat the optimization procedure using this intermediate relation and the rest of the relations that are not part of it.

IDP-M(k,m) : This is a natural generalization of the earlier variant . It differs from IDP in that instead of choosing one -way join out of all possible k-way joins, we keep such joins and throw the rest away,where is another parameter to the algorithm. The motivation behind this algorithm is that the first variant is too aggressive about pruning the plan space and may not find a very good plan in the end.

Table 1 shows the number of bid requests required for different query graph shapes. The total cost of costing here also depends on the number of rounds of communication required(n/k).

3.3 Two-phase Optimization

Two-phase optimization has been used extensively (M. N. Garofalakis & Y. E. Ioannidis. 2005.) in distributed and parallel query optimization mainly because of its simplicity and the ease of implementation.

This algorithm works in two phases:

Phase 1: Find the optimal plan using a System R-style algorithm extended to search through the space of bushy plans as well. This phase assumes that all the relations are stored locally and uses a traditional cost model for estimating costs. If the physical database design is known (e.g., existence of indexes or materialized views on the underlying data sources), then this information is used during the optimization process.

Phase 2: Schedule the optimal plan found in the first phase. This is done by first requesting the costs of executing the operators at the involved data sources from the bidders and then finding the optimal schedule using an exhaustive algorithm.

4. Experimental Study

In this section, we present our initial experimental results comparing the performance of various optimization algorithms that we discussed above. The main goals of this experimental study are to motivate the need for dynamic costing as well as to understand the trade-offs involved in the optimization process.

4.1 Experimental Setup

We have implemented the algorithms described earlier in a modified version of the Cohera federated database system, a commercialization of the Mariposa research system. The experiments were carried out on a stand-alone Windows XP machine running on a 466MHz Pentium with 256 MB of Memory. Both the optimizer and the underlying data sources connect to a Microsoft SQLServer running locally on the same machine. A set of bidders was started locally as required for the experiments. We simulate a net work by using the following message cost model: A mes-sage of size N bytes takes $\alpha+\beta*N$ time to reach the other end, where $\alpha$is the startup cost and$\beta$is the cost per byte. We experimented with two different communication settings corresponding to a local area network (LAN) withα=10ms, β=0.001ms and a wide area network (WAN) with α=120ms, β=0.005.

4.2 Optimization Quality

In this section, we will see how the different optimization algorithms perform under various circumstances and further motivate the need for better costing in the optimization process. The algorithms that we compare are Exhaustive (E)(Section 3.1), Two-Phase (2PO)(Section 3.4) and four variants of Iterative Dynamic Programming(Section 3.3),IDP(4), IDP(3), IDP-M(4,5) and IDP-M(3,5).

Figure 2(i) showsthe mean for these scaled costs as well as the standard deviation for these 40 random runs for each of the algorithms. We show only the results for a wide-area network since the trends observed are similar in the local area network. As we can see, though the two-phase algorithm performs some what worse than the exhaustive algorithm, in many cases it does find the optimal plan.

Figure 2(ii) shows the relative performance of these optimization algorithms in this case. As we can see, for two of the queries, Query 1 and Query 4, 2PO finds a much worse plan than the optimal plan. For queries 2 and 3, on the other hand, it performs almost as well as the optimal plan. The main reason for this is that since we have extended the first phase of the two-phase optimizer to search through bushy plans as well, it finds bushy plans for these queries and as such, they can be effectively parallelized. The IDP variants perform almost the same as the earlier experiment, though with higher deviations in some cases.

Figure 2(iii) shows the results from this experiment for queries Q1 and Q2. The results for Q3 were similar, whereas Q4 is not affected by this view. As we can see, 2PO consistently produces a plan much worse than the optimal plan. IDP variants once again show unpredictable results with IDP-4 performing very well, since it is able to take advantage of the view, whereas IDP-3 performs almost as bad as two-phase optimizer, since the restriction of choosing the lowest cost subplan of size 3 makes it choose the wrong plan.

4.3 Discussion

As we can see, the IDP variants are quite sensitive to their parameters, but in almost all cases, at least one of IDP(3) and IDP(4) performed better than the two-phase optimizer. This suggests that a hybrid of two such algorithms might be the algorithm of choice in the federated environment, especially when the physical designs of the underlying data sources may be hidden from the optimizer.

The most surprising fact that arises from our experiments is that the two-phase optimization algorithm does not perform much worse than the exhaustive algorithm for total cost optimization if the physical database design is known to the optimizer.

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Table 1. Number of Bid Requests

Shape of the query	DP w/o multi-joins	DP with multi-joins	IDP(k)[5] (for k $\ll$ n)	IDP-M(k,m)[5] (for k $\ll$ n)
Chain	$O(n^3)$	$O(n2^n)$	$O(n^2k)$	$O(mn^2k)$
Star	$O(n2^n)$	$O(3^{n+1})$	$O(n^k)$	$O(mn^k)$
Clique	$O(3^n)$	$O(2^{2^n})^5$	$O((2n)^k)$	$O(m(2n)^k)$

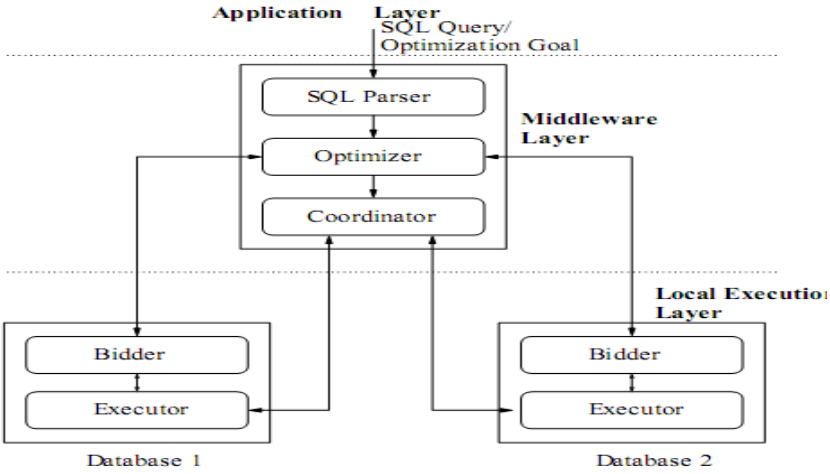

Figure 1. System Architecture

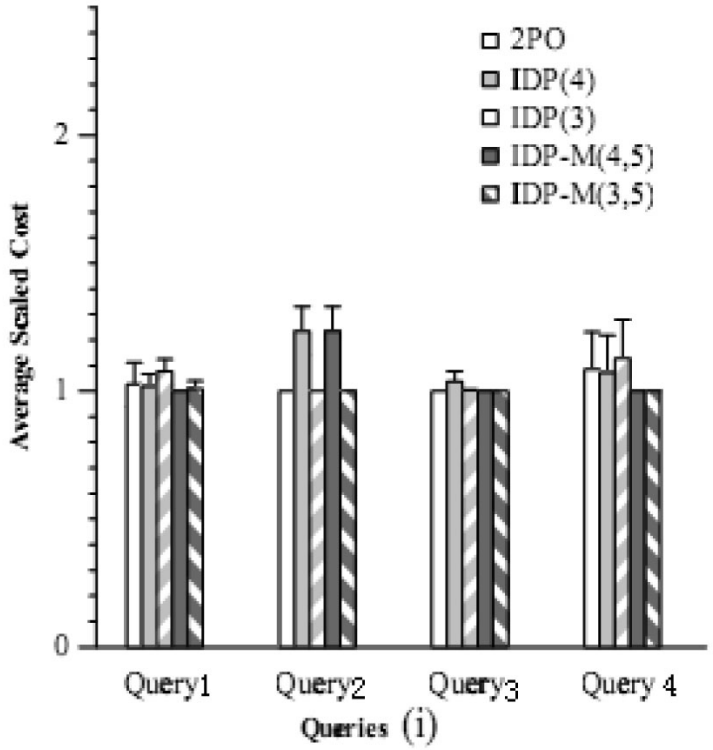

Figure2(i) Total cost optimization

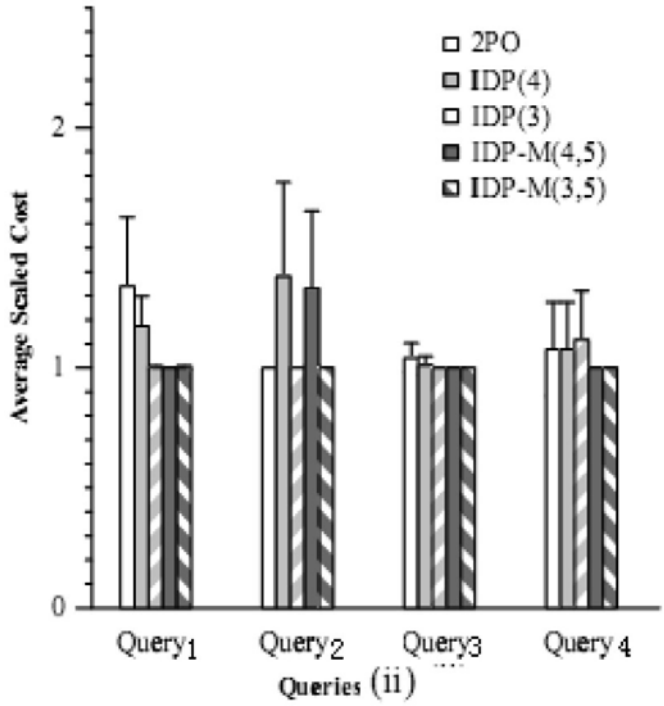

Figure2 (ii) Response time optimization under uncertain load conditions

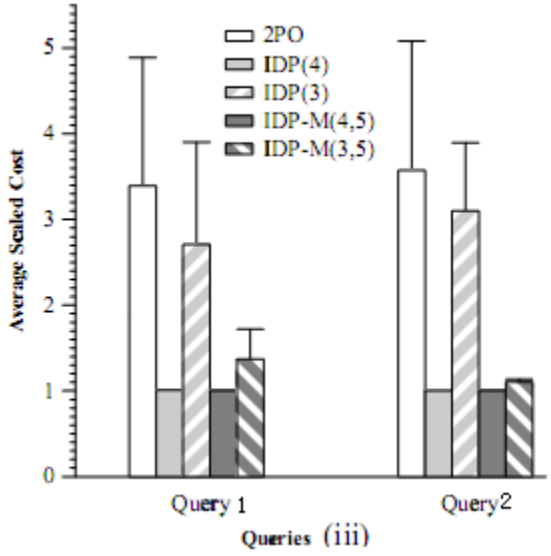

Figure 2 (iii) Total cost optimization in presence of materialized views

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Study on the Optimization Method of Select Query Sentence in Standard SQL Language

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Abstract

In the actual information management system, the query operation is the main part, and the query method is completed by the Select sentence in SQL language, so the efficiency of Select sentence directly influences the query efficiency, and the factors influencing query efficiency include query condition, view, index, link, operator and memory process. In the article, combining with examples, we analyzed the influences of various factors on the query speed and summarized the strategy which used these five factors to optimize Select query sentence, and the concrete example indicated that these optimization process are simple, convenient and effective, and they could enhance the response speed of query.

Keywords: SQL language, Select sentence, Query, Optimization

1. Introduction

With the gradual development of computer application, the application of large scale database is more and more extensive. In the large scale database, people have begun to concern how to enhance the query efficiency under the premise ensuring the correct result, especially in large scale or complex database, the efficiency of query largely influences the application of the system.

SQL is the representative database language integrating data definition and data control, and it is a sort of interactive language that nay one database management system should provide to users. Select sentence is the main tool of database query, and it is the connection ligament between users and database, and user's query operation to the database is implemented by it. Because in same query process, we can express it by multiple forms of Select sentence, and the execution efficiencies of the Select sentences with different forms are different, so when we compile the software of database application, if we can reasonably optimize the Select sentence, we could improve the query efficiency, optimize the query speed of database, and reduce the interactive time between users and data, especially in the application program design of B/S network database, it could reduce users' waiting time and enhance the response time of the system from the view of optimizing database query.

In this article, we would analyze the influences of six aspects including Select sentence query condition, view, index, operator, link and memory on the query algorithm to offer their optimization forms, and these optimization methods would largely enhance the query efficiency of database.

Convenient for the demonstration, the database of "student management" is supposed in the article, and the database includes following five sheets.

(1) Student (student number, department number, name, sex, birth data, address)

(2) Achievements (student number, advanced mathematics, foreign language, gym)

(3) Department (department number, department name)

(4) Transient student (student number, department number, name, sex, birth data, address)

(5) Borrowing books (department number, student number, book name)

2. Optimization of Select query conditions

2.1 Query of "OR"

Translate the query with "OR" in the sub-sentence of "WHERE" into the query contain multiple "UNION ALL" without "OR". When OR represents the limitation condition to different sheets, this method is preponderant.

For example, in the sheet of "achievement", we have respectively established indexes for two fields including "advanced mathematics" and "foreign language", and we want to inquire students' "name" and the achievements of "advanced mathematics" and "foreign language" whose achievement of "advanced mathematics" exceeds 90 or whose achievement of "foreign language" exceeds 95, so the SQL query sentences are

SELECT name, advanced mathematics, foreign language FROM achievement WHERE advanced mathematics> 90 OR foreign language> 95

This Select sentence may not require the query optimizer use the index, so it would reduce the query efficiency. And it could be improved as follows.

SELECT name, advanced mathematics, foreign language FROM achievement WHERE advanced mathematics> 90 UNION ALL SELECT name, advanced mathematics, foreign language FROM achievement WHERE foreign language> 95

2.2 "Flatting" technology of sub-query

Transform sub-query into link, half-link or inverse-link to achieve the intention of query optimization.

For example, inquire the "department name" that the student's achievement of "advanced mathematics" exceeds 90.

SELECT B. department name FROM department B WHERE B. department number IN (SELECT C. department number FROM achievement C WHERE C. advanced mathematics> 90)

This query will scan every line in the department sheet to check students' records which fulfill the query condition, so we can take the achievement sheet as the interior sheet of link when optimizing. In this condition, the query is implemented as the usual link, and first filtrate distinct "department number" to the sheet of "achievement" in order to eliminate redundant department numbers. The improved SQL sentences are

SELECT B. department name FROM (SELECT DISTINCT department number FROM achievement WHERE advanced mathematics> 90) C, department B WHERE C. department number= B. department number

2.3 Implementing multiple selection operation in same sheet

The sequence of selection condition largely influences the computation quantity of query sentence, and if we want to enhance the response speed of query, we should write the strict selection condition in front, and put the weak condition back, so in the execution process, the line which couldn't fulfill the conditions will be deleted quickly.

2.4 Selection operation of multiple sheets

When implementing selection operation to multiple sheets, the sequence of sheet influences the response speed of query also. So we need a queuing principle, i.e. operating to one selection condition will return the sheet with multiple lines in front, and return the sheet with few lines back to reduce the operation of insert.

For example, suppose the sheet of "student" include 10000 students in Tongliao, and the sheet of "transient student" include 100 students in Tongliao.

(1) SELECT name FROM student, transient student WHERE address= "Tongliao"

(2) SELECT name FROM transient student, student WHERE address= "Tongliao"

In the concrete execution process, (1) firstly selects the sheet of "student" and obtains one temporary sheet with 10000 lines, then selects the sheet of "transient student" and obtains the record with 100 lines, and finally implements 100 times insert operation, and insert the 100 lines record into the temporary sheet. Contrarily, if exchange the sequences of two sheets, enter into (2), so first obtain one temporary sheet with 100 lines record, and finally implements 10000 times insert operation, and the computation quantity will far exceed (1).

3. Optimizing Select sentence by view

3.1 Establishing view

Some problems still exist in the data sheets stored in the database management system, and the first one is the scale of

total sheet is large, but users usually need one little part of it, and every operation will waste much time. And the second one is that the total sheet generally contains some secret data which users couldn't acquire, so we can establish the view to dispose and store data in common use in advance by the form of view, which could largely enhance the speed of query, especially when the scale of view is smaller than the original sheet, the query after transformation is much quicker than original query.

For example, inquire the students whose native place is "Tongliao", we can establish the following view.

CREATE VIEW AS SELECT name FROM student WHERE address= "Tongliao"

3.2 Combination of views

Some queries need define the view to reduce the data scale returned in the sub-query, and the combination of views is to eliminate the query with view through combining the view definition with query.

For example, inquire the student's average of "advanced mathematics" whose "department number" is "05".

CREATE VIEW AS SELECT AVG (advanced mathematics) FROM achievement WHERE department number= "05"

4. Optimizing Select sentence by index

Index is one important database object in the database, and the essential of index is a series of finger which point at the sheets which pass the index, and once define the index for certain attribute, when searching the attribute, and the database management system will directly search the index of the attribute, so to establishing the index is the important method to optimize the query, but to establish the index will increase the speeding of time and space for the system, so we should keep to following principles when using index.

(1) Establish index to the line used in WHERE sub-sentence, for example, the "student number" in the sheet of "student."

(2) Establish index to the line frequently implementing "grouping" or "ranking", especially for some lines which need to implement ranking with multiple lines, we can establish composite index on these lines, for example, the achievements of various subjects in the sheet of "achievement".

(3) Don't establish index to the line with few different values, for example, the line of "gym" in the sheet of "achievement" which only have two sorts of value such as "eligible" and "ineligible".

(4) For the inserting and deleting of large quantities of data records, first delete the index, then implement data operation, and finally consider rebuilding necessary index to reduce the consumption of system time.

(5) For the line with large numbers of repetitive values, range query, grouping and ranking, we can establish the clustered index, and it will reduce 50% time than non-clustered index.

(6) For the multiple lines storing at the same time and every line contains repetitive values, we can consider establishing the combined index which should cover the key query form index possibly and the precursor line is certainly the line which is used most frequently.

5. Optimizing Select sentence by operator

5.1 Avoiding using normal expression of fuzzy query possibly

MATCHES and LIKE keywords support the wildcard character matching and it is called as normal expression technically. It is more convenient and direct to use the normal expression to describe the query condition, but this sort of matching especially wastes time, for example, in the query, sometimes, it needs compare the character strings. The LIKE operator could complete the fuzzy matching to the character string, but large numbers of characters should be compared one by one, and the query efficiency will be largely reduced.

For example, student number is numbered by the information such as enrollment year, now we should inquire the information of the student who enrolled in 2005.

SELECT * FROM student WHERE student number LIKE "2005%"

Even if we establish the index on the field of SNO, we should also adopt the mode of sequent scan under this situation. If the sentence is modified as

SELECT * FROM student WHERE student number> "2005000" AND student number< "2006000"

This sentence will inquire by using the index when implementing the query, and obviously it will largely enhance the executive speed of sentence.

5.2 Any operation to line would induce the scanning of sheet, it includes the database function, computation expression and so on, and the operation should be moved to the right of the equal sign possibly

For example, SELECT * FROM student WHERE LEFT (student number, 4) = "2006"

SELECT * FROM student WHERE AMOUNT/30< 1000

Any operation result of WHERE sub-sentence to the line is obtained by the computation line-by-line when SELECT runs, so it must implement sheet search, so the index on the line is not used, and if these results could be obtained when inquiring compiling, so it could be optimized by SQL optimizer, use index and avoid the sheet search, so the SELECT could be modified as

SELECT * FROM student WHERE LIKE "2006%"

SELECT * FROM student WHERE AMOUNT< 1000*30

5.3 Work sheet is usually used in IN and OR sub-sentence, which will invalidate the index, and if large numbers of repetitive values don't occur, we can take part the sub-sentence, and the sub-sentence should include index

For example, the sheet of "student" has twenty thousand lines, and the "student number" has non-clustered index.

SELECT COUNT (*) FROM student WHERE student number IN ("20060001", "2006008")

The SELECT sentence could be modified as

SELECT COUNT (*) FROM student WHERE student number= "20060001"

SELECT COUNT (*) FROM student WHERE student number= "20061008"

Make one addition operation for the results of above two sentences, we will get the same result, and because every sentence uses index, so the execution time will be largely reduced.

5.4 Comparing with constant possibly in the comparison

For example, SELECT *FROM achievement WHERE advanced mathematics> foreign language

The selection condition contain two comparisons of attribute, and the logic computation quantity of the condition comparison is large, so we should avoid use it.

5.5 Avoiding using negative query and negative forms such as !=, <>, NOT IN and NOT EXIST

For the query tree of general database, because the traversal method of B-tree is unfit for the comparison of inequality, so these relationship operators could not be used in the optimization of index selection, i.e. the system needs direct search sheet.

6. Optimizing Select sentence by link

6.1 Link and selection operation by multiple sheets

For the link and selection operation process of multiple sheets, the computation quantity which first implements the selection operation, then implements the link operation is small, and the response time of query is short and the demand of memory is small.

For example, SELECT * FROM achievement A, student B WHERE A. student number= B. student number AND A. advanced mathematics> 90

SELECT * FROM student B WHERE B. student number = (SELECT A. student number FROM A WHERE advanced mathematics> 90)

Two sentences return same result, but the response times of query are different, and the former would first link and obtain a temporary sheet with many lines, then select in the temporary sheet, and the later would first select, which will delete large numbers of redundant data, and then link two sheets, so it will largely enhance the performance of database.

6.2 Selection of interior and exterior sheets when linking

Before the multiple sheet operation is actually executed, the query optimizer will list several groups of possible link projects and find out the optimal project that the system spending is least according to the link condition. The link condition should fully consider the sheet with index and the sheet with many lines.

The selection of interior and exterior sheets could be confirmed by that the lines matching in the exterior sheet multiply the query times of every line in the interior sheet, and the selection that the product is least is the optimal project.

For example, the sheet of department has 7000 lines, and the department number has one non-clustered index, and the sheet of borrowing books has 180000 lines, and the department number has one clustered index. Under different sheet link conditions, the executions of two SELECT sentences are

SELECT*FROM borrowing book A, department B WHERE A. department number= B. department number

SELECT*FROM borrowing book A, department B WHERE B. department number= A. department number

Under the first link condition, the optimal project is to take "borrowing book" as the exterior sheet and take "department" as the interior sheet. Utilize the index on the department, and the I/O times can be represented as 180000 lines in the

exterior sheet of "department" * 3 pages which should be inquired in the interior sheet department corresponding to the first line of the exterior sheet = 540000 times I/O.

Under the second link condition, the optimal project is to take "department" as the exterior sheet and take "borrowing book" as the interior sheet. Utilize the index on "borrowing book", and the I/O times can be represented as 7000 lines in the exterior sheet of "borrowing book" * 4 pages which should be inquired in the interior sheet of "borrowing book" corresponding to every line of the exterior sheet = 28000 times I/O.

So it is obvious that only for sufficient link condition, the real optimal project can be executed.

6.3 Same condition limitation of multiple sheets link

If the limitation condition for one data sheet is available to the data sheet which should be linked, in another words, two sheets possess same attribute line and same limitation, so the data quantity of two sheets could be reduced before linking.

For example, look for the department name which "department number" exceeds or equal to "04" and the average achievement of "advanced mathematics", we can use following optimized SELECT sentences to obtain higher efficiency.

SELECT A. department name, B.AVG (advanced mathematics) FROM department A, achievement B WHERE A. department number> "04" AND B. department number>= "04" AND A. department number= B. department number

In the example, we will first eliminate the data which don't accord with the condition through selecting condition before linking, which will largely reduce the data of two sheets when linking. The method is more important for the sheet which has large scale when linking.

7. Process of storage

The storage process is a group of Transact-SQL sentence which is defined in advance and compiled, and it could receive parameter, return status value and parameter value, and it could be transferred again, and when one storage process is transferred, the system transfers the storage process into the memory and compiles it completely, and when the storage process is transferred again, we can deal with it at once, and there is no any extra spending, so the query speed is enhanced.

8. Conclusions

The optimization of SELECT query sentence expression could enhance the search performance of data, and the optimization design of query in the development and maintenance of database could enhance the system performance, especially for the database system which is often used and possesses large scale data.

Through the analysis of five aspects, we possibly reduce the I/O times of sheet scan, reduce the demand of memory, enhance the speed of interview, reduce the response time and reduce the computation quantity under the premise that the SELECT query result is correct.

In a word, only to exactly observe and analyze various information offered in the system, fully combine the actual application characters, we could reasonably establish good optimization strategies, and realize rapid and highly efficient data query and application analysis, and finally write high efficient SELECT query sentences.

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Tracking High Speed Skater by Using Multiple Model

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Abstract

Color-based tracking is a very popular technique for object tracking. However, under varying environmental conditions in video sequences, the existing tracking methods tend to be unreliable for tracking high speed objects. It is possible under such a complex environment that the targets may disappear totally or partially due to occlusion. To over this problem, a novel approach of multiple-color model is proposed in this paper. Different colors extracted from the skater's head and body are tracked with Kalman filter, respectively. A confidence measure representing the reliability of each color tracking result is presented to guide possible re-detection for continuous tracking. Experimental results show that the proposed approach is very efficient and effective in tracking high-speed skater in real short track sequences.

Keywords: Multiple model tracking, Kalman filter, Occlusion

1. Introduction

The most common method to track objects is to detect them using background subtraction of an established correspondence frame by frame (Wren et al., 1997; Lou et al., 2002). Despite its popularity, it can only be applied to imagery acquired by "stationary camera". An alternative approach to background subtraction is using simple geometric models to transform the object from frame to frame. Comaniciu et al. (Comaniciu et al., 2003) use the mean-shift approach to compute the translation of a circular region. The object appearance is modeled by weighed histograms.

Tracking of the complete object can be achieved by employing the active contours, which were introduced by Kass et al (Kass et al., 1988). In (Mansouri, 2002), Nonrigid object motion can be modeled in terms of combining optical flow with active contours, Mansouri uses a probabilistic form of the brightness constraints, where the color is defined by a Gaussian distribution. Optical flow derived from the brightness constraint is computed. However, the brightness constraint requires very small variation in the intensities and it is not suitable for images with high dynamic intensity ranges.

Tracking with multiple cue fusion becomes more and more popular. In (Ozyildiz et al., 2002), an autobinomial Gibbs Markov random field is used for modeling the texture and a 2D Gaussian distribution is used for modeling the color. This allows a probabilistic fusion of the texture and color cues. Similarly, in (Yilmaz et al., 2004), visual features (color, texture) and the object shape are considered. Color and texture models are generated for the object and the background regions. A shape prior is used for recovering occluded object parts during the occlusion.

There are many computer vision systems for many sports domains. Pingali et al. (Pingali et al, 1998) develop a real time tracking technology for enhancing the broadcast of tennis matches from stationary cameras. Recently, Yan et al. (Yan et al, 2006) propose a data association algorithm to track a tennis ball in low-quantity tennis video sequences. Pers et al. use two stationary cameras mounted directly above the court and propose a new approach for modeling the radial image distortion more accurately. The tracking algorithm combined with color feature and the template is exploited to track the player, using color feature is to avoid a drift caused by the template tracking. Their systems are applied to many sports domains including handball (Pers et al, 2002) and basketball (Jug et al, 2003). But there are two limitations in their works: first, the cameras must be placed above the playing court, which is a rigorous condition for regular league or championship matches. Second, how to handle occlusion in tracking process seems not to be solved.

The goal of our study is to track high-speed nonrigid skater under a complex environment, where background drastically changes and successive occlusion often occurs and the colors of similar clothing are very close, etc. Many above methods using ideal model or some constraint are not suitable.

In this paper, a novel approach for tracking high-speed skater is proposed. Color features are firstly extracted from

skater's head and body. Then, Kalman filter is utilized to estimate the search region and to evaluate each color, respectively. Afterwards, these evaluations are integrated to determine which part of the object needs to re-detect. The detection result is regarded as the initial data of tracking module. To enhance the robustness of tracking, a confidence measure representing the reliability of each color tracking result is presented to guide possible re-detection for continuous tracking. Moreover, the lost tolerance of object is introduced in order to avoid stopping tracking exceptionally due to totally occlusion. The approach is robust and can perform real-time skater detection and tracking.

2. Proposed Approach

Our computer vision system aims to automatically track the movements of skaters on a large-scale complex and dynamic rink. Our goal is to exploit it not only in daily training but also in competitions. We used a single panning camera, which was mounted at the top auditorium of the stadium as close as possible to the center in order to reduce the projection error. Due to little texture information on the rink, unlike (Intille & Bobick, 1994; Okuma, 2003), zooming was abandoned, it can make recording the high-speed target more difficult and enlarge the error of lens distortion. Though the camera center moves by a small amount, due to an offset from the camera's optical center, the approximation of pure rotation is indeed sufficient such as proven in (Hayman & Murray, 2003).

2.1 The Framework of Our Algorithm

The flow chart of the proposed algorithm shown in Figure 1 consists of three major processing modules:

1) Object detection based on colors.

2) Kalman filter prediction.

3) Object re-detection determined by confidence measure.

2.2 Color Space Selection

An important aspect of any color-based tracking system is to choose a color space that is relatively invariant to minor illuminant change. The two most popular color spaces robust to minor illuminant changes are HSV and normalized RGB. (Terrillon & Akamatsu, 2000) and (Bradski, 1988) proved that normalized RGB color model is more sensitive to lighting changes since the saturation influenced by lighting is not separated out of that model. Hence the best color space is HSV which has been applied to many color tracking problems (Bradski, 1988; Sigal et al., 2004). HSV space separates out hue and saturation from intensity, and we create color models by 2D histograms from the hue and saturation channel in HSV space.

2.3 Kalman filter prediction

The Kalman filter is one of the most popular estimation techniques in motion prediction because it provides an optimal method for linear dynamic systems with white Gaussian noise. In general, the Kalman filter describes a system with a system state model and a measurement model as in Eqs. (1) and (2):

$$S_{k+1} = A \cdot S_k + w_{k+1} \tag{1}$$

$$M_{k+1} = H \cdot S_{k+1} + v_{k+1} \tag{2}$$

The system state S_{k+1} at the time $k+1$ is linearly associated with the state at the time k, and there is also a linear relationship between the measurement M_{k+1} and the system state S_{k+1}. The random variables w_{k+1} and v_{k+1} represent the state and measurement noise, respectively. A is the state transition matrix that relates the state at frame k to the state at frame k+1, and H is called the observation matrix that relates the state to the measurement. In our case, the system state S consists of the following components:

$$S = \begin{bmatrix} x: & x-coordinate\ \ of\ \ Center \\ y: & y-coordinate\ \ of\ \ Center \\ v_x: & horizontal\ \ velocity\ \ of\ \ Center \\ v_y: & vertical\ \ velocity\ \ of\ \ Center \\ w: & width\ \ of\ \ bounding\ \ box \\ h: & height\ \ of\ \ bounding\ \ box \\ s: & area\ \ of\ \ T\arg et \end{bmatrix} \tag{3}$$

The state transition matrix A, the observation matrix H and the measurement M are given by:

$$A=\begin{bmatrix}1&0&1&0&0&0&0\\0&1&0&1&0&0&0\\0&0&1&0&0&0&0\\0&0&0&1&0&0&0\\0&0&0&0&1&0&0\\0&0&0&0&0&1&0\\0&0&0&0&0&0&1\end{bmatrix} \tag{4}$$

$$H=\begin{bmatrix}1&0&0&0&0&0&0\\0&1&0&0&0&0&0\\0&0&1&0&0&0&0\\0&0&0&1&0&0&0\\0&0&0&0&0&0&1\end{bmatrix} \tag{5}$$

$$M=[x',y',v_x',v_y',s']^T \tag{6}$$

2.4 Object Confidence Measure

It is frequently the case in our tracking problem that an actual measurement on a target is not reliable due to occlusion and complex environment. When an actual measurement is heavily corrupted, the measurement error accumulates through the feedback cycle and the reliable estimation can not be obtained, which results in tracking failure. Therefore, we should get an optimal detection result as possible as we can. A confidence measure (CM) representing the reliability of each color tracking result is given by the following formula:

$$CM=\begin{Bmatrix}-1 & P(H_k^s)=0\wedge P(B_k^s)=0\\ 0 & P(H_k^s)=0\wedge P(B_k^s)=1\\ 1 & P(H_k^s)=1\wedge P(B_k^s)=0\\ 0.5+\alpha\cdot P(error) & P(H_k^s)=1\wedge P(B_k^s)=1\end{Bmatrix} \tag{7}$$

$$P(H_k^s)=\begin{Bmatrix}0 & H_k^s=0\\ 1 & H_k^s>0\end{Bmatrix} \tag{8}$$

$$P(B_k^s)=\begin{Bmatrix}0 & B_k^s=0\\ 1 & B_k^s>0\end{Bmatrix} \tag{9}$$

$$P(error)=\beta\cdot P(H_k^v,H_{k-1}^v)+(\beta-1)\cdot P(B_k^v,B_{k-1}^v) \tag{10}$$

$$P(H_k^v,H_{k-1}^v)=\begin{Bmatrix}0 & \left|H_k^v-H_{k-1}^v\right|>Th\\ 1 & \left|H_k^v-H_{k-1}^v\right|\le Th\end{Bmatrix} \tag{11}$$

$$P(B_k^v,B_{k-1}^v)=\begin{Bmatrix}0 & \left|B_k^v-B_{k-1}^v\right|>Th\\ 1 & \left|B_k^v-B_{k-1}^v\right|\le Th\end{Bmatrix} \tag{12}$$

where H_k^s and B_k^s represent the detected area of head and body at time k, respectively. H_k^v and B_k^v represent the velocity of head and body at time k, respectively. α and β are weighted factors, Th is a prior threshold of velocity. Consequently, the unreliable part determined by CM will be re-detected by the reliable part according to the correlation of initial model.

3. Experimental Results

In short track skating, the skaters are very close and compete with others furiously and overtaking is allowed all the time. As a result, occlusion happens frequently and successively, which is a real challenge to the robustness of tracking

system. The experiments demonstrate that the performance of the proposed approach is very good.

In Figure 2, the competitor skating through the curve is exactly tracked despite successive occlusion and size variation. Figure 3 shows good tracking result under a complex environment, where the color of advertisement baffle-board is similar with that of skater's clothing (body).

The experiment results also demonstrate the robustness of our method. Once one of multiple color features is tracked exactly (or not corrupt) even none of them is tracked within limit frames, our tracking system can still work continuously. The unreliable color feature determined by confidence measure (CM) is re-detected according to the correlation of the initial model, which improves the tracking accuracy in every frame to avoid accumulated error.

The trajectory of a skater in an individual race of 500 meters is illustrated in Fig. 4, different lines denote the trajectory of the skater when he/she skates along different loop. More information and statistic of the competitions are available such as the trajectory and velocity, which can be further processed and analyzed by the sports experts.

Our approach saves more computational time than that in (Ozyildiz et al., 2002). The program has been implemented by using Visual C++ on a PIV 3.0GHz machine and it takes only 28ms to process averagely on a true color image with 720 ×576 resolution and can achieve real-time processing.

4. Conclusions

A novel approach for tracking high-speed skater is proposed. Color features are firstly extracted from skater's head and body. The combination of them is efficient and effective for tracking skater under a complex environment or successive occlusion. A confidence measure representing the reliability of each color tracking result is presented to guide possible re-detection for continuous tracking. Moreover, the lost tolerance of object is introduced in order to avoid stopping tracking exceptionally due to totally occlusion. The approach is robust and can achieve real-time skater detection and tracking.

It will fail under some special conditions such as all color features lose successively or the light is too dark so as to the color feature in HSV space is unstable and not exactly detected due to non-removable singularity (Cheng et al., 2001). It will be investigated in the future.

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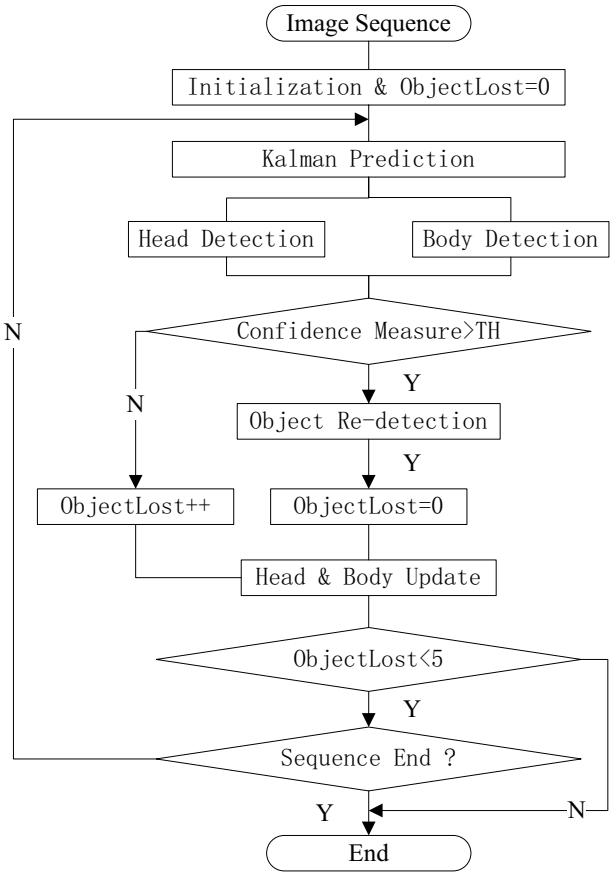


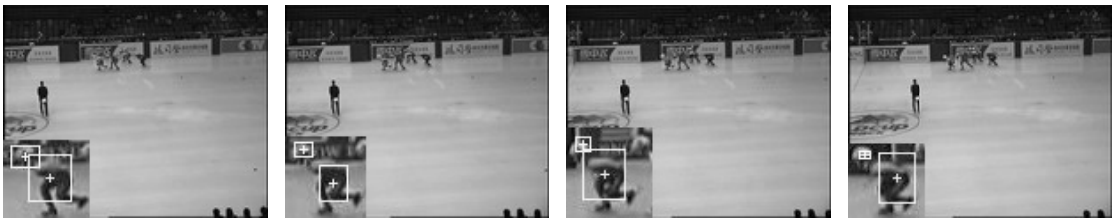
Figure 1. Flow chart of the proposed algorithm

Frame 320 Frame 325 Frame 330 Frame 335

Frame 340 Frame 345 Frame 355 Frame 365

Figure 2. Tracking results of successive occlusion

Frame 375 Frame 376 Frame 377 Frame 378



Frame 379 Frame 380 Frame 381 Frame 382

Figure 3. Tracking results under a complex environment

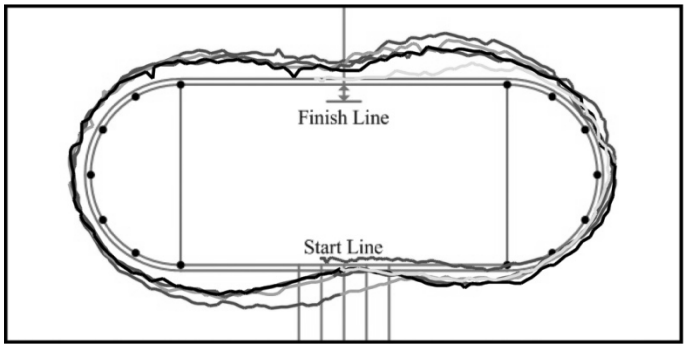


Figure 4. The trajectory of a skater in an individual race of 500 meters

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Digital Divide: Issues Facing Adult Learners

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Abstract

Technology had enabled many adult to pursue their education. However, technology changes in terms of type and accessing had caused "digital divide" (DD) to exist among students of all ages. In this paper, issues which should be incorporated in measuring digital divide for adult learners are discussed. The issues which are discussed in this paper are age, gender and income. Why these issues should be included in evaluating DD are examined.

Keywords: Digital divide, Adult learners

1. Introduction

Among the educational resource which is gaining importance is technology (Anderson, *et.al* (2001). The evolution of technology had changed the way teaching and learning is carried out. The ever changing technology (as shown in Table 1) could create an imbalance in a society. Researches had shown that, developments in technology had reduced employment opportunities for older workers (Aubert, Caroli & Muriel, 2006). Although the role of technology in influencing the learning and teaching process in education is disputed but its presence is necessary. This makes it important that technology should be made available to every student.

In the case of school students, it would be the responsibility of the authorities in providing the technology to every student. On the contrary, for adult learners the onus is on the learner himself and not others. Adult learners are people who have finished their secondary education and pursuing their education. Many adults pursue education because they believe it will enhance their employability and eventually increase earnings (Wiseman, 1987). Innovations and advancement in technology had enabled many working adults to pursue their education. Computer assisted learning environment has helped adult learners in coping with their education (Thompson & Savenye, 2007).

However, the advancement in ICT had resulted in a digital divide among the students. Digital divide (DD) is also known as digital equity (DE) (Becker, 2006). Digital divide is defined as the different use of technology in education based in ethnicity and socioeconomic status, while DE refers to the activity of ensuring that all students have the same amount of access to information and technology for learning (Judge, Puckett & Cabuk, 2004). The term DD began to appear in American vocabulary back in the 1990's (Light, 2001). If the DD is big among the students of an institution, it could lead to an imbalance and unfair scenario in student's performance.

There are some researches done in evaluating DD among the adult learners. Access and usage of technology especially internet had spurred many researches in measuring DD for students. The role and effect of computer usage in the learning process for adult learners depends on the extent of DD (Gorard, 2003). In this paper, issues which must be incorporated in measuring DD for adult learners are explored. Issues faced by adult learners and how it might influence DD are discussed in this paper.

2. Issues In Digital Equity

2.1 Age

Research in cognitive sciences had shown that there is a relationship between age and technology adoption in learning. Younger people are more receptive in adapting changes in the way they learn compared with older people (Bosma et al., 2003). Technology assimilation among older people is slower compared to younger people (Morris & Venkatesh, 2000). A study in Canada on teaching Mathematics using computer found that adult learners' academic performance was better when computers and teachers were used simultaneously. On the other hand, comparing with school children, teacher's

role in the teaching and learning process is required less (for children) compared for adult learners (Li & Edmonds, 2005). Since the age of adult learners varies, any study on the DD should consider age as a factor.

2.2 Gender

Attitudes and perceptiveness of technology is different between the sexes. While males perceive technology positively and easy, female thinks it as otherwise (Menard-Warwick & Dabach, 2004, Bain & Rice, 2007; McKinney et.al, 2008). Lack of interest and participation of girls and women in technology had prompted the formation of AAUW Educational Foundation Commission on Technology, Gender, and Teacher Education in 1998 (AAUW, 2000).

Many countries are facing a gender imbalance in student enrollment. As shown in Figure 1, many ASEAN countries are having higher enrollment of girls than boys at tertiary level enrollment. Many studies on DD, does not take whether the results would be different if gender was included in the computation of the value. Many adult learners are enrolled in tertiary level programs. Since the probability of more females than male students is higher, any measurement on DD should take note of this.

2.3 Income

There is a correlation between income and technology (Frank, 1995). Since technology is not a public good, owning a computer itself will consume some of the income (Kalyanpur & Kirmani, 2005). Technology utilization usage especially internet and broadband facilities will require an individual to bear the expenses incurred. Although this sum could be minimal but when the person's income is low, it could be a significant portion.

Table 2 shows the correlation between computers per 1000 with the household income for selected countries. In countries where household income is low, computer ownership is highly significant. But in developed countries such as Belgium and Sweden, computer ownership does not really depend on household income. This could be because the amount of income, in terms of percentage, devoted for computer is small in developed countries compared in developing or undeveloped countries.

Since most adult learners are working, thus their income level could hinder their use technology. The amount a person could allocate or spend on technology access depends on the amount of his/her disposable income. When a person's disposable income is high and the cost of accessing technology i.e internet, is low, thus proportionately it is low. Ultimately the cost of accessing technology would not jeopardize his/her consumption on other goods. On the other hand, if the proportion is high it would force the adult learner to do some sacrifice in consuming or purchasing other goods. Although one could argue, that being a student, priority should be given to education, but being a human being who are subjected to needs and wants, this could be easier said than done.

Since finance is an influencing factor in human's daily life, thus income of adult learners who are working should be considered when discussing DD. "Income's" influences in DD would be higher if the cost of accessing technology is high proportionately to income.

2.4 Language Mastery

English is the main language used in internet (See Table 3). Most of the materials in the internet use English as the medium of instruction. This hinders some people from using the internet. Even in countries where there is internet facilities, proficiency in English could discourage some from accessing the internet. As shown in Table 4, among the ASEAN countries, only Filipinos uses English when online. Countries such as Indonesia and Malaysia, non-English language are more widely used.

Thus, adult learners in these countries could face some difficulties when accessing the internet. Since most of the materials are not in their familiar language, this could increase the inequity in accessing the technology. Therefore when evaluating DD, language mastery especially English should be taken as a factor.

3. Conclusion

By taking into consideration factors that influence DD among adult learners, it would be possible for curriculum designers to incorporate the findings. Adult learners should be given all the necessary encouragement in pursuing their education. By taking into consideration factors affecting DD adult learners, methods on evaluating them could be designed in such a way which would be beneficial to both the learner and teacher. However this does not mean that different standards should be set for adult learners with various characteristics but concessions should be thought of. For example, a more flexible time of completing a study programme should be given to adult learners with different characteristics.

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Table 1. ICT's and their potential for education

Technology	Outreach	Flexibility	Interactivity
Radio	High	Limited	Limited
Television	High	Limited	Limited
Video	Low	Limited	Limited
Personnel Computers	Low	High	High
Internet	Highest	High	Highest

Source: Adapted From Mar, 2004

Table 2. Correlation between computer ownership and household income

Country	**Significance Level**
Austria	√
Belgium	X
Brazil	√
Chile	√
Denmark	X
India	√
Indonesia	√
Malaysia	√
Philippines	√
Singapore	X
Sweden	X

Source: Computed by author based on data provided by UN

Note: √ = Significant

X = Not significant

Table 3. The 10 Most Highly Represented Languages on Web Pages (2000)

Language	Web Pages (in millions)	Percent of total
English	241.250	68.39
Japanese	18.336	5.85
German	18.070	5.77
Chinese	12.114	3.87
French	9.263	2.96
Spanish	7.573	2.42
Russian	5.901	1.88
Italian	4.883	1.56
Portuguese	4.291	1.37
Korean	4.046	1.29

Source: Gorski, 2005.

Table 4. Number of people online in each language (2004)

Country	Language Analysis (in millions)				Total
	English	Chinese	Malay	Thai	
Indonesia			8.1		8.1
Malaysia	0.2	2.9	5.8		8.7
Philippines	3.5				3.5
Singapore	0.2	2.1	0.3		2.6
Thailand				7	7

Source: Global Reach, 2006

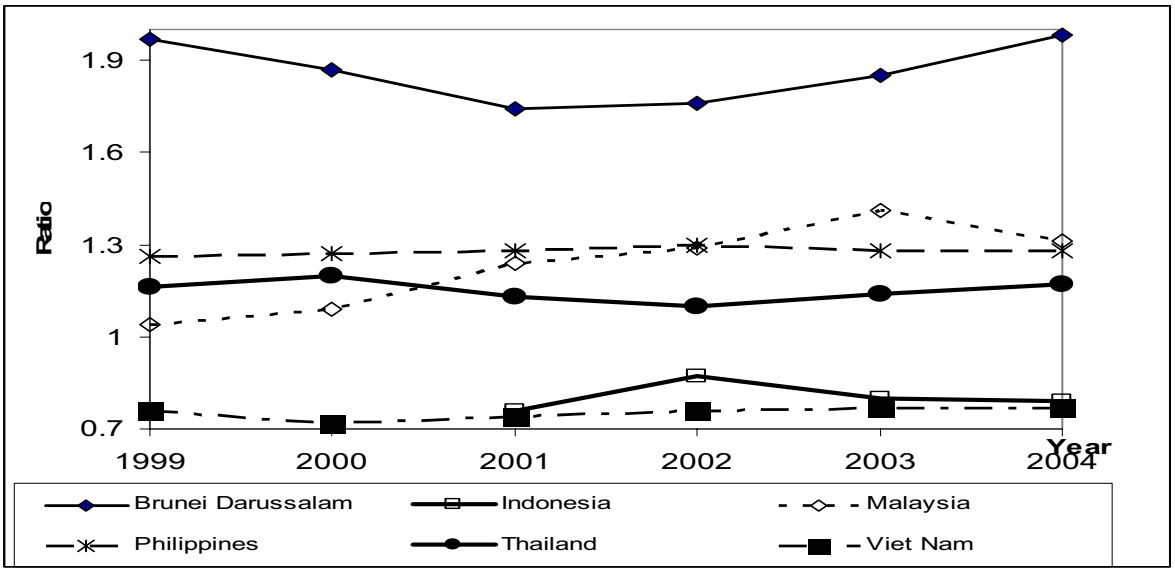

Figure 1. Tertiary Level Enrollment: Girls to Boys Ratio (ASEAN)

Source: UN

Note: Values more than 1 indicate, girls are more than boys


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To Construct Search Engine Analyzer for Electrical Enterprises Based on Lucene

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Abstract

There are many professional vocabularies in electrical enterprises, and existing analyzer could not fulfill the application when constructing the search engine for electrical enterprises. In this article, we take the operation system of electrical enterprises as the background, and put forward a sort of word segmentation algorithm based on the implementation of vocabulary in order to design the analyzer of search engine which could be applied in electrical enterprises. The analyzer is completed based on the electrical professional dictionary and could solve many unsatisfactory problems of existing analyzer. At the same time, we adopt the method constructing the word tree, and when loading the vocabulary, first construct a words and expressions tree in the memory, and corresponding word could be segmented only by traversing the tree when segmenting word, which could solve the limitation that one maximum word length must be enacted in usual maximum matching algorithm, and largely enhance the efficiency of word segmentation and avoid meaningless matching algorithm. Finally, we compare the analyzer with two interior analyzers in Lucene, and the result indicated that the analyzer was better than the internal analyzer in Lucene whether for time and the efficiency of word segmentation for the application system of electrical enterprise, which proved that the analyzer could fulfill the requirement to construct the search engine for electrical enterprises.

Keywords: Lucene, Analyzer, Vocabulary, Electrical enterprise, Search engine

1. Introduction

Many operation databases and large numbers of documents exist in the interior of electrical enterprise, and these resources are dispersed in various application systems and servers, and many resources have not been effectively treated and utilized. On the one hand, employees who need to require resources can not find out necessary documents. On the other hand, large numbers of resources can not be utilized, which induces low work efficiency. Therefore, it is necessary to establish search engine in the interior of electrical enterprises, and it is the key measure to enhance the level of resource utilization, and the key technology to establish the search engine is the Lucene developed by Apache.

Lucene is a telescopic information research base with high performance (Qiu, 2007). More and more application systems select Lucene to add index and search abilities for applications. It is very important to select a proper analyzer when using Lucene. There are many professional vocabularies in electrical enterprise, the interior analyzer of Lucene can not fulfill the requirement, so we need to construct a user-defined analyzer, and the component module of Lucene makes this process become very easy.

2. Interior analyzer of Lucene and its limitation

The interior analyzer of Lucene could deal with usual application for English word segmentation, but it has inborn shortage for Chinese information processing, and though we can find two Chinese processing analyzers, i.e. Chinese Analyzer and CJK Analyzer, in Sandbox of Lucene, but the word segmentation effect of these two analyzers is disappointed, and it is difficult to fulfill actual applications. Chinese Analyzer segments by word, and it is basically same the Standard Analyzer, and CJK Analyzer segments by two-character word, and it is arbitrary, and garbage Token (Lucene uses Token to represent the word after segmentation, and one word is one Token) will occur and influence the size of index (Otis Gospodnetic, 2007). These two analyzers are more awkward to Chinese word segmentation in special domain, so it is necessary to establish the analyzer which could be applied in special domain. In this article, aiming at characters of electrical enterprises, we construct the analyzer of search engine to fit electrical enterprises.

3. To construct the analyzer based on Lucene

Analysis is the process which translates the field text into the most basic index denotation unit, i.e. term in Lucene. The

analyzer operation occurs in two stages, i.e. to establish index and to use Query Parser object (Otis Gospodnetic, 2007).

In Lucene, the class of analyzer is the basic class of all analyzers. It literally translates the text into word unit stream by a sort of good mode, and one example is Token Stream. The only statement to require analyzer implement the method is

public Token Stream to ken Stream (String fieldname, Reader reader).

To construct the analyzer based on Lucene, there are flowing key approaches.

(1) Segment Token from the document stream according to our own word segmentation method. It needs to further extend the basic class of Tokenizer, and the key method is next(), and every next() will return a Token.

(2) Implement the method of Token Stream. The function of Token Stream is similar with enumerator, and it will continually return Token objects, and return null when arriving at the end of text.

In this article, we adopt the word segmentation algorithm based on the vocabulary of electric enterprises to realize the analyzer of search engine which is fit for electrical enterprise, and the analyzer is current, and it could be conveniently applied in other industries only by replacing the vocabulary of the analyzer.

3.1 Traditional word segmentation algorithm

People have put forward many automatic word segmentation algorithms by computer and these algorithms could be divided into two sorts, i.e. comprehensive segmentation method (knowledge word segmentation method) and mechanic matching method (or conformation word segmentation method) (Feng, 2002, P.29).

3.1.1 Comprehensive segmentation method

The word segmentation system of the comprehensive segmentation method is composed by vocabulary, repository and inference machine. Lemmas are stored in the vocabulary, and formalized language rules, expression knowledge, the general knowledge and experiences when linguists implement reasoning and judgment in the process of word segmentation are stored in the repository, and the inference machine utilizes the vocabulary and repository to offer large numbers of data and knowledge, simulate linguists' logic thinking process and realize automatic word segmentation. That is an expert system of automatic word segmentation in fact. And this system has large spending, and the problem of system complexity exists except for theoretic difficulties, and it is difficult to be realized.

3.1.2 Mechanic matching method

The mechanic matching method is mainly based on the principle of character string matching. It doesn't implement expression analysis and semantic analysis, and only matches and compares mechanically. Based on enough large vocabulary, it adopts certain processing strategy to match the character string in the text with the word in the vocabulary one by one, and if succeed, it will cognize the string is the word. The usual word segmentation methods include positive maximum matching method, inverse maximum matching method and the least segmentation method (Zou, 2000, P.4 & Lei, 2000, P.1270). The usual maximum matching word segmentation algorithm in mechanic matching method is easily to be implemented, but it has many obvious deficiencies.

(1) Length limitation

Because the maximum matching method must first enact an initial value of matching word length, and this length limitation is a sort of compromise between efficiency and word length for the maximum matching method. The word length is too long, the efficiency is low, and the word length is too short, the long word will be segmented wrongly.

(2) Low efficiency

Even if the word length could be enacted very shortly, but when the word length is 5 (notice: we can not shorten the word length again, because the words exceeding 5 length are too much, and we can not scarify the nicety of word segmentation), most word lengths are 2, so three times matching algorithm are wasted at least.

(3) Maximum matching is certainly not the wanted word segmentation mode

The idea of the maximum matching method is to find out the maximum matching word, but sometimes maybe we only need one part of the word except for the maximum matching word.

Based on above analysis, we put forward the improved solution project which makes the efficiency of word segmentation algorithm and the length limitation of word segmentation even the treatment of different meanings to be improved.

3.2 Improved Chinese word segmentation algorithm

3.2.1 To establish the vocabulary of electrical enterprises

The vocabulary structure in the application adopts simple text formatting. And every word occupies one line, and it could use # to note, and the content of notation will be ignored. Single-character word would not be embodied in the vocabulary. The structure of the vocabulary is seen in Figure 1.

In turn, n-character word could be denoted as $C_1C_2C_3…C_n$, and it should not be confused with sentence. In practice, our vocabulary is stored in one text document by the UTF-8 coding. If you want to open it by the editor which is similar with notepad, please notice the problem of coding.

In the application, our vocabulary is seen in Figure 2, and it is stored in the text document which must be coding format of UTF-8.

To improve the efficiency, the length limitation of word segmentation even the treatment of different meanings for the maximum matching word segmentation algorithm, we must have a vocabulary to match the word in the text with the word in the vocabulary. It needs to rebuild the vocabulary and make the vocabulary more fit for matching and word segmentation (Chen, 2000, P.419-423).

The method in the article is to establish the tree of words and expressions after reading the vocabulary into the memory, and every node of the tree contains one word, for example, China, Chinese, Chinese Ethnic Peoples and the People's Republic of China could compose the structure of the tree. After the vocabulary is rebuilt by such way, any one sentence will be divided into single word to match with single word with tree structure, and the length of word becomes into the altitude of the tree, and every matching becomes into the traverse of tree, and the efficiency of this traverse is linear.

3.2.2 The idea of algorithm design

After establishing the above Chinese vocabulary, we analyze the approaches of word segmentation.

(1) Read the text which will be segmented into the buffer.

(2) First traverse the text in the tree structure, and if the matching is found, continue, and if meeting the terminal symbol, we will find that the word is a complete word, so we can regard the word as one word segmentation.

(3) Continue to do the approach (2) for the next word of the segmentation until the word is segmented.

We can see that the process of word segmentation is similar with the association function of input. Read one word, and associate until the association could not be continued. If the present segmentation could compose the word, return one Token. If the present segmentation could not compose word, remount to the nearest node which could compose the word, return. The worst situation is to return the first single word, and then begin to associate from the next word in the return result.

Here, the efficiency of character matching is almost linear. Take one word to find corresponding matching in the tree, and every matching cost is O(1), so the time complexity of matching is the length of the character string. For the character string which length is n, its complexity of word segmentation is O(n). The average complexity of maximum matching is $O(n^2)$. And we didn't consider the inclusion of various meanings and the branch disposal, and the complexity is still limited even if adding these instances. The core codes of word segmentation algorithm includes

```
public final Token next() throws java.io.IOException {
   length = 0;
   start = offset;
//construct association stream and simulate the association function of input
   AssociateStream assoStream = new AssociateStream(WordTreeFactory.getInstance());
//process of association word segmentation
   if (assoStream.associate(c)) {
            push(c);
     if (!assoStream.canContinue()) {
        assoStream.reset();
        return flush();}}
  else {
//when present node could compose one word, return a Token
  if (assoStream.isWordEnd()) {
       assoStream.reset();
bufferIndex--;
offset--;
return flush();}
```

```
else if (assoStream.isOccurWord()) {
//if the word exists in the association stream, remount to the former node which could compose the word, and return token
assoStream.backToLastWordEnd();
bufferIndex=bufferIndex-(length-
    assoStream.getSetp()) - 1;
offset = offset - (length-
    assoStream.getSetp()) - 1;
length=assoStream.getSetp();
assoStream.reset();
return flush(); }
//if the word doesn't exist in the association stream, output the single word as a Token
else {if (length > 0) {
bufferIndex = bufferIndex - (length - 1) - 1;
offset = offset - (length - 1) - 1;
length = 1;
assoStream.reset();
return flush();}
assoStream.reset();
push(c);
return flush();}
}
}
```

3.3 Problems should be concerned when segmenting word

When using the method based on the vocabulary, we must face one problem, i.e. to read the vocabulary into the memory, and it usually wastes long time, but fortunately we only need do the work once, and when we load the vocabulary into the memory, all works will be implemented in the memory, and the speed of word segmentation will be enhanced largely. When the opportunity that we preload the vocabulary is the time that we first implement word segmentation, it is same to lazy load, and we will initialize it only when we use it.

3.4 Experimental result of Chinese word segmentation

In the experiment, we select the article with about two thousand words (essay in electrical industry), and disposal it by three sorts of analyzers. And the experimental results are seen in Table 1.

Standard Analyzer and CJK Analyzer didn't check the vocabulary, so they didn't segment the word accruing to any semantics. Standard Analyzer only simply divided the Chinese letter in the article into single word, but CJK Analyzer segmented the text to two-character word according to the two-character segmentation method, and many garbage words and expressions occurred. The experiment result is very amazing, and after preloading the vocabulary, the word segmentation speed of the analyzer in this article actually far exceeds the algorithm of Standard Analyzer which needs not checking any vocabulary.

4. Conclusions

Aiming at the applied particularity of electrical enterprise, after analyzing the key technology of Lucene analyzer, we put forward the analyzer implementation based on the vocabulary, realize the analyzer by the interface offered by Lucene and acquire better effect of word segmentation.

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Table 1. Result of experiment

Analyzer	Word segmentation algorithm	Time consumption
Standard Analyzer	Segmenting by word	67ms
CJK Analyzer	Segmenting by two-character word	7ms
Chinese Analyzer (it is implemented in the article)	Improved word segmentation algorithm	Without vocabulary preload: 1247ms Vocabulary preload: 44ms

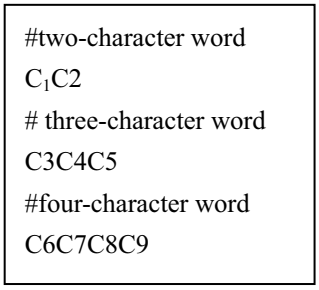

Figure 1. Vocabulary Structure

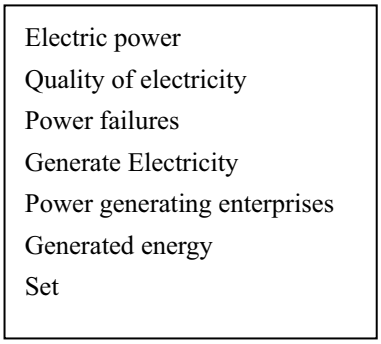

Figure 2. Vocabulary Structure in this Application

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The Characteristic and Success Factors of an Organizational Memory Information System

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Abstract

Data, information and knowledge have increased within organization across time. They become wasted memories due to retired staff, died or replace to another department. This could give great impact when intellectual capital do not being used wisely especially as competitive advantage element. Therefore, there is a need to manage memories accordingly. Otherwise, time, money and energy are wasted when the same task, research and findings need to be done repeatedly. This paper discusses the implementation of organizational memory system (OMS) which also known as organizational memory information system (OMIS). Before that, the basic theory of organizational memory (OM) will be described for better understanding. This paper indicates that there are 5 blocks of success factor to evaluate OMIS implementation; system quality, information quality, success measure in terms of usage, individual impact and organizational impact. OMS is proposed as a prototype to be implemented for the whole module of Faculty of Computer Science and Information System in order to protect their intellectual capital and optimizing the efficiency by managing organizational memory. The paper provides details of solution to academic management on the approach to making organizational memory information system work in practice. The approaches to manage memories in the model have yielded a number of benefits as demonstrated by a case study. This work will be beneficial to researchers and practitioner who are interested in applying OMIS in organization.

Keywords: Organizational, Memory, Corporate, Knowledge, Success factors, Information system

1. Introduction

Organization will be more efficient and gain competitive advantage with the utilization of collective memories. These memories can be in a form of data, information, or knowledge regarding certain problem solving and decision making. Which is inefficient organization will re-do process and research to the same area for the same problem or situation. Besides, this lack of memories due to staff replacement can cause of what we called as "corporate amnesia". As a result, we need to construct an Organizational Memory (OM).

OM is defined as a method for acquisition, retention, retrieval and knowledge accessible for organizational purposes (Walsh and Ungson, 1991). It is also called as "corporate knowledge" or "corporate genetic" by Pralahad and Hamel (1994) and "corporate memory" by Annie (1999). Rose *et al*. (1998) also use the term "corporate memory" (Borghoff and Pareschi, 1998; Kransdorff, 1998) for knowledge repository that being used as a knowledge management tool.

In general, OM contains both structure and mental artifacts. This mental consist of data, information and knowledge while structure involves process or knowledge creation. However, OM can be assign as repositories of knowledge for future use. Besides that, it can store not only raw data or information but also the meaning of it. Then, because of this benefit awareness, information technology (IT) had been seen as a mechanism for better utilization in OM. Computer base system can give information automatically in shorter time and precisely. Non-IT base memory usually lies in

individual mental which it will be an advantage if can be accessed and connected in understandable context. Otherwise, it becomes loss as the individual leaves the organization (Stein and Zwass, 1995) with the knowledge resides in their brains. Memories will damage in terms as a whole and its' accuracy across time. On the other hand, IT-based memory is quasi-permanent; knowledge is logged, indexed, secured and organized in such a way that it becomes accessible. IT contributes to organizational memory in at least two ways; by making accumulated knowledge accessible to organization members or by making individuals with knowledge known (Ackerman, 1996). However, IT-based memory suffers from limitations that have been pointed out by Ackerman (1996) such as the impossibility of having a unified organizational memory reflected in incomplete, fragmented and/or overlapping databases and files. Furthermore, IT often lacks the capability of providing necessary clues in light of the context in which memory is found most useful.

Yet, there is still no agreement as to which technologies best support this memory by whatever means. Lehner *et al*. (1998) suggested that organizational memory cannot be served by a single technology. Baird and Cross (2000) contend technology is not enough to accumulate information in electronic repositories and organizational members rely upon a network of relationships for both information and advice. Nevertheless, IT can be consider supporting organizational memory. OM with technology support is called Organizational Memory Information System (OMIS) (Wijnhoven, 1999).

In this paper, OMIS background and its' implementation towards a case study in FSKSM was discussed and focused to the Unit of Academic Management. As a year passed by, knowledge and experience had increased, then became wasted memories due to retired staff, died or replace to another department. This could give great impact when intellectual property did not being used wisely especially as competitive advantage element. Therefore, there is a need to manage memories accordingly. Otherwise, time, money and energy are wasted when the same task, research and findings need to be done repeatedly.

2. Methodology

2.1 Framework of OMIS

An OMIS is defined as "a system that functions to provide a means by which knowledge from the past is brought to bear on present activities, thus resulting in increased levels of effectiveness for the organization" (Stein and Zwass, 1995). Some authors use the terms Organizational Memory System (OMS). OMS can be define as a system which (a) realizes parts of the organizational knowledge base with the help of information and communications technologies and/or (b) realizes and supports tasks, functions and procedures that are connected to the use of the organizational knowledge base (Lehner et al., 1998). Ackerman (1994) describes that OMS offer the possibility that computer system can better serve the information storage and retrieval needs of an organization's memory can present technical and social methods. In essence, some researchers view an OMIS or OMS as a component of organizational memory.

Wijnhoven had improved Walsh and Ungson (1991) organizational memory framework. Wijnhoven (1999) suggest computer based information system and non-IT record and files elements should be include supporting OMIS besides individual, culture, transformation, structure, ecology and external environment. In our case study, this model had been selected. However, Stein and Zwass (1995) present a framework for an OMIS consisting of two layers. The first layer incorporates four subsystems that derive from four effectiveness functions; integration, adaptation, goal attainment and pattern maintenance.

Integration is a coordination and management of information across the organization while adaptation is an ability of the organization to adapt to changes in its environment. The third subsystem, goal attainment depends on the ability of the organization to set goals and evaluate the degree of their fulfillment. Next, pattern maintenance is an organization ability in order to maintain the cohesion and the morale of the workforce. The second layer consists of mnemonic functions including knowledge acquisition, retention, maintenance, search, and retrieval. These two layers can be either IT-based or non-IT-based.

2.2 Components of OMIS

Figure 1 illustrates the three forms of OMIS are possible: paper documents, computer documents, and self-memory (Jennex, 1997).

- *Paper documents* are organization-wide references that reside in central repositories such as a corporate library. Examples of paper documents include reports, procedures, and technical standards. An important part of this memory is in the chronological histories of changes and revisions to these paper documents as they reflect the evolution of the organization's culture and decision making processes.

- *Computer documents* include all computer-based information that is maintained at the work group level or beyond. These may be made available through downloads to individual workstations, may reside in central databases or file systems. Additionally, there are the processes and protocols built into the information systems that are reflected in the

interface between the system and the user, by who has access to the data, and by the formats structured system inputs and outputs.

- *Self-memory* includes all paper and computer documents that are maintained by an individual.
- Typical components include files, notebooks, written recollections, and other archives. These typically do not have an official basis or format. Each person's self-memory is determined by what is important to that person and reflects that person's experience with the organization.

Nevertheless, it is important to identify how the knowledge stores in organization, it is physical mechanism. Below are some methods that should be considers at first place discussed by Annie (1995):

- *Document* – normal method such as books, manuals, electronic document and many more.
- *Document from Document Management System (DMS)* – quite difficult to develop, manage and process effectively. Especially, many changes being done in particular documents. So one mechanism should exist to control these changes. Then the latest document format will be used.
- *Groupware* such as *Lotus Notes* – is use for knowledge sharing on specific task. For example DMS, infrastructure for undefined knowledge (Dodgson,1993)
- *Expert System or Knowledge Base System* – using artificial intelligence. Computer system shall help in problem solving besides to achieve the deep knowledge. It is a combination of four main components; knowledge base, include engine, elaboration function and user interface.

Stein and Zwass (1995) argue that certain contingencies will limit the implementation and use of an OMIS. They note that even though an OMIS may be demonstrated to be effective for an organization, the project to develop it may not be initiated. Even if the project is initiated, it may not be concluded. If the project is concluded, the system may not be used. If the system is used, it may not be used properly. And, even if used properly, it may not achieve its full potential. A model of OMIS success should enable the assessment of the extent to which an implemented OMIS will achieve its potential with respect to enhancing organizational effectiveness.

2.3 OMIS Success Model

Jennex *et al.* (1998) had come out with success model customization towards OMIS context from the former De Lone and McLean's (1992) I/S Success Model (**Figure 2**). The model is a block-recursive one that includes 5 blocks. This new model has separate system quality and information quality into different block. This is because the system quality block has been expanded to include the characteristics of the OMIS. Refer to table 1 for more details.

Practitioner and researcher may use this model to justify the success factors in implementation of OMIS in an organization. Begin with system quality block to determine in terms of operational characteristics. Then will lead to measure information quality for its output. The third block will measure in terms of usage of OMIS components. Individual impact is to identify individual performance due to productivity. Lastly, organizational impact of the overall OMIS implementation will be assessing by internally and externally.

2.4 Unit of Academic Management as a case study

Faculty of Computer Science and Information System (FSKSM) is one of an organization in University of Technology Malaysia. Core business of FSKSM is learning and service. Many information need to be manage wisely, especially in academic sector; thesis, curriculum, subject registration, and many other academic artifacts. This study is about data, information and knowledge management which is faculty's intellectual property. Every year, there are replacement and increment in terms of students and staffs. As a result, intellectual property became overload and the changes done without control. In fact, without our knowledge, faculty lost their property (treasure) when it cannot be retrieved. Next, the lost can give impact towards faculty performance and quality.

As for this study, the focus is unit of academic management in FSKSM. Currently the faculty is running two Computer Science programs and is introducing six new specialization programs for the coming intake. They are facing problem in tracking the curriculums for all the programs. Furthermore each semester, the lecturers are allowed to update the syllabus according to the current technology and concepts. Several similar programs and changes in syllabus make some students and lecturers confused. This occurs when different code for same subject but for different course. Besides that, the curriculum information also hard to collect, and retrieved back. Other than that, thesis became overloaded as the semester and year passed by. This intangible asset is the most powerful assets in faculty but yet to be lost without notice. The suggestion here is to have a memory or some kind of repository to store and manage all academic information. We called the OMIS solution for FSKSM as "*MemorIS"*. Hope with the repository or storage bin provided in MemorIS can protect our intellectual property and besides it can be retrieve to improve excellent learning environment.

2.5 Element of OMIS

OMIS framework/model selected is proposed by Wijnhoven (1999) which had been improved from Walsh and Ungson (1991) OM framework (**Figure 3)**. The overall principal of this OMIS starts from the first storage bin which is individual whom responsible to their own knowledge. In order to retrieve back the information or knowledge, some kind of culture need to be embedded. So the whole story of this information will play its role.

Besides that, third bin consists of process and procedure in transformation of knowledge creation also takes part in this OMIS. However, individual roles that responsible to this OM will be instructed in the structure. Some changes had been made in order to meet the case study implementation, whereby ecology bin was turn to be a "Meta-Memory". This Meta-memory will be a computer based knowledge repository. All IT based files and records will stored here as suggested by Wijnhoven (1999). Last but not least, external bin as non-IT resource such as paper document that store physically distributed (example: Academic Guideline).

In summary, the above elements were constructed for FSKSM's memories. It is based on requirement and specifically for FSKSM. This was implemented by combining elements suggested by Walsh and Ungson (1991) and Wijnhoven (1999). Whereby, some of the element had been eliminate and replace with other element that suit with OMIS application in FSKSM. Refer to above OM (for Walsh and Ungson, 1991) and OMIS model (for Wijnhoven, 1999) sub topic.

2.6 Meta-Memory as Repository

In this research, meta-memory is a critical knowledge which contents of faculty curriculum. This is because; meta-memory can give data about the requested curriculum memory. From our findings, academic management really needs a knowledge repository for them to emphasize their work besides solving problem. Refer to table 2 for suggested list of academic management meta-memories.

However there is several alternatives storage that will focus on IT-based documents whereby files are kept in repository for easy in access. Besides that, will provide the facilities for end-user to download and upload the documents to MemorIS. Then, the hardcopy documents such as paperwork will be stored distributed to responsible individual; head of department. Academic guideline will provide to all students and master copy of it will be stored in Academic Management office while the MemorIS will have the location information provided to all.

2.7 OM Flow in FSKSM

The flow of OM in FSKSM curriculum management (**Figure 4)** composed of the followings:

- Stakeholder : Unit of Academic Management
- Object : Curriculum
- Artifacts : Paperwork, Syllabus L1 and Course Planning Outline
- Output: Checklist and program assessment.
- Personal: Registrar Assistant, Head of Department and lecturer.
- Resource: Documents (paperwork and academic guideline)

The overall flow in MemorIS, in academic management (mainly curriculum) will act differently. Assistant of Registrar will perform as system administrator to assist in checklist for contents of faculty programs. If there is some missing point, then he/she will notify to responsible head of department for inquiry. In order to complete the task, some lecturers will be appointed by head of department via email with job task to be done. The process will help head of department in managing the task and perform effectively. Besides that, MemorIS also provide facilities for lecturer to interact and head of department virtually by directly uploading and sharing the documents on-line. This is actually to adopt the sharing culture to all members of FSKSM. However, the above activities have to be supported by below utilities:

- Repository Backup – all documentation will have backup and stored in other server. This is to ensure the data integrity and security.
- Checklist – is a list of repository content. To track the complete modules in MemorIS. Head of department and system administrator can do checking easily and identify incomplete contents and the steps to be taken,
- Forum – place to voice out opinion and discussion on particular topics. It is open discussion between lecturers and head of departments to get better ideas and decisions. Besides to share opinion among members.
- Individual Diary – extra utility for better enhancement in private notes and time management. Will have the information of activities and important memo to remember.

3. Results and Discussion

3.1 MemorIS System Architecture

As a result, the MemorIS prototype system had been proposed and suggested to be restricted within the FSKSM intranet. Head of department and lecturers will be the main user. Their responsibility is to complete the content of FSKSM curriculum. Other then that, system admin or assistant registrar will maintain, and manage overall system flow.

Basically, they have different roles in using the system. All users will be connected to database using interfaces. These interfaces will allow the user to retrieve, create and to store FSKSM program information easily and efficiently (**Figure 5).**

3.2 Program Architecture

MemorIS was develop using PHP programming language as server-side HTML – embedded scripting also called as hypertext preprocessor. PHP was chosen because it is an open source where the programming code can easily and freely download from various resources (internet, books and etc.). Flexibility of PHP language helps in dynamic website development becomes simple and easy.

Figure 6 shows the sample code program that link all php website -*.php with MemorIS database - memoris.sql.

3.3 Function Architecture

This function architecture includes connection user with MemorIS functions. Besides it shows the level of data retrieval between user and MemorIS. Table 3 will have more details.

3.4 Database Architecture

Database is the backbone for MemorIS. It will provide storage for FSKSM program documents. Complete database architecture will allow optimum data retrieval. MemorIS consists of three main databases; user, FSKSM program memories and checklist. User database is to store information about registered system user according to several categories; head of department, lecturer or system admin. Besides, it will identify last time login for each user.

Second part of database is an FSKSM program memory which is the core for this system. It allocates all files to be shared among system user. Relevant file information will be store here. Last but not least, is the checklist database that will have overall information needed and status for each program.

3.5 Interface Architecture

System interface work as medium of communication between user and process available in the system. It is design based on OM flow. **Figure 7** shows hierarchy of graphical user interface in MemorIS.

4. Conclusion

In this paper, we have addressed the use of information technology to obviate the problems involved in the use of organizational memory. Then, we explored OMIS components and development strategies in terms of information types and mnemonic processes which is OMIS framework. Through literature analysis, insight has been gained into the different types of information that can be incorporated into an OMIS. Finally, we have pointed out a model of OMIS success with 5 blocks and different success factors. This model enables the assessment of the extent to which an implemented OMIS will achieve its potential with respect to enhancing organizational effectiveness and competitive advantage. This model enables the assessment of the extent to which an implemented OMIS in MemorIS will achieve its potential with respect to enhancing organizational effectiveness and competitive advantage.

In our case study, there are several constraints that limit the scope of this research especially in MemorIS development. For example, due to distributed and unorganized information storage, some of this intellectual property had been lost. However, MemorIS is a good start for unit of academic management in FSKSM to protect their intellectual property. In conclusion, the implementation of OMIS is very challenging since it involved dealing with soft and hard issues such as technology and human factors. IT contributes as a core element for knowledge management system then towards an organizational learning.

As a result, we hope this article will contribute and guide the practitioner as well as the researcher in implementing OMIS. Therefore, for future research, we encourage further in implementation process and empirical study in selected Malaysian organizations to justify and test the implementation of OMIS model in Malaysian context. Furthermore, OMIS success model will be the tools to self assess of the organization's OMIS implementation.

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Table 1. Description of OMIS Success Factors

Success Factor (block)	**Description**
System Quality	Determine how good the system is in terms of its operational characteristics. It contains three constructs: the technical capabilities of the organization, the form of the OMIS, and the level of the OMIS. Technical resources define the capability of an organization to develop and maintain an OMIS.
Information Quality	In terms of its output. Factors in this category span a broad range from importance, relevance, usefulness and in formativeness to clarity, content, accuracy, and completeness. Information quality affects the system usage block.
Success Measure in Terms of Usage	Information use refers to the utilization of the system's outputs. It measured OMIS components with the usage on five dimensions: number of tasks performed, actual daily usage, frequency of use (e.g., hourly, daily, etc.), number of application packages used, and level of sophistication of usage.
Individual Impact	The impact of an OMIS on an individual is rooted in performance changes, but has other facets. It will be measured in terms of productivity.
Organizational Impact	Organizational impacts relate to the effectiveness of the organization as a whole. These measures relate to assessments performed by external organizations, as well as those performed internally.

Above table is the detail of success model customization towards OMIS context by Jennex *et al.* (1998).

Table 2. List of Meta-Memories for Curriculum Management

No.	Storage	Meta-Memory
1.	Paperwork	Course name, title of paperwork, name of person in-charge, file location, update date, version, paperwork contents.
2.	Specification Program	Programme name, programme code, file location
3.	Syllabus L1 – Course Outline	Department name, subject name, subject code, lecturer, update date, file location
4.	Curriculum by semester	Program name, course name, update date, file location, person in-charge
5.	Check list	Checking date, person in-charge, list of checking, notes

Above table represent the list of meta-memories for Curriculum Management of FSKSM.

Table 3. Function Architecture with MemorIS User

Function\Type of User	Lecturer	Head of Department	System Admin	Public
Register system user		√	√	
Update profile	√	√		
Upload document	√	√	√	
Download document	√	√		√
Send Email	√	√	√	
Send message-forum	√	√		
Login list name			√	
System maintenance			√	
Ensure system running smoothly			√	
System content checklist		√	√	
Update program evaluator panel		√		

Above table represent the interaction between user and MemorIS function.

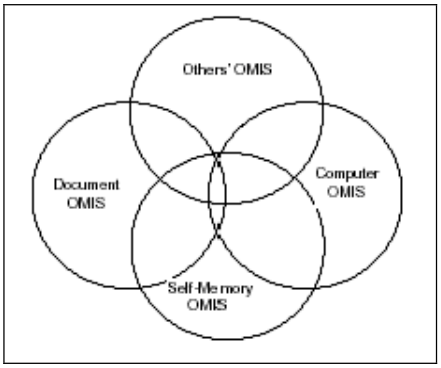

Figure 1. Components of an OMIS (Jennex,1997)

This figure shows inter-related of four components in OMIS.

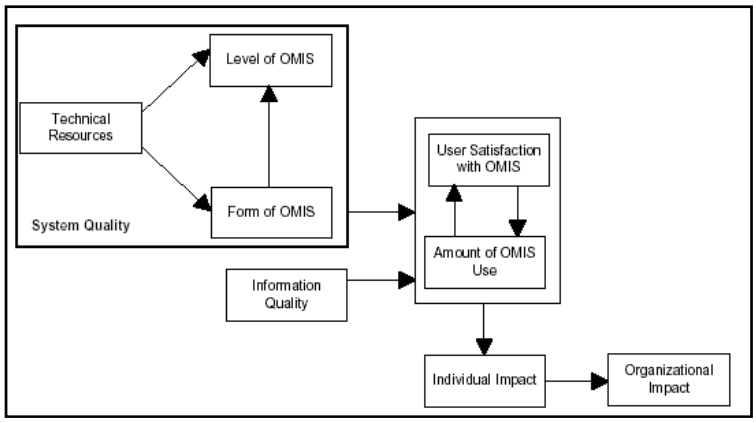

Figure 2. OMIS Success Model

The above figure is an OMIS success model proposed by Jennex *et al.* (1998) that have five blocks to measure.

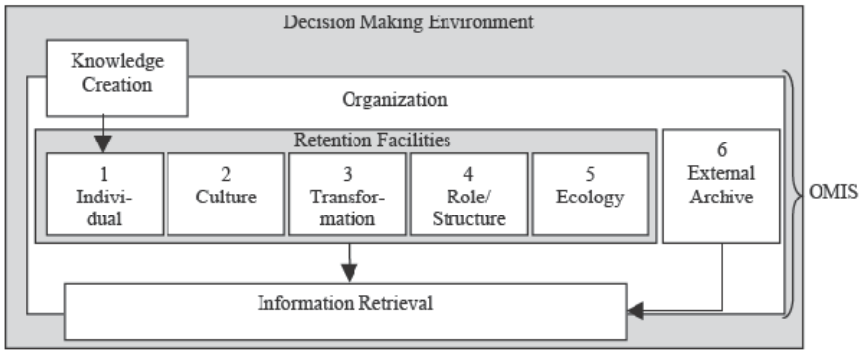

Figure 3. OM Framework (Walsh and Ungson, 1991)

Above figure is OM framework proposed by Walsh and Ungson which consists of six storage bin for different purpose.

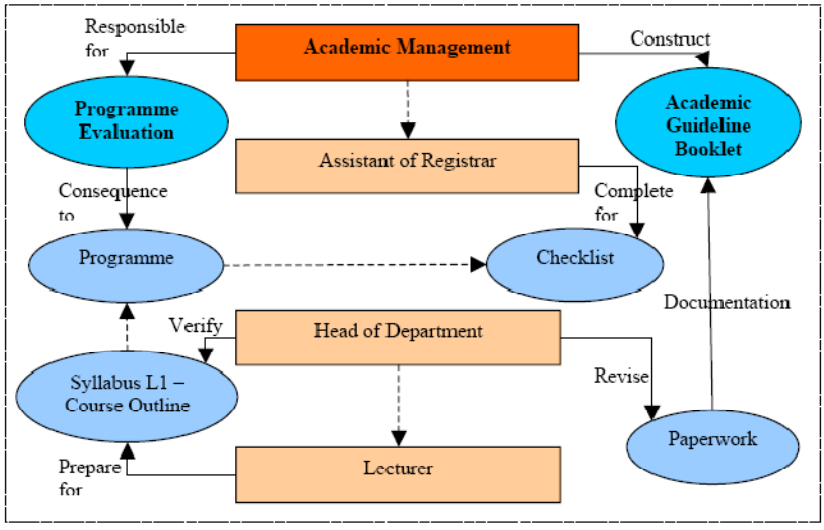

Figure 4. MemorIS Flow Model

This is MemorIS Flow Model based on Academic Management in FSKSM.

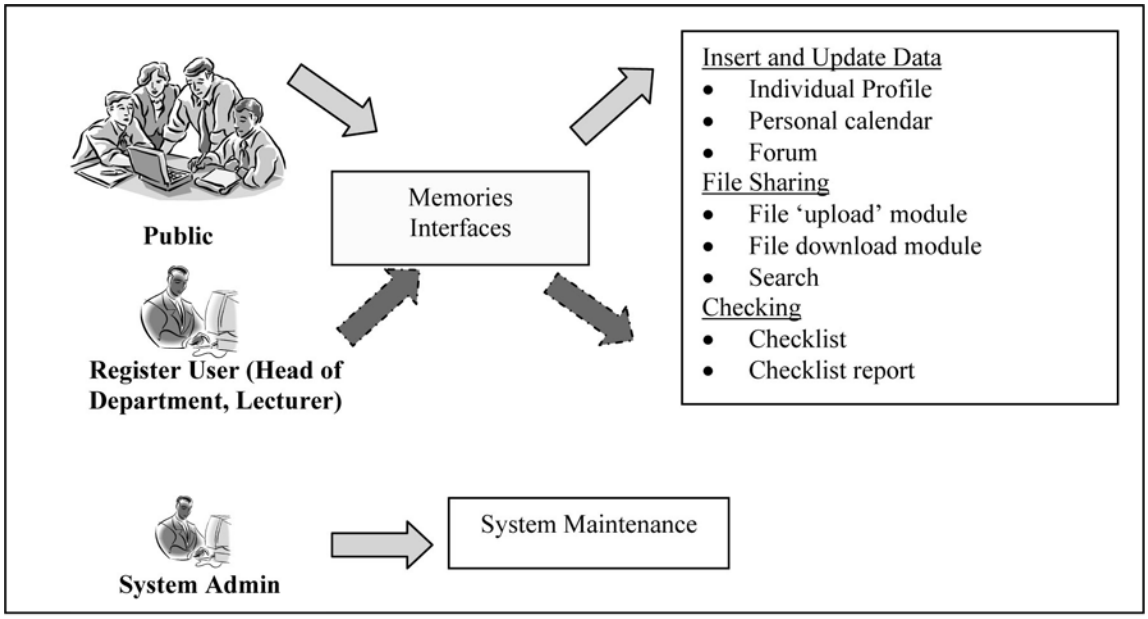

Figure 5. MemorIS System Architecture

The above figure shows the proposed MemorIS system architecture for FSKSM.

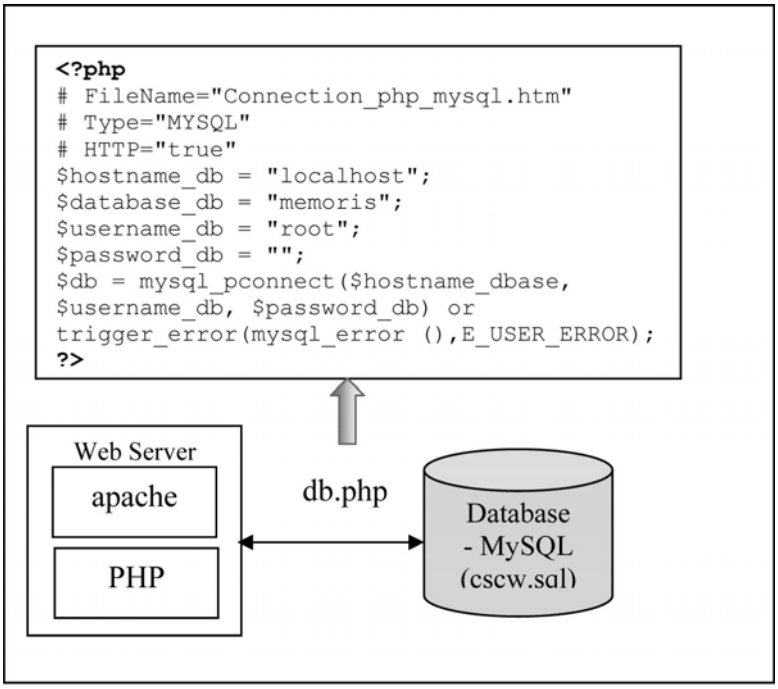

Figure 6. Web and Database Connection

This is the database connection to the PHP website.

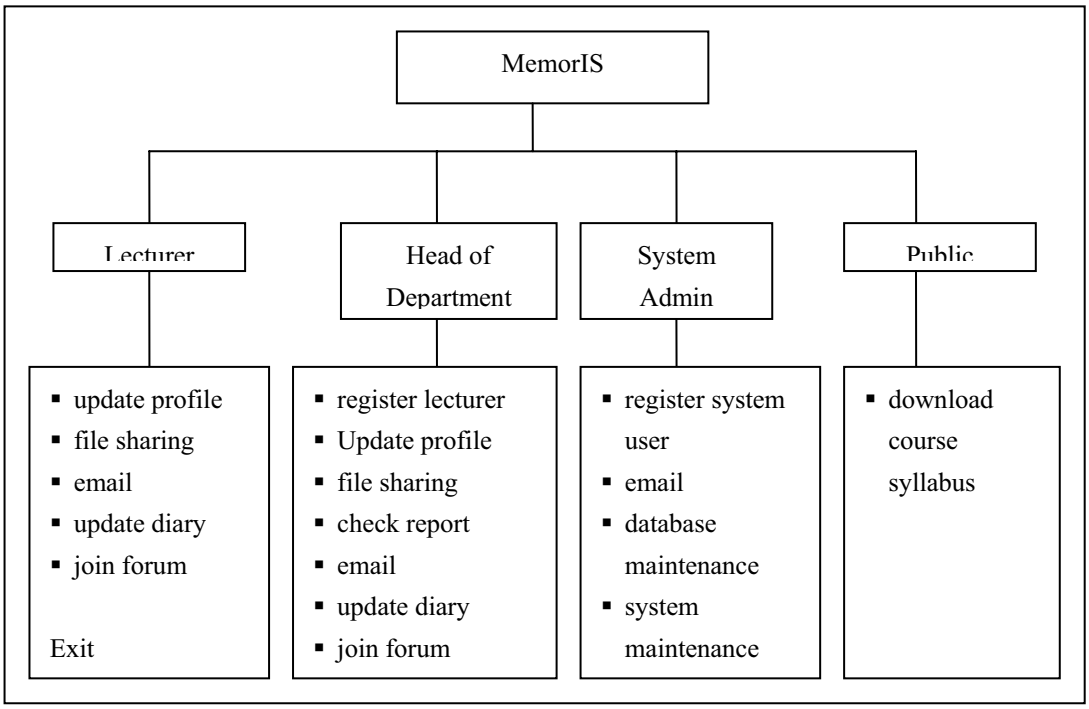

Figure 7. MemorIS User Interface Hierarchy

The above is the list of MemorIS user interface hierarchy.

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The Research of the Model of Communication System Depending on the Queuing Theory

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Abstract

Queuing theory based on the actual situation in the communication system must be defined within the mathematical model of the building and analysis. To shorten the time for communication time as the target of communications equipment, the average rate services to scientific and reasonable request is analyzed in-depth in the paper.

Keywords: Queuing theory, Communication system, Mathematical model

1. Foreword

Under war circumstances, communications between equipments are quite different from usual circumstances, most of the equipments in the battlefields are high-tech electronic devices ,and has much high sensitivity. The research of the mathematical model of communications system is carried out to reasonably deploy communication resources, effectively and swiftly communicate, improve the capability, which enables us to make the best use of communication system at war.

Communication system is a big complex system, which consists of equipments, persons, information and some other factors. In an effort to make the best use of the system and fulfill the mission in the shortest time with limited resources, the mathematical model of the system is defined to adjust the factors that can affect average service rate such as equipments and information. Based on queuing theory, a research on the modeling and analysis of communication system is given in this paper.

2. Proposition of the problem

The communication procedure can be divided into three sub-processes. The process of sending out information is illustrated as an example in this paper, which is shown below.

This system can be concluded into a problem of queuing that consists of both sub-systems in series and sub-system in parallel serves the customers with information. According to this, the following objectives are supposed to achieve as follows

1) Allocating proper communication resources to adjust the whole communication time in order to fulfill certain communication efficiency, in other words, make the whole time within the time limit which is requested by war.

2) Allocating the communication resources properly to coordinate different sub-systems in order to make them work in certain intensity to improve system efficiency.

3. Mathematical model and Analysis

3.1 Assumptions

Based on Queuing theory, the mathematical model of the communication system is analyzed and the assumptions are made as follows:

(1) All the input and output.

(2) Equipments works on FCFS principle (First come, first serve).

(3) All the equipments are in good shape.

3.2 Building of the model

In order to guarantee the consistence in symbols in the following passage, some regulations is made as follows,

λ_i =average information that system receives per time span;

μ_i =average serving rate of i;

ρ_i =average serving intensity of equipment i;

It is mainly concerned about two parameters of the system as follows:

1) Wsi, average lingering time, which is the expected value of working time of equipments i.

2) Wqi, average waiting time, which is the expected value of waiting time of information at equipment i.

3.2.1 Building of the model of sub-systems

Seen from the Diagram 1, the system has both sub-system in series and sub-system in parallel, so it is complicated. But the system can be converted into an equivalent one which consists of only sub-systems in series by converging a1, a2 into sub-system1, and converging b1, b2, b3 into sub-system2. As we can see below,

So the system can be regarded that consists of two M/M/1system in series, the I/O distribution and the time that information is served are listed below

$$P_n(t)=\frac{(\lambda_1 t)^n}{n!}e^{-\lambda_1 t},\quad F_{V_i}(t)=\mu_1 e^{-\mu_1 t}\quad (t\geq 0)$$

In above formula, random variable Vi stands for the time that information is served(i=1,2,…). Based on above conclusions, the serving intensity of exchange equipment is listed $\rho_1=\frac{\lambda_1}{\mu_1}$.

Meanwhile, average lingering time and average waiting time are concluded

$$W_{s1}=\frac{1}{\mu_1-\lambda_1},\quad W_{q1}=\frac{\lambda_1}{\mu_1(\mu_1-\lambda_1)}.$$

After analyzing and inducing, it is known that I/O of customers of transmitting equipments comply with Poisson distribution, and the time that information arrives complies with minus exponential distribution. So the average lingering time and average waiting time are correspondingly listed below,

$$W_{s2}=\frac{1}{\mu_2-\lambda_2},\quad W_{q2}=\frac{\lambda_2}{\mu_2(\mu_2-\lambda_2)}$$

Based on Diagram2, the exchange equipment can be divided into three parts below,

As these two different equipments in exchange equipments are dependent to each other, information is allocated to two devices a1, a2 in proportion. For the equipments deal with the information randomly, the set of all the input incidence of the two equipments is $\Omega=\{A_1,A_2\}$, $\sum_{i=1}^{2}A_i=\Omega$,the probability formula is listed $\sum_{i=1}^{2}P(A_i)=1$.

As information is allocated to exchange devices at random in line with probability distribution, it can be considered as two M /M /1-type serving system with different arrival rate of information. If the ratio of two equipments is supposed to $l_1:l_2$, there are

$$\lambda_1=\sum_{i=1}^{2}\lambda_{1i}=\sum_{i=1}^{2}P(A_i)\lambda_1\quad ,\quad \mu_1=\sum_{i=1}^{2}\mu_{1i}=\sum_{i=1}^{2}l_i\mu_1\qquad (\lambda_{1i}=P(A_i)\lambda_1,\mu_{1i}=l_i\mu_1)$$

Provided that the system is constantly stable, the formula of average lingering time and average waiting time are concluded

$$W_{s1i}=\frac{1}{l_i\mu_1-P(A_i)\lambda_1}\quad ,\quad W_{q1i}=\frac{P(A_i)\lambda_1}{l_i\mu_1(l_i\mu_1-P(A_i)\lambda_1)}\quad ,(\ i=1,2\ ).$$

The input incidence is $\Omega=\{B_1,B_2,B_3\}$, $\sum_{j=1}^{3}B_j=\Omega$.

The probability formula is $\sum_{j=1}^{3}P(B_j)=1$.

If the serving rate ratio of the two equipments is defined as $k_1:k_2:k_3$, average lingering time and average waiting time of information are known as follows

$W_{s2j} = \dfrac{1}{k_j\mu_2 - P(B_j)\lambda_2}$, $W_{q2j} = \dfrac{P(B_j)\lambda_2}{k_j\mu_2(k_j\mu_2 - P(B_j)\lambda_2)}$, ($j = 1, 2, 3$).

3.2.2 Modeling of the system and solution

Under specific circumstance, it is only need to know average lingering time and average waiting time of information and it′s minimum. Based on the above conclusion, it is known that

$W_{\text{total(s)}} = \max\{W_{s1i}\} + \max\{W_{s2j}\}$, $W_{\text{total(q)}} = \max\{W_{q1i}\} + \max\{W_{q2j}\}$

If $\mu_1 = \lambda_2$, it is known that

$$\begin{cases} \min W_{toatal(s)} = \max\{\dfrac{1}{l_i\mu_1 - P(A_i)\lambda_1}\} + \max\{\dfrac{1}{k\mu_2 - P(B_j)\mu_1}\} \\ s.t.\sum_{i=1}^{2} P(A_i) = 1, \sum_{J=1}^{3} P(B_J) = 1, \sum_{i=1}^{2} l_i = 1, \sum_{J=1}^{3} k_J = 1 \\ l_i, k_j \geq 0, i = 1, 2; j = 1, 2, 3 \end{cases}$$

$$\begin{cases} \min W_{\text{total(q)}} = \max\{\dfrac{P(A_i)\lambda_1}{l_i\mu_1(l_i\mu_1 - P(A_i)\lambda_1)}\} + \max\{\dfrac{P(B_j)\mu_1}{k_j\mu_2(k_j\mu_2 - P(B_j)\mu_1)}\} \\ s.t.\sum_{i=1}^{2} P(A_i) = 1, \sum_{i=1}^{3} P(B_j) = 1, \sum_{i=1}^{2} l_i = 1, \sum_{i=1}^{3} k_j = 1 \\ l_i, k_j \geq 0, i = 1, 2; j = 1, 2, 3 \end{cases}$$

$P(A_1) = P(A_2) = \dfrac{1}{2}, P(B_1) = P(B_2) = P(B_3) = \dfrac{1}{3}$, and when $l_1 = l_2 = \dfrac{1}{2}, k_1 = k_2 = k_3 = \dfrac{1}{3}$,the minimum of $W_{total(s)}$ and $W_{total(q)}$ are below

$W_{total(s)} = \dfrac{2}{\mu_1 - \lambda_1} + \dfrac{3}{\mu_2 - \mu_1}$, $W_{total(q)} = \dfrac{2\lambda_1}{\mu_1(\mu_1 - \lambda_1)} + \dfrac{3\mu_1}{\mu_2(\mu_2 - \mu_1)}$.

3.3 Analysis of the model

The optimum can be gain by adjusting System 2 to make sub-systems′ serving rate μ_1, μ_2, μ_3 equal.

According to the solution, the communication systems and the whole communication time can be further analyzed.

$W_{total(s)} = \dfrac{2}{\mu_1 - \lambda_1} + \dfrac{3}{\mu_2 - \mu_1}$, $W_{total(q)} = \dfrac{2\lambda_1}{\mu_1(\mu_1 - \lambda_1)} + \dfrac{3\mu_1}{\mu_2(\mu_2 - \mu_1)}$

Based on the above conclusions, it is known that when λ_1 is fixed the serving rate of exchange devices and transmitting devices μ_1, μ_2 can be adjusted in order to make $W_{total(s)}$ and $W_{toatal(q)}$ minimized and reasonable, which also help us to minimize the whole communication time and get an optimum.

4. Conclusion

Through building and analyzing of the model, the efficiency of the system can be improved and the time can be reduced by adjusting the serving rate of the equipments. Besides, the model helps the commanders who organize the communication with the decision. What′s more, it is still need some improvement on the model, as there are more things to do when a more complicated situation and the details are discussed.

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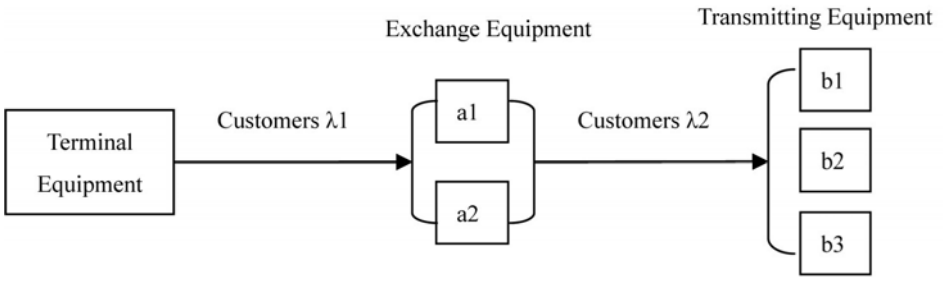

Figure 1. Communication procedure

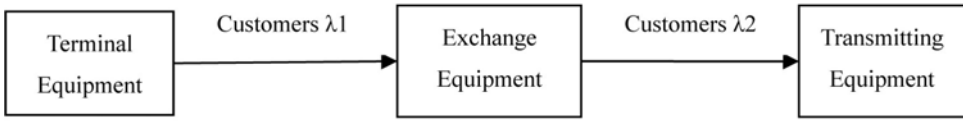

Figure 2. Serial communication system procedure

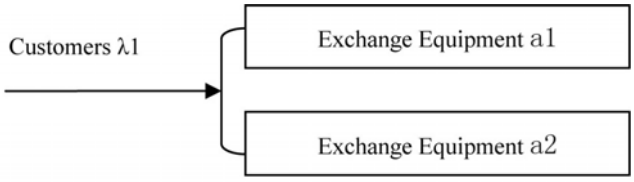

Figure 3. Parallel communication system procedure

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Estimate 3D Arm Motion with Hierarchical Limb Model

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Abstract

Focusing on the problem of low computation efficiency in the process of tracking human 3D motion, an algorithm for Estimating 3D arm motion with Hierarchy Limb Model (HLM) is proposed. In our algorithm, the Hierarchy Limb Model (HLM) is proposed based on the human 3D skeleton model. Facilitated by graph decomposition, the arm motion state space, modeled by Hierarchy Limb Model (HLM), can be discomposed into low dimension subspaces. The Top-Down search strategy and the Particle Filter are used to tracking the arm motion, thus the amount of particle in tracking can be reduced. To handle server self-occlusions, the weighted color histogram and image contour are used to modeling the observation likelihood function. The result of experiment shows that our algorithm can advance the computation efficiency and handle effectively self-occlusions.

Keywords: 3D Arm Motion, Hierarchy Limb Model, Top-Down strategy, Particle Filter

1. Introduction

The human 3D motion estimation has received a significant amount of attention in recent years driven by its wide applications such as video surveillance, human activity analysis, computer animation, etc. But human 3D motion Estimation is still a challenging task because of the exponentially increased computational complexity in terms of the degrees of freedom of the object and the severe image ambiguities incurred by frequent self-occlusions.

Moeslund (Moeslund, 2001, Moeslund, 2006) *et al.* comprehensively summarized the research results of the human 3D motion estimation. They classified the existing research pose estimation algorithms into learning-based algorithm and model-based algorithm. Furthermore, learning-based algorithm for the human 3D motion estimation can be separated into two strategies. The one is the category based on human motion prior knowledge learning. The category of solution uses strong motion prior to constrain the search into the most likely region of the parameter space (Urtasun, 2006, North, 2000). One way to cope with the high-dimensional state-space is to learn low-dimensional latent variable models. In this category, many algorithm are applied to learn the latent variable models, such as *Principle Component Analysis* (Sidenbladh, 2000, Urtasun, 2005, Sidenbladh, 2002), *Relevance Vector Regression* (Agarwal, 2004), nonlinear Gaussian process dynamic models (Urtasun, 2005) and the Partial Least Square (Xinyu, 2007), etc. The model-based category builds the human motion model with human prior knowledge and the human motion constraints, and the use of stochastic sampling techniques in model-based analysis-by-synthesis to obtain the optimal estimation based on the Bayesian network framework. As one nonlinear filter algorithm based on the Bayesian estimation framework, the use of particle filter (Blake,1998) has been widely application (Azad, 2004, Saboune, 2005) in the area of human 3D motion

estimation. Deutsher (Deutsher, 2005) *et al.* proposed the annealed particle filter to track the human 3D motion. *Markov Chain Monte Carlo* (Sminchisescu, 2003, MunWai, 2006,) is utilized to solve the particle *degeneracy* problem. Recently, the structure graphical model (Sigal, 2004) has been used to facilitate the estimation of human 3D motion.

Although the lower computation efficiency and ambiguities have been solved effectively, the learning-based methodology can't track the random activity in natural scene but tracking the motion which has been learned. Furthermore, a great amount of samples and expensive time cost are always the challenge in learning process because of the complexity of human motion. The model-based methodology needs a great amount of sample to describe the human motion. The number of sample and time cost show exponential growth with the dimension of human motion state space.

Wu (Wu, 2003) *et al.* proposed a mean field Monte Carlo algorithm based on a dynamic Markov network for 2D articulated body tracking, and decomposes the human motion state space into multiple linear subspaces via the MFMC. Wei (Wei, 2007) *et al.* proposed decentralized articulated graphical model to improve computation efficiency based on 2D human motion tracking. With the improvement of decentralized articulated graphical model, we propose the particle filter based on the hierarchy limb model for estimating the arm 3D motion. Facilitated by graph decomposition, the hierarchy limb model decomposes the right arm motion state space into two linear subspaces. Based on the hierarchy limb model, our algorithm searches each subspace with the particle filter. As a result, our algorithm can advance the computational efficiency because of the lower dimensionality of the search space and the reduced amounts of particle. To handle efficiently handle the severe self-occlusion problem, our algorithm propose the angle relation model between upper arm and lower arm in the arm motion process. To build the angle relation model, the least square is used to fitting linear of the arm contour.

The paper is organized as follows. Section 2 describes the hierarchy limb model, and the tracking algorithm based on particle filter is proposed. The iamge likelihood function are described in Sention 3. Experimental results and analysis are shown in Section 4, and finally concludes the paper.

2. Frameworks

In this section, we describe the key components of the arm motion estimation framework, namely, the hierarchy limb model, and the estimation framework based on the particle filter.

2.1 Arm Hierarchy Limb Model

Our algorithm uses a generic model that represents the arm structure. The arm model, as illustrated in Figure. 1, consists of two components: *kinematics model* and *structure graphical model*.

2.1.1 Arm Kinematics Model

Each limb of arm kinematics model includes two components: kinematics vector and shape vector. Kinematics vector consists of six parameters and is used to the prediction of arm 3D motion. Shape vector is used to describe the approximated arm 3D shape, including seven parameters.

To represent kinematics state of each limb, we define the kinematics vector as $x = \{T, \theta_x, \theta_y, \theta_z\}$, where T is global translation vector, and the rotation vecotr, $\theta = \{\theta_x, \theta_y, \theta_z\}$, presents the angles that the limb rotate around three coordinate axises as shown Figure. 1(c). The limb shape vector include three 3D cylinder constants and four shape constants in image plane. Three cylinder constants include the height l of cylinder, the radius r of cylinder, and the origin O of local coordinate system where $O \in SO(3)$. The shape vector e is equal to the vertex set of the quadrilateral that is the approximation of the cylinder on the image plane, as liiustrated in Figure. 2. We define the shape vector e as $e = \{e_1, e_2, e_3, e_4\}$, where $e_i = (x_i, y_i)$, $i = 1, 2, 3, 4$. As a result, the shape vector can be defined as $\Phi = \{l, r, O, e_1, e_2, e_3, e_4\}$.

The arm state space is represented as $x = \{x_0, x_1, x_2\}$. Where x_0 is formatted by the 3D coordinate triplets that is the ground truth of the right shoulder, x_1 is presented for the right upper arm, and x_2 is presented for the right lower arm. We denote model of each limb as follows:

$$x_i = \{T_i, \theta_{i,x}, \theta_{i,y}, \theta_{i,z}\}, i = 1, 2 \quad (1)$$

$$\Phi_i = \{l_i, r_i, O_i, e_{i,1}, e_{i,2}, e_{i,3}, e_{i,4}\}, i = 1, 2 \quad (2)$$

2.1.2 Arm Structure Graphical Model

The right arm can be represented by an arm graphical model such as shown Figure. 3 (a). The circle nodes corresponds to a part of right arm, such as the right upper arm and the right lower arm. The square nodes are the observation values assiocated with each circle nodes. The undirected links represent physical constraints among different parts of the right arm. The directed link from a part's state to its associated observation represents the local observation likelihood. In order to describe the motion of an articulated object, we accommodate the state dynamics by a dynamical graphical model such as shown in Figure. 3 (b). It contains two consecutive time frames.The directed links between consecutive states represents the dynamics translation from time *t*-1 to time *t*.

According to the characteristics of arm motion, the motion of any node of the arm only interacts with its children nodes. For example, the motion of lower arm is not constrained by any limbs but only the motion of corresponding upper arm. Figure. 4 (a) show the descomposion result for the right arm in Figure. 3 (b), and Figure. 4 (b) is the associated *moral graph* via the *separation theorem* and the charactics of the dynamic Markov network.

Using the arm hierarchy model, the problem of tracking right arm motion can be formulated as the prediction of x at time t .

2.2 Tracking with Particle Filter

Via the arm hierarchy limb model, we propose the tracking framework based on particle filter and the particle generation.

2.2.1 Tracking framework

Using the arm hierarchy limb model, the right arm motion can be decomposed into the motion of two parts, while the state space is decomposed into three low-dimensionality state spaces in the tracking process. Based on the decomposition, the overall state space optimization process can be formulated as the state subspace optimization of each limb following by the top-down search strategy via the Particle Filter.

The state parameter x_t of right arm motion at time t is represented by the form of joint state as shown Eqn. 3:

$$x_t \square \{x_{i,t}\}_{i=1}^{2} = \{x_{1,t}, x_{2,t}\} \tag{3}$$

Where i is the index of parts. Assmued the father node of ith node defined as $F(i)$, the observation state of all limbs is respresented as $z_t = \{z_t^i\}_{i=1}^{2}$. The posterior probability distribution for the right arm motion is given by:

$$P(x_t \mid z_t) = P(x_{0,t} \mid z_{0,t}) \prod_{i=1}^{2} P(x_{i,t} \mid x_{F(i),t}, z_{0,t}) \tag{4}$$

Where $x_{i,t}$ is defined as the prediction value of ith parts at time t, $x_{F(i),t}$ is the observation value of the father associated with $x_{i,t}$, $P(x_{0,t} \mid z_{0,t})$ is defined as the maximum a posterior (MAP) for the right shoulder where is the constant. As a result, $P(x_{i,t} \mid x_{F(i),t}, z_{i,t})$ can be approximated by the following expression:

$$P(x_{i,t} \mid x_{F(i),t}, z_{i,t}) \approx cP\left(z_{i,t} \mid x_{i,t}, x_{F(i),t}\right) \sum_{k} w_{i,t-1}^{k} P\left(x_{i,t} \mid x_{i,t-1}^{k}\right) \tag{5}$$

Where N is count of particle, K is the index of particles, $x_{i,t-1}^{k}$ is the *kth* particle of *ith* part at time *t*-1, $w_{i,t-1}^{k}$ is the weight value associated with $x_{i,t-1}^{k}$ and can be modified as Eqn. 6.

$$w_{i,t}^{k} \propto w_{i,t-1}^{k} P(z_{i,t} \mid x_{i,t}^{k}, x_{F(i),t}) \qquad \sum_{k=1}^{N} w_{i,t}^{k} = 1 \tag{6}$$

Substituting Eqn. 6 into Eqn. 3, the joint state x_t can be approximated as shown Eqn. 7:

$$x_t = \{x_{i,t}\} \approx \{\sum_{k} w_{i,t}^{k} \times x_{i,t}^{k}\}_{i=1}^{2} \tag{7}$$

2.2.2 Particle Generation

In this section, we describe in details the praticle generation based on the arm hierarchy limb model and tracking framework.

In particle filter theoretical framework, the state transition model, by which particle is generated, is described as shown Eqn. 8.

$$x_t = x_{t-1} + v_t, \quad v_t \square N(\mu, \sum) \tag{8}$$

Where v_t is the Gaussian noise that the expectation μ is a 3×1 scalar, which is defined as the motion speed of part, and the variance $\sum$ is the 3×3 diagonal matrix.

The motion speed of part i depends on the speed of part i at time t-1 and the motion speed of its father part *F(i)*. We respresent the motion speed of part i at time t as the row vector $v_{i,t} = (v_{i,t}^{x}, v_{i,t}^{y}, v_{i,t}^{z})$, where superscript of each element of vector is defined as the rotation angle speed of X axis, Y axis, and Z axis while each element of the row vector is

independent. The row vector $v_{F(i),t} = (v^x_{F(i),t}, v^y_{F(i),t}, v^z_{F(i),t})$ is defined as the motion speed of *F(i)*. If t<3, $v_{i,t}$ is confirmed as following equation:

$$v_{i,t} = \begin{cases} (0,0,0) & t = 0 \\ (x_{i,t} - x_{i,t-1}, y_{i,t} - y_{i,t-1}, z_{i,t} - z_{i,t-1}) & t = 1,2 \end{cases} \tag{9}$$

If t ≥ 3, $v^x_{i,t}$, $v^y_{i,t}$, $v^z_{i,t}$ can be calculated independently by Eqn. 10.

$$\begin{aligned} v^x_{i,t} &= \alpha_{i,t-1} \times (v^x_{i,t-1} \quad v^x_{F(i),t})' \\ v^y_{i,t} &= \beta_{i,t-1} \times (v^y_{i,t-1} \quad v^y_{F(i),t})' \quad t \geq 3 \\ v^z_{i,t} &= \gamma_{i,t-1} \times (v^z_{i,t-1} \quad v^z_{F(i),t})' \end{aligned} \tag{10}$$

Where, the coefficient $\alpha_{i,t-1}$, $\beta_{i,t-1}$, $\gamma_{i,t-1}$ are the 2×1 scalar obtained by least squares method, which is represented as the speed coefficient vector of part *i* at time *t*-1 in the X axis, Y axis, and Z axis.

3. Image Likelihood Function

The observation likelihood model is represented for the matching relationship between the human appearance model and the features subtracted from the image among the particle filter theoritical framework. In this section, color distribution and image edge information are used to calculate the matching similarity between the human appearance model and the features subtracted from the image.

3.1 Color Distribution Likelihood

Color distributions are used as target models as they achieve robustness against non-rigidity, rotation and partial occlusion. The weighted color histogram, which consists of m=8×8×8=512 bins, is choosen and calculated in HSV color space to decrease the effection of the illumination.

The projection quadrilateral of the set e of the limb shape vector is defined as Dr, y is the point which is the projection of the origin of the local coordinate system on image plane, and color distribution is defined as $p^y_c = \{p^{y,u}_c\}^m_{u=1}$. For any pixel point $\tilde{x}^i \in Dr$, $p^{y,u}_c$ can be calculated as following expression:

$$p^{y,u}_c = C\sum_{j=1}^{n} k(\left\| \frac{y - \tilde{x}^i}{S_{Dr}} \right\|)\delta[h(\tilde{x}^i) - u] \tag{11}$$

Where $\delta(x)$ is the *Delta* function, S_{Dr} is the area of Dr, C is the normalized constant. The Bhattacharyya distance is used to calculate the simility between two weigthed color histograms.

3.2 Edge Likelihood

We split the arm from the background with the method combined with the background substract and skin detector. The least square is used to fit the image edge points obtained from the edge to calculate the slope of long edge of contour.

(1) Human contour is subtracted from the background by background difference, and mathematical morphology is used to distrill the whole human contour.

(2) Split the right arm contour from the human contour using the ground truth of initial frame.

(3) The point set of contour E_C can be detected from the arm contour via the contour detection methods. The The point set of contour E_C can be devivded into two subsets by the skin detector, including the point set of right upper arm contour, E^U_C, and the point set of right lower arm contour, E^L_C.

(4) L_1 is the slope of the long edge of the right upper arm by the fitting linear using least square method , and L_2 associated with the right lower arm.

Assumed at time *t*, $l^k_{i,t}$ is the slope of the long edge of the quadrilateral, which is the projection of the set $e^k_{i,t}$ of the limb shape vector of part *i*. Then $l^k_{i,t}$ can be modeled as a Gaussian distribution as following:

$$p(l^k_{i,t}) = \exp(-\frac{(l^k_{i,t} - \mu)^2}{2\sigma^2}) / (\sigma\sqrt{2\pi}) \tag{12}$$

Where *i* is the index of limbs, *k* is the index of particle, μ is equality to $l_{i,t}$ that is the slope the long edge associated with limb *i*, σ is the covariance of the slope set $l_{i,t}$.

3.3 Self-occlusion

To handle with the server self-occlusion, we proposed the algorithm based on the angle relation model for two intersecting lines modeled by the method described in section 3.2.

The angle between the upper arm and the lower arm is defined as ω, and ω_{th} is the constant threshold determined by empirical value. So the posterior probability $P(z_{i,t} \mid x_{i,t}^{k}, x_{F(i),t})$ can be represented as shown Eqn. 13.

$$P(z_{i,t} \mid x_{i,t}^{k}, x_{F(i),t}) = \begin{cases} p_{i,t}^{k(u)} \times p(l_{i,t}^{k}) & \omega > \omega_{th} \\ p(l_{i,t}^{k}) & \omega \le \omega_{th} \end{cases} \tag{13}$$

4. Experimental Results and Analysis

4.1 Experimental Design

We have done experiments to track the right arm motion using the HumanEva data sets (Sigal, 2006), which were captured at 25 fps by Leonid et al. of American Brown University using the VICON system. The experiment chooses the right arm motion color video made in the front to reduce the self-occlusions. The tracking experiments have done by Visual Studio .NET 2003 u dual-core 1.8GHz and 1G DDR memory PC. The video has 796 frames image sequence and image resolution is the 640×480.

Spatial position of the right shoulder joint has not evidently change in experimental video. Then the Eqn. 5 can be simplified as the following equation:

$$P(x_t \mid z_t) = \prod_{i=1}^{2} P(x_t^i \mid x_t^{F(i)}, z_t^i) \tag{14}$$

In subsection 3.3, the angle threshold is the empirical value: $w_{th} = \pi / 6$.

4.2 Experimental Result

Based on the parameters set in the previous subsection, we track the right arm motion using particle filter based on arm hierarchy limb model. In each experiment, the count of particle for tracking each limb is 50, 100, 150, and 200; respectively, the count of particle for all joints is 100, 200, 300, and 400.

Table 1 is the comparison of *mean error*, *Mean*, and *error variance*, *Std.* between the ground truth and the prediction value of the right lower arm under different count of particle using our algorithm in X direction, Y direction and Z direction. The Eqn. 15 is represented for *mean error*. The Eqn. 16 is represented for *error variance*.

$$Mean = \frac{\sum_{t=1}^{T} (x_t - X_t)}{T} \tag{15}$$

$$Std = \sqrt{\frac{\sum_{t=1}^{T} (x_t - Mean)^2}{T}} \tag{16}$$

In Eqn. 15 and Eqn. 16, the frames of test video is described as *T*, and *T*=796. x_t is the prediction value, X_t is the ground truth at frame *t*.

From Table 1, the *mean error* and *error* variance between the prediction and ground truth have not evidently changes as the particle count of limbs increasing. Then we can draw the conclusion that the count of particle for limbs can not affect the tracking result of our algorithm. Figure. 5 shows the tracking results of 3D arm motion by our algorithm as the count of particle for limbs is 400. It is no evidently different between the tracking results of our algorithm and the real pose of arm motion.

4.3 Experimental Analysis

The count of joints, which need be tracked in each tracking process, is defined as *K*. Each joint needs *N* particles to track the joint. Then our algorithm, particle filter based on arm hierarchy limb model (AHLMPF), need *KN* particles for all limbs and its computational complexity is *E(KN)*. While standard particle filter generates N^K kinds of combination patterns of particle in whole state space, which is formulated as N^K kinds of motion states and the computational

complexity of the standard particle filter is $E(N^K)$. In our experiment, K is 2, and N will be 200, 150, 100, and 50. To track the right arm motion, the particle count of our algorithm, AHLMPF, is 100, 200, 300, and 400, while the standard particle filter will generate 40000, 22500, 10000, and 2500 kinds of combination pattern in state space.

Based on the parameters set in subsection 4.1, Table. 2 show the comparison of average time for tracking one frame image between two algorithms. Table. 3 show the comparison of *mean error*, *Mean*, *error variance,* and *Std.* between the prediction values using two algorithms and the ground truth in X direction, Y direction, and Z direction.

Following Table 2, the time-cost of AHLMPF is less than SPF as the particle count increasing, and the computational efficiency is improved obviously. As Shown in Table 3, the Mean and Std have not evident difference compared the ground truth with the tracking result of AHLMPF and SPF.

5. Conclusions

The paper proposes 3D arm motion fast tracking algorithm. Based on the AHLM, the algorithm can transfer the global optimal search of the whole state space to the top-bottom search based on the joints under the case that the dimension of state space is unchangeable. In the process of tracking, the particle count is reduced by the prediction of each joint of AHLM. The experiment shows that the tracking result using our algorithm is not evident difference compared with the standard particle filter under the same dimension of state space. The algorithm can effectively apply to track 3D arm motion based on Particle Filter.

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Table 1. The Mean Error and Std. under different count of particle in our algorithm

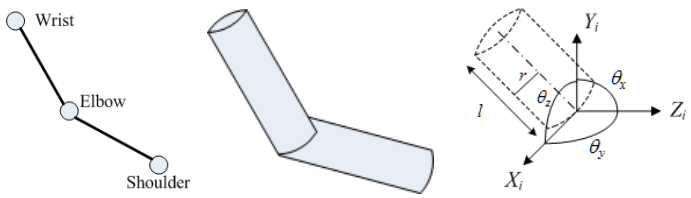
		the count of particle for all limbs			
		400	**300**	**200**	**100**
X	***Mean***	15.5854	14.8932	14.3304	15.8442
	Std.	13.5604	12.9412	12.7845	13.2104
Y	***Mean***	14.6420	14.8668	13.3681	14.1709
	Std.	13.0121	12.9268	12.0737	12.2031
Z	***Mean***	11.0992	11.3492	10.5854	11.6533
	Std.	11.1532	11.9329	10.8260	11.3366

Table 2. the time-cost comparison between AHLMPF and SPF under different particle counts

		Time-Cost per frame image (ms)			
		***N*=200**	***N*=150**	***N*=100**	***N*=50**
AHLMPF	**Time (ms)**	2908	2014	1543	782
	Particle Count	400	300	200	100
SPF	**Time (ms)**	14653	8650	5253	2830
	Particle Count	40000	22500	10000	2500

Table 3. the comparison of Mean and Std. for tracking right wrist using AHLMPF and SPF

		N=200		**N=150**		**N=100**		**N=50**	
		AHLMPF	**SPF**	**AHLMPF**	**SPF**	**AHLMPF**	**SPF**	**AHLMPF**	**SPF**
X	***Mean***	15.5854	14.6005	14.8932	15.5477	14.3304	14.4146	15.8442	15.0641
	Std.	13.5604	13.2656	12.9412	13.5994	12.7845	12.7099	13.2104	13.2622
Y	***Mean***	14.6420	11.9950	14.8668	12.1771	13.3681	12.0101	14.1709	12.3643
	Std.	13.0121	10.8131	12.9268	10.8082	12.0737	10.8933	12.2031	11.1384
Z	***Mean***	11.0992	13.7927	11.3492	13.0867	10.5854	13.6143	11.6533	14.1985
	Std.	11.1532	12.4430	11.9329	11.7670	10.8260	12.5962	11.3366	12.5667



(a) (b) (c)

Figure 1. Arm hierarchical limb model represents the articulated structure of the arm.

(a) Kinernatics description characterized by the joints position,

(b) arm shape approximated by two cylinders,

(c) Local coordinate system of limb *i*.

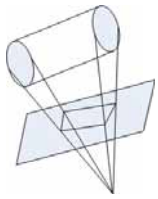
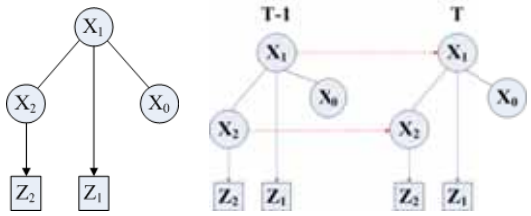
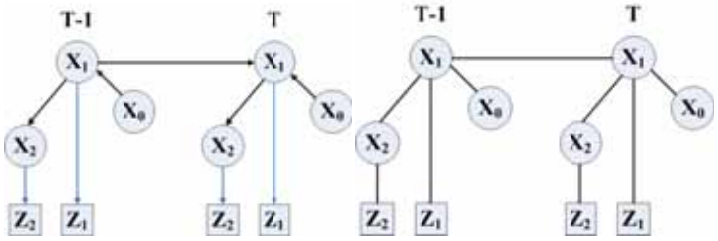


Figure 2. Arm shape image planar approximation via the projection equation.



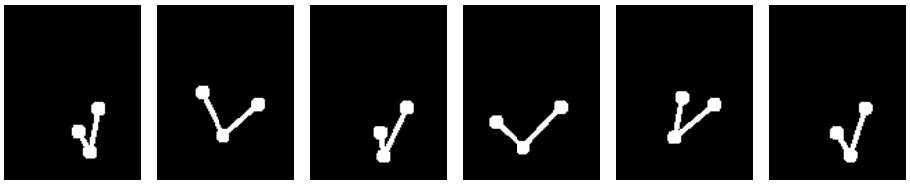
(a) (b)

Figure 3. Arm structure graphical model, (a) Graphical model for arm,
(b) Dynamical graphical model for arm motion analysis.



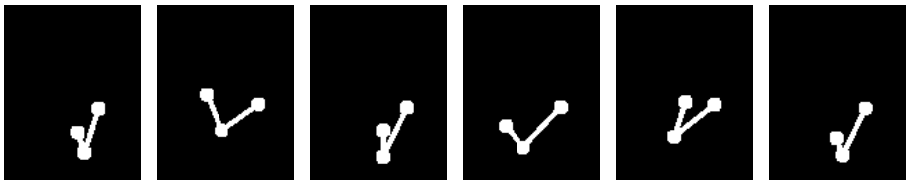
(a) (b)

Figure 4. Arm graphical model decomposition, (a) The decompostion of dynamical graphical model;
(b) Corresponding moral graph.



Frame 100 Frame 200 Frame 300 Frame 400 Frame 500 Frame 600

Figure. 5(a) 3D animation for the tracking value of our algorithm



Frame 100 Frame 200 Frame 300 Frame 400 Frame 500 Frame 600

Figure. 5(b) 3D animation for the ground truth

Figure 5. 3D animation Comparison between the tracking result by our algorithm and ground truth

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Study on the Software Development Based on AOP Technology

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Abstract

With more and more extensive application of AOP (Aspect Oriented Programming), almost all OO languages are extended from aspect orientation, and the aspect adjustment mode implements the basic task of weaver through a set of class. In this article, we introduce the basic concept and programming idea of AOP, expatiate on the software development approach based on AOP and one implementation tool, AspectJ, and introduce some application examples of AOP.

Keywords: Aspect orientation, Object orientation, AOP, OOP, AspectJ, Design pattern

1. Introduction

With continual extension of computer application software and continual enhancement of complexity, traditional software development methods such as process oriented programming and object oriented programming (OOP) have not gradually adapted this change. In recent years, a new programming method, AOP has been concerned by domestic and foreign scholars, and it was appraised as one of ten sorts of technology which had most influences to the economy and human living and work mode by MIT Technology Review. At present, there are AspectC, AspectC++, AspectJ and other languages to support AOP.

2. Production background of AOP

2.1 Problems faced by process-oriented programming

The process oriented programming is a sort of programming method from top to bottom, and its essential is to decompose the software from function, and it is fit for small-sized software system. In the large-sized application system, the method from top to bottom has many intrinsic disadvantages whether for the confirmation of system structure, the evolvement and maintenance of system or for reusing of software.

2.2 Problems faced by traditional object-oriented programming

Traditional OOP language acquired large successes because of its good encapsulation, arrangement and inheritance, and the object model can be better mapped to the actual domain. But in the lifecycle of software, it has following disadvantages.

(1) In the design stage, because of taking class as the unit to organize the modeling, so it can not comprehensively reflect the demand of software system.

(2) In the coding stage, the idea which encapsulate data and method into the class increases the security of data and the modularization of software, but it reduce the reusing of code.

(3) In the maintenance stage, because there are various special applied codes in the classes, so it is very difficult to maintain the system.

23 sorts of design module put forward by GoF (Erich Gamma, 1994) relieves thus situation, and he classified common problems according to module, and translated traditional program module division method by function or object into the program module by system character, which is the basic idea of AOP.

2.3 Production of AOP

In the European Conference on Object-Oriented Programming (ECOOP) of 1997, the top scientist of Palo Alto Research Center of Xerox Corporation, the professor of UK Colombia University Gregor Kiczales et al first put forward the concept of AOP (Kiczales, 1997). After that, the professional proseminar about AOP would occur in ECOOP every

year. At 15 March of 2001, Palo Alto Research Center issued the first support language of AOP, AspectJ.

3. AOP language character and its core idea

3.1 Character of AOP

As a sort of program design method, AOP pays attention to enhance the abstract degree and module character of software, which could fully improve the expansibility, reusing, easy comprehension and easy maintenance of software and enhance other factors influencing the quality of software.

(1) Expansibility. AOP offers the expansible mechanism on the system layer, various relative parts of system will be changed through expanding Aspect (AspectJ supports the inheritance mechanism) or increasing Aspect. One advantage is to fully simplify the testing complexity of software and enhance the testing precision through shielding some Aspects in the software test.

(2) Reusing. The system module in AOP includes system subassemblies and characters influencing these subassemblies, and AOP could enhance the reusing character of subassembly (including class or function) through separating the subassemblies realizing basic functions with applied system characters, and make the reusing of system factors (Aspect) which could not be used to encapsulate to class or function possible.

(3) Easy comprehension and easy maintenance. In AOP, we can use a sort of method with clear boundary to modularize the crosscut concern points, and produce the system structure which could be more easily designed, implemented and maintained.

3.2 Core idea of AOP

AOP uses a sort of method with clear boundary to modularize the crosscut concern points, and produces the system structure which could be more easily designed, implemented and maintained. The crosscut software development by AOP technology could centralize public codes occurring and needed many times to implement, so it could fully reduce the redundancy and coupling of codes, increase the reading character, weaken the degree that designers get in the dilemma situation of deficient design or over design, and even additional demand occurs in the anaphase, AOP could independently realize the demand through separating it in corresponding object and aspect, and it would reduce the maintenance costs of code.

3.3 What is AspectJ

AspectJ is the popular AOP language at present, and it is the AOP expansion based on Java language developed by Xerox Corporation, and it is not only a sort of AOP language criterion, but a sort of language implementation. The part of language criterion defines multiple language structure and the modes that they support the aspect oriented example, but the compiling, transfer and the tool producing the document from code are defined by the part of language implementation.

The language structure of AspectJ is extended from Java language, so all legal Java programs are legal AspectJ programs. The production of AspectJ compiler is coherent with standard Java bytecode. Class document and JVM with any standards could explain the executive codes. Because of selecting Java as its own language base, so AspectJ possesses all advantages of Java language.

To better support the idea of AOP, AspectJ expands following language structure based on the Java language.

(1) Join point. It means the points which could be marked in legal program execution process. For example, the entrance transferring certain method to certain object is a legal join point which could be marked.

(2) Point cuts. It is used to capture the language structure of special join point. And it could appoint and combine needed join points and search special context information of join pints.

(3) Advice. It defines the executive operation at the join point, and its function is similar with Aspect in the classes.

(4) Aspect. The join point, point cuts and advice could be integrated as an independent unit which is similar with the concept of class in OOP.

3.4 Weaver

The process combining the subassembly (object) codes with the codes of crosscut subassembly in AOP is called as weaving, and the weaving process is completed through the weaver. In the language domain, there is not the concept of weaver with complete meaning, and for different aspects, the weaving is implemented through different mechanisms, and only the aspects with definite meaning which could be discriminated by the compiling system could be the legal composing part of program. In AOP language through the expansion of OO language, as a new legal language structure, aspect is translated into one composing part in the object code through the weaver with complete meaning criterion before compiling, and AOP language doesn't limit the meaning of aspect, but strictly regulate the denotation form of aspect.

4. Approaches of AOP design

4.1 Software development approaches based on AOP

AOP adopts a sort of loose coupling mode to realize independent concern points, and then combines these implementations, and establish final system. The system established by AOP is built by the crosscut concern points implemented by loose coupling and modularization, and these modularized crosscut units in the system are aspects, but in OOP, the establishment of system is realized by modularized common concern point coupling, and this sort of modularized concern points are called as classes. The software development mode based on AOP is to organically combine both sides together (seen in Figure 1).

The software development mode based on AOP includes three clear approaches.

(1) Aspect decomposing. The decomposing demand requires picking up common concern points and crosscut concern points, i.e. separating the core module concern points and the crosscut concern points in one system.

(2) Implementation of concern point. For common concern points, we could adopt OOP technology to implement, but for crosscut concern points, we would adopt AOP technology.

(3) Recombination of Aspect. The aspect complier appoints the rule of recombination through Aspect, and the rule regulate how Aspect combines with the basic codes implemented by OOP to establish the final system, and this recombination process is the weaving.

4.2 Language implementation of AOP

The main function implemented by AOP language is to validate the correctness of codes according to the language standard and translate it into the form which could be executed by the machine. The compiler execution of AOP includes two operations, installing concern points and translating the installation result into executive codes. The implementation of AOP could realize the weaving through many modes including the conversion from sound code to sound code. As seen in Figure 2, the Aspect codes implemented by crosscut concert points organically combine with the codes implemented by common concern points through Aspect weaving, and it forms the codes which could be discriminated by basic language and executed by the compiler of basic language, produces executive codes and completes the weaving process from crosscut concern point codes to common concern point codes.

4.3 Application examples of AOP

At present, many research institutions have begun to combine the idea of AOP with actual application, and there are several classic cases.

(1) a-kernel. The a-kernel project group in the UK Colombia University of Canada introduced the idea of AOP into the design of operating system design, tried to enhance the module character of operating system code. They utilized AspectC to modify the kernel of FreeBSD v3.3 operating system, and took the memory page deficiency processing of the operating system as one aspect to deal with, and acquired better effects (Miller, 2001).

(2) Lasagne. Lasagne in Belgium Katholieke University is a sort of middle component based on aspect, and it is mainly used in the service customization of distributing system. Adopting the idea of Aspcet, Lasagne could implement the dynamic program extension without changing codes. Service is taken as one sort of aspect and exists by the form of Wrapper, and it utilizes the weaving idea to implement dynamic selection when running (Truyen, 2001).

(3) FACET. The FACET (Framework for Aspect Composition for an Event Channel) project group of Washington University implements the customized middle component by the method of AOP. They used AspectJ to develop a real time event channel, and the channel possessed better module character, few codes, briefness, easy expansibility and other characters comparing with TAO real time event channel (Hunleth, 2001).

5. Conclusions

As a new programming method, AOP has many works need to be completed in future extensive application. The support languages need to be further enriched and ensured their accuracies, and more tools should be studied to support AOP and fulfill the demands in various stages from software design to maintenance. In the day that the software scale increasingly increases and the software structure is increasingly complex, the software development pattern based on AOP technology would certainly exert more and more important function.

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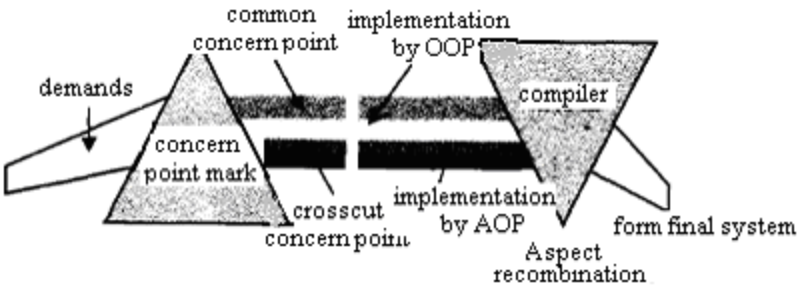

Figure 1. Development Mode by Adopting AOP

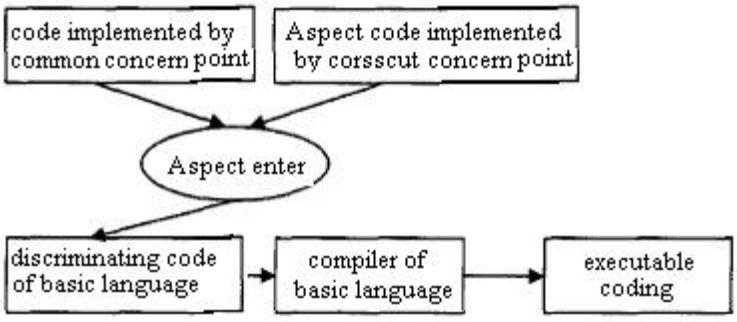

Figure 2. Compiling Process of AOP

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Analysis of BitTorrent on an Open Source VPN Technology to End User

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Abstract

The local broadband provider Streamyx has imposed an in admitted practice of line throttling. As the result it affects the speed of BitTorrent download. To overcome the issue a procedure is to be found. Based on the fact that VPN is normally untouched by most ISP hence this technology is explored to be deployed on BitTorrent. Subsequently in this part of the article a further observation and analysis are done to supplement the previously rudimentary findings to gauge the effect of VPN circumventing the throttling. A final conclusion is thus deduced to find out whether this procedure is effective 24/7 or it is bounded by the constraint of the normal working hours of the week i.e. Monday to Friday or otherwise beyond it.

Keywords: BitTorrent, Broadband, End user, File sharing, ISP throttling, Jaring, Open Source, OpenVPN, P2P, Peer-to-Peer, Proxy server, Streamyx, uTorrent, VPN

1. Introduction

The Malaysian broadband scenario has seen an in admitted throttling by Streamyx (Asohan, 2007 and Teoh, 2006). It was compounded after the Taiwan earthquake which disrupted the Malaysian international link and the throttling seems to stay indefinitely. To confirm this Zeropaid.com (2008) in its latest report has identified that Streamyx is one of the world ISPs offender of BitTorrent. Furthermore it is also mentioned that the strategy plan in which VPN is to be deployed on the BitTorrent download is shown as Figure 1 below.

<<Figure 1. Location of VPN server>>

This figure shows the virtual path of VPN maneuvering from the US high speed backbone through the international line via Malaysia right up to the end user where the final leg is determined by the local ISP opted by the end user (TM News Release, 2007). However, it has to be realized that the server hardware must be placed at the region of high bandwidth such as to create the origin of the VPN tunnel. The server side must be ensured that no throttling is imposed at that point. The end user or client who is at the end of the tunnel will get the speed determined by the local ISP bandwidth as opted by the user. Finally, the overall arbitrary tunnel created by VPN is visualized as shown in the Figure 2 below.

<<Figure 2. The arbitrary tunnel created by VPN>>

Figure 2 above shows that the origin of any download will start at the high speed backbone point whereas the user or client will be anywhere else as not confined to any particular location.

2. Methods and materials

2.1 Server and client side

On the high bandwidth backbone, server hardware has to be acquired while on the server machine the OpenVPN was installed. This OpenVPN has to be configured accordingly. A proxy server was also installed to suite each member of end user accordingly to its opted speed. On the other hand, for the Client side, the OpenVPN was installed where a certificate for the client was provided by the administration. A BitTorrent software client has to be setup up accordingly as given by the admin such as Proxy IP address number and Proxy Port number.

2.2 Broadband speed

Prior to doing the full analysis it is appropriate for the user to initially test the line speed using any of the speed tests available on the internet. There is one provided by Streamyx but at the time of this paper is prepared the site is unavailable (Figure 3). Fortunately, Jaring another local ISP has the facility and was used instead. Figure 4 shows the result of the local streamyx line done by Jaring.

<<Figure 3. Streamyx speedometer speed test

(Source: http://202.188.95.52:8080/speedometer/)>>

<<Figure 4. Speed test result given by Jaring ISP on Streamyx line.

(Source: http://www.jaring.my/service/broadband/index.cfm?cont=bandwidth_business)>>

Next, a second speed test is initiated. This time the speed test is done after the installation of VPN server at the foreign high speed backbone line. This test includes the speed from the international line to the end user. The result is shown as in Figure 5 below.

<<Figure 5. Line speed from VPN server to Malaysia

(Source: http://www.speedtest.net/)>>

Based on these 2 tests, the local speed maximum achievable speed is 843kb/s and the latency 28ms. The Jaring speed test overall speed included the international line from the origin of VPN to end user maximum achievable speed is 1085kb/s with a latency 314ms speedtest.net. However, to be more realistic the line speed of the user taking into account various parameters either known or unknown or simply taking the worse case of 30% degradation the expected maximum achievable speed should be around 774kb/s [5]. This figure seems relevant to the Jaring's figure of 843kb/s.

2.3 Benchmark files

In the next observation and analysis a benchmark file for download should be identified. The main criterion for this file is that it should be readily available at anytime for 24/7.

Apparently it is known that Linux Ubuntu OS is one of it and it is readily available and very popular. Its download activities are active among Linux community. Moreover it is also considered to have a stable download speed where it has enough number of seeds and peers. Thus this file is chosen to be the main benchmark download file. Two tests are conducted on this particular file. One will be downloading without VPN and the next with VPN deployed. With the test results this shall be the basis benchmark of the performance. The 24/7 is required to gauge whether the time of day or the working days of a week affect the VPN download speed or otherwise.

2.4 Ubuntu downloads without and with VPN

For the initial observation on the Linux Ubuntu OS file it is downloaded using uTorrent in a normal way without VPN. The uTorrent client software is used due to it is currently the top BitTorrent software surpassing Azureus (http://torrentfreak.com/p2p-statistics-080426/). Figure 6 shows uTorrent in action downloading Ubuntu without VPN.

<<Figure 6. uTorrent downloading ubuntu without VPN>>

Table 1 below shows the data gathered for a selected hour within 24/7 for analysis and Graph 1 shows the performance in a graphical view. Briefly it is noted that from the Table 1 below the performance of the uTorrent downloading speed on TMNET Streamyx is unstable and slow for 24/7 irrespective of hours of day or whether it is during the working days of the week or otherwise.

<<Table 1. Ubuntu download performance without VPN for 24/7>>

<<Graph 1. Ubuntu download speed without VPN for 24/7>>

Additionally the following facts are noted where the download speed ranges from as low as 2.8kB/s and as high as 38.9kB/s. For 24/7 the average download speed is 25kB/s. The number of seed only exist around 27 which means each seed only contribute less than 1kB/s. Although the download speed figure average at around 30kB/s, this file is accepted as a benchmark for testing because the file is available 24/7.

On the other hand Table 2 shows the results taken throughout 24/7 by downloading Ubuntu deploying VPN see also Figure 7 shows uTorrent in action downloading Ubuntu with VPN. The purpose of this process is to observe whether it is bounded by hours of day or the working hours of the week. Graph 2 shows the performance in graphical view. Briefly it is noted that from the Table 2 and Graph 2 as below the performance of the downloading speed is greatly improved. It is stable irrespective of hours of day or whether it is during the working day of the week. Thus in brief VPN has elevated the download process, improved instability and improved download speed. Hence this Ubuntu is correctly chosen as a benchmark file. It is important that the ISP connection line to the user and the number of seeds be considered. It is encouraged that the download speed ranges from as low as 97.4kB/s and maximized at 117.2kB/s. For 24/7 the average download speed is about over 110.6kB/s. The number of seed increases to around 70 which means each seed contributes more than 1kB/s.

<<Figure 7. uTorrent downloading ubuntu with VPN >>

<<Table 2. Ubuntu download performance with VPN for 24/7>>

<<Graph 2. Ubuntu download speed with VPN for 24/7>>

2.5 Random files downloaded without and with VPN

The next observation is done on random files which basically end user will do. Two tests are conducted on this particular file. One will be downloading without VPN and the next with VPN deployed. Table 3 and Graph 3 below show the result for selected hours within 24/7 for analysis, see also Figure 8 below that shows uTorrent is in action downloading random files without VPN. Briefly it can be noted that from the Table 3 below the performance of the uTorrent downloading speed on TMNET Streamyx is unstable and slow for 24/7 irrespective of hours of day or whether it is during the working days of the week or otherwise.

It is to be noted that the download speed ranges from as low as 3.1kB/s and maximized at 44.9kB/s. For 24/7 the average download speed is: 17kB/s. The number of seed only exist around 38 which means each seed only contribute less than 1kB/s.

<<Table 3. Random files download performance without VPN for 24/7>>

<<Graph 3. Random files download speed without VPN for 24/7>>

<<Figure 8. uTorrent downloading random files without VPN>>

In the final observation a random file is downloaded with VPN where Figure 9 below shows uTorrent is in action downloading random files with VPN. The result is tabulated as in Table 4 with Graph 4 showing the performance in a graphical view format.

<<Table 4. Random files download performance with VPN for 24/7>>

<<Graph 4. Random files download speed with VPN for 24/7>>

<<Figure 9. uTorrent downloading random files with VPN>>

Observing Graph 4 there are few discrepancies on the download performance. A repeat downloads on the particular time and days are conducted later. The Table 5 shows the new data on those particular instances. The new data is then modified to the former Table 4 which gives rise to Table 6 and the final graph is plotted as in Graph 5.

<<Table 5. Remedial observation on the specific days and time>>

<<Table 6. The new modifies random files download performance with VPN for 24/7>>

<<Graph 5. The new modified random files download with VPN for 24/7>>

Based on the new data gathered the discrepancies that occurred were merely predominate at that point of time. It is to be noted that the maximum speed of 120.8kB/s with 34 seeders, the minimum speed is 98.1kB/s with 25 seeders, the average speed is 110kB/s and the minimum seeder to give adequate speed is above 20.

3. Results and discussion

From the observations carried out thus far VPN has in fact improved and elevated the download speed of any files. The outcome is seen to be stable and the speed may reach the maximum allowable figure. There is no obvious constrain bounded to it either time of day or day of the week is observed.

In general, it was found that the speed of download can be maintained at above 100kB/s or about 20% of the allowable user maximum speed (Cheshire, 1996). From the observation it is also noted that when the user is seeding to other peers and the tracker is down the download speed is affected. This probable phenomenon happens during Monday, Thursday, Friday, Saturday and Sunday during which the data was first observed for the random files download. This is only a random state which may not be repeated and only prominent at that instant.

Ignoring the time when uTorrent is seeding the download speed is mainly at around 100kB/s or average at 110.4kB/s. However, if any discrepancy is considered the average download speed is nearly about 104.7kB/s which is still above 100kB/s average irrespective of times, days or weeks. On the other hand, when the download speed dips there are a few reasons to this phenomenon. It might be caused by the tracker which was downed at that time that resulted in the user uTorrent seeding to other peers or because the ISP line was bad. The number of seeds of around 30+ is enough to give the maximum download speed of 100kB/s but the number of peers is again not that relevant.

From the result obtained the behavior of any random file download is always high when VPN is implemented. However to achieve the speed as high as the benchmark speed it is noted that the number of seeders must be adequately large or the quality of seeder must be good and finally the ISP line condition should also be good. Observing the behavior of random file with and without VPN in graphical view (Graph 2, Graph 4 and Graph 5), it can be stated that the performance is obviously uplifted with VPN.

4. Conclusion

Briefly this paper has clearly illustrated that VPN is obviously able to circumvent the ISP (Streamyx) throttling in Malaysia. The most important point to note is that the VPN server should be located on the high bandwidth backbone before the ISP could impose the throttling practice. And only then the end user will benefit the maximum bandwidth speed provided by the ISP. The other advantages gained by end user using VPN are the encrypted traffic where nobody can sniff the traffic even ISP. It is able to be surfed anonymously where the actual IP address of origin was not revealed and to be as if the surfer is from the server site IP. In addition, it is able to bypass site which has been blocked by the local ISP since the origin of the server is located elsewhere away from it.

The above results of the experiment are achieved where the condition of the service is in a normal condition. But if the line is of a non-quality condition the effect is not fully realized. But as in the normal way the service provided by Streamyx to home user is usually found to be erratic, unstable and unpredictable.

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Table 1. Ubuntu download performance without VPN for 24/7

Tme / Day	8 am	10 am	12 noon	2 pm	4 pm	6 pm	8 pm	10 pm	12 midnight	2 am	4 am	6 am
Monday	23.8kB/s S 27(50) P 6(82)	29.3kB/s S 28(47) P 7(152)	18.2kB/s S 21(37) P 5(15)	15.7kB/s S 30(35) P 4(13)	17.5kB/s S 22(35) P 2(15)	21.6kB/s S 34(39) P 3(20)	17.1kB/s S 23(38) P 0(6)	17.7kB/s S 35(50) P 1(15)	23.8kB/s S 33(46) P 3(56)	29.0kB/s S 19(54) P 3(110)	15.6kB/s S 35(55) P 2(196)	26.4kB/s S 17(37) P 1(4)
Tuesday	10.2kB/s S 4(11) P 1(6)	11.2kB/s S 19(28) P 2(8)	9.3kB/s S 30(40) P 6(35)	8.6kB/s S 18(48) P 0(7)	15.0kB/s S 26(53) P 6(20)	10.5kB/s S 30(86) P 4(18)	23.2kB/s S 35(114) P 1(68)	23.2kB/s S 36(114) P 1(68)	27.0kB/S S 34(111) P 1(9)	28.6kB/s S 38(116) P 0(10)	30.1kB/s S 35(46) P 2(9)	32.7kB/s S 36(46) P 2(12)
Wednesday	30.0kB/s S 35(114) P 2(6)	34.9kB/s S 32(124) P 4(9)	36.7kB/s S 34(45) P 3(8)	37.8kB/s S 29(37) P 2(8)	35.9kB/s S 34(40) P 2(6)	34.1kB/s S 32(40) P 4(11)	36.2kB/s S 34(50) P 3(11)	33.8kB/s S 32(37) P 4(9)	27.4kB/s S 32(113) P 4(122)	37.0kB/s S 30(121) P 2(118)	36.8kB/s S 32(49) P 3(20)	33.8kB/s S 34(41) P 1(9)

Thursday	33.2kB/s S 30(37) P 6(11)	32.1kB/s S 31(37) P 3(12)	34.2kB/s S 29(38) P 5(11)	33.3kB/s S 35(81) P 2(11)	38.3kB/s S 34(50) P 3(17)	31.3kB/s S 34(116) P 3(9)	29.4kB/s S 27(94) P 6(14)	24.6kB/s S 30(94) P 6(18)	32.3kB/s S 32(75) P 6(13)	37.6kB/s S 34(47) P 3(13)	36.6kB/s S 34(115) P 3(16)	37.4kB/s S 25(62) P 1(21)
Friday	16.1kB/s S 34(45) P 1(115)	16.7kB/s S 34(52) P 3(112)	15.7kB/s S 29(37) P 4(12)	15.5kB/s S 31(119) P 5(15)	14.4kB/s S 33(58) P 5(84)	25.1kB/s S 29(40) P 3(17)	22.3kB/s S 27(35) P 3(10)	25.7kB/s S 24(34) P 2(8)	25.4kB/s S 28(68) P 2(13)	30.6kB/s S 31(70) P 3(18)	22.4kB/s S 32(39) P 3(16)	26.0kB/s S 27(34) P 3(9)
Saturday	25.8kB/s S 26(36) P 0(9)	14.7kB/s S 32(41) P 5(33)	27.7kB/s S 16(37) P 0(16)	23.2kB/s S 30(33) P 4(6)	2.8kB/s S 12(30) P 0(9)	7.3kB/s S 30(39) P 6(71)	20.7kB/s S 16(34) P 2(19)	16.8kB/s S 28(34) P 6(17)	28.3kB/s S 16(32) P 4(67)	33.1kB/s S 18(33) P 6(67)	29.2kB/s S 23(29) P 2(65)	38.9kB/s S 26(30) P 5(67)
Sunday	27.1kB/s S 16(30) P 3(117)	34.6kB/s S 14(22) P 2(74)	36.7kB/s S 14(22) P 2(166)	18.3kB/s S 3(19) P 0(6)	14.6kB/s S 12(32) P 4(11)	25.0kB/s S 22(31) P 1(12)	17.8kB/s S 37(83) P 2(122)	16.6kB/s S 24(42) P 1(10)	17.9kB/s S 12(38) P 3(10)	16.6kB/s S 17(39) P 4(12)	15.8kB/s S 28(55) P 8(17)	25.0kB/s S 26(39) P 2(13)

Table 2. Ubuntu download performance with VPN for 24/7

Time / Day	8 am	10 am	12 noon	2 pm	4 pm	6 pm	8 pm	10 pm	12 midnight	2 am	4 am	6 am
Monday	108.3kB/s S 72(1252) P 3(72)	112.4kB/s S 68(1256) P 5(71)	110.1kB/s S 69(1260) P 6(75)	110.6kB/s S 56(1288) P 2(90)	103.1kB/s S 29(1235) P 2(99)	105.1kB/s S 67(1246) P 5(100)	112.6kB/s S 71(1261) P 4(76)	111.4kB/s S 69(1265) P 6(76)	105.4kB/s S 69(1246) P 1(100)	106.6kB/s S 67(1261) P 4(102)	104.6kB/s S 70(1261) P 3(102)	105.5kB/s S 70(1279) P 2(103)
Tuesday	112.1kB/s S 68(1197) P 6(92)	104.1 S 69(1204) P 6(88)	114.3kB/s S 72(1267) P 3(77)	111.0kB/s S 35(1207) P 0(89)	111.1kB/s S 73(1207) P 2(89)	111.2kB/s S 75(1213) P 1(88)	109.7kB/s S 36(380) P 1(22)	110.8kB/s S 71(1272) P 4(80)	112.3kB/s S 73(1213) P 2(88)	112.9kB/s S 74(1227) P 1(89)	113.0kB/s S 74(1235) P 1(87)	113.6kB/s S 74(1241) P 1(89)
Wednesday	110.3kB/s S 72(1203) P 4(74)	113.6kB/s S 66(1218) P 3(77)	115.2kB/s S 73(1229) P 2(74)	111.3kB/s S 74(1235) P 0(76)	111.8kB/s S 73(1240) P 2(75)	106.4kB/s S 61(1242) P 3(78)	111.8kB/s S 68(1247) P 2(77)	111.9kB/s S 72(1251) P 2(77)	109.4kB/s S 60(1242) P 2(78)	108.8kB/s S 73(1242) P 2(78)	117.2kB/s S 74(1205) P 2(69)	112.1kB/s S 74(1205) P 2(69)
Thursday	110.4kB/s S 72(1249) P 3(79)	105.3kB/s S 70(1214) P 3(82)	111.8kB/s S 73(1258) P 2(82)	109.2kB/s S 72(1267) P 2(81)	112.1kB/s S 72(1267) P 2(82)	111.4kB/s S 73(1211) P 1(73)	109.4kB/s S 47(62) P 5(107)	112.8kB/s S 71(265) P 4(236)	109.7kB/s S 73(238) P 3(171)	112.2kB/s S 71(132) P 3(398)	114.2kB/s S 73(636) P 2(33)	111.3kB/s S 73(774) P 2(41)
Friday	110.9kB/s S 75(499) P 0(32)	108.8kB/s S 66(1262) P 5(87)	111.2kB/s S 73(612) P 1(37)	106kB/s S 74(963) P 2(51)	111.8kB/s S 75(723) P 0(42)	114.7kB/s S 74(810) P 0(47)	107.5kB/s S 73(963) P 1(51)	111.5kB/s S 75(885) P 0(52)	110.9kB/s S 71(963) P 1(51)	114.5kB/s S 71(1170) P 1(59)	113.0kB/s S 73(1182) P 2(60)	112.5kB/s S 47(1185) P 1(61)
Saturday	111.1kB/s S 75(1038) P 1(68)	113.2kB/s S 74(1114) P 0(71)	112.4kB/s S 75(1163) P 0(72)	112.1kB/s S 76(1180) P 0(72)	111.2kB/s S 74(1184) P 1(74)	109.7kB/s S 71(1181) P 3(73)	110.1kB/s S 72(1188) P 3(73)	111.5kB/s S 73(1196) P 2(74)	111.0kB/s S 74(1192) P 2(66)	111.2k|B/s S 73(1192) P 2(66)	110.0kB/s S 73(1194) P 2(66)	111.4kB/s S 74(1201) P 1(66)
Sunday	113.1kB/s S 74(1214) P 1(78)	111.5kB/s S 72(1230) P 2(80)	112.6kB/s S 73(1239) P 2(81)	111.2kB/s S 72(1245) P 2(81)	97.4kB/s S 52(1342) P 5(79)	110.8kB/s S 77(1204) P 1(67)	111.9kB/s S 73(1244) P 1(82)	109.3kB/s S 75(1256) P 1(82)	112.3kB/s S 24(1204) P 0(67)	112.2kB/s S 72(1222) P 3(67)	109.0kB/s S 71(1225) P 3(68)	113.2kB/s S 74(1230) P 1(71)

Note:

1. The download speed is in kByte/s

2. S n1(n2) where n1 is the number of seed which is currently connected, while n2 is the number of seed which is active globally

3. P n1(n2) where n1 is the number of peer which is currently connected, while n2 is the number of peer which is active globally

Table 3. Random files download performance without VPN for 24/7

Time / Day	8 am	10 am	12 noon	2 pm	4 pm	6 pm	8 pm	10 pm	12 midnight	2 am	4 am	6 am
Monday	29.8kB/s S 31(1134) P 1(125)	28.6kB/s S 34(1138) P 0(124)	30.9kB/s S 37(1138) P 0(124)	24.7kB/s S 37(1138) P 0(124)	36.5kB/s S 34(1138) P 2(121)	24.1kB/s S 31(1164) P 2(114)	29.7kB/s S 34(1159) P 2(114)	34.7kB/s S 33(1153) P 2(113)	10.6kB/s S 5(1156) P 0(113)	25.1kB/s S 35(1156) P 1(113)	27.6kB/s S 37(1156) P 0(113)	23.1kB/s S 38(1156) P 0(113)
Tuesday	25.9kB/s S 34(1161) P 2(109)	15.1kB/s S 35(1161) P 2(109)	26.1kB/s S 36(1171) P 1(108)	3.1kB/s S 12(1479) P 0(147)	7.0kB/s S 12(1479) P 0(147)	5.1kB/s S 18(1490) P 0(148)	5.6kB/s S 29(1482) P 1(147)	4.0kB/s S 24(1482) P 0(147)	14.9kB/s S 25(1482) P 1(147)	7.5kB/s S 29(1482) P 1(147)	3.9kB/s S 28(1482) P 0(147)	4.3kB/s S 23(1482) P 0(147)
Wednesday	4.9kB/s S 30(1482) P 1(147)	10.4kB/s S 28(1468) P 0(136)	13.7kB/s S 22(1468) P 0(136)	7.5kB/s S 29(1476) P 0(136)	20.2kB/s S 33(1476) P 0(136)	24.0kB/s S 32(1476) P 0(136)	26.7kB/s S 29(1476) P 0(136)	35.6kB/s S 33(1476) P 0(136)	44.9kB/s S 27(1483) P 0(120)	33.9kB/s S 28(1483) P 0(120)	12.3kB/s S 13(1828) P 2(162)	4.4kB/s S 11(1824) P 0(165)
Thursday	4.4kB/s S 26(1831) P 2(167)	14.1kB/s S 36(1831) P 0(167)	11.6kB/s S 30(1831) P 0(167)	7.8kB/s S 30(1831) P 0(167)	12.7kB/s S 23(1831) P 0(167)	25.7kB/s S 33(1846) P 1(170)	15.7kB/s S 26(1846) P 1(170)	18.8kB/s S 25(1853) P 3(172)	9.6kB/s S 27(1846) P 1(176)	12.9kB/s S 32(1846) P 0(176)	11.4kB/s S 18(1846) P 0(176)	26.7kB/s S 30(1846) P 0(176)
Friday	7.0kB/s S 12(1738) P 0(137)	7.4kB/s S 24(1738) P 1(137)	9.5kB/s S 23(1738) P 2(137)	8.6kB/s S 25(1728) P 2(144)	12kB/s S 22(1728) P 2(144)	13.3kB/s S 23(1737) P 3(143)	16.9kB/s S 30(1737) P 3(143)	7.1kB/s S 28(1737) P 5(143)	9.1kB/s S 32(1737) P 2(143)	19.0kB/s S 21(1737) P 0(143)	20.9kB/s S 25(1737) P 0(143)	21.0kB/s S 16(1737) P 0(143)
Saturday	9.6kB/s S 14(1737) P 0(117)	8.9kB/s S 24(1737) P 1(117)	22.5kB/s S 28(1737) P 1(117)	16.6kB/s S 28(1737) P 0(117)	16.4kB/s S 27(1737) P 1(117)	12.6kB/s S 25(1737) P 0(117)	15.2kB/s S 2(1725) P 0(124)	4.9kB/s S 13(1723) P 0(124)	12.7kB/s S 24(1720) P 1(125)	16.9kB/s S 14(1720) P 0(125)	33.9kB/s S 26(1720) P 1(125)	27.1kB/s S 26(1720) P 1(125)
Sunday	4.7kB/s S 4(1129) P 1(127)	4.0kB/s S 3(1129) P 1(127)	6.7kB/s S 7(1137) P 1(129)	9.2kB/s S 10(1141) P 3(129)	13.0kB/s S 15(1141) P 3(129)	21.1kB/s S 23(1142) P 4(127)	18.2kB/s S 22(1135) P 5(128)	31.6kB/s S 32(1132) P 4(126)	11.8kB/s S 3(1134) P 0(125)	16.6kB/s S 32(1134) P 0(125)	24.3kB/s S 34(1134) P 0(125)	27.0kB/s S 35(1134) P 0(125)

Table 4. Random files download performance with VPN for 24/7

Time / Day	8 am	10 am	12 noon	2 pm	4 pm	6 pm	8 pm	10 pm	12 midnight	2 am	4 am	6 am
Monday	40.3kB/s S 45(2520) P 30(3986)	75.4kB/s S 15(3808) P 1(306)	106.9kB/s S 33(3816) P 1(303)	110.1kB/s S 63(3822) P 3(305)	109.1kB/s S 66(3821) P 0(304)	108.5kB/s S 75(3811) P 0(299)	110.6kB/s S 73(3815) P 1(293)	110.3kB/s S 70(3818) P 1(295)	107.0kB/s S 28(2392) P 2(182)	113.7kB/s S 35(2392) P 2(182)	113.1kB/s S 35(2392) P 2(182)	119.8kB/s S 34(2392) P 2(182)
Tuesday	110.7kB/s S 34(2392) P 3(182)	113.1kB/s S 33(2392) P 3(182)	110.9kB/s S 34(2392) P 2(182)	115.2kB/s S 35(2392) P 2(182)	114.4kB/s S 36(2392) P 1(182)	120.6kB/s S 31(2387) P 3(184)	111.0kB/s S 74(3806) P 0(299)	110.6kB/s S 75(3809) P 0(296)	113.0kB/s S 23(2406) P 5(211)	109.0kB/s S 36(3839) P 2(323)	109.8kB/s S 35(3839) P 2(323)	106.6kB/s S 34(3814) P 2(323)
Wednesday	107.3kB/s S 54(3807) P 2(297)	107.4kB/s S 35(2688) P 1(210)	107.0kB/s S 53(2683) P 4(213)	107.8kB/s S 66(2692) P 4(215)	110.0kB/s S 34(3831) P 2(324)	109.4kB/s S 33(3847) P 2(322)	112.6kB/s S 73(2691) P 3(219)	107.9kB/s S 70(2688) P 2(217)	115.5kB/s S 31(3847) P 2(322)	105.1kB/s S 37(3847) P 0(322)	105.6kB/s S 33(3847) P 0(322)	108.7kB/s S 37(3847) P 0(322)
Thursday	111.3kB/s S 71(2695) P 1(216)	37.5kB/s S 27(3355) P 48(7314)	111.8kB/s S 56(2700) P 3(217)	111.7kB/s S 69(2700) P 2(215)	108.1kB/s S 60(4914) P 2(429)	108.0kB/s S 74(4914) P 1(429)	111.4kB/s S 69(4914) P 2(429)	106.3kB/s S 73(5057) P 2(427)	111.0kB/s S 37(3819) P 0(353)	111.8kB/s S 37(3819) P 0(353)	111.7kB/s S 37(3819) P 0(353)	53.7kB/s S 32(3715) P 35(8391)
Friday	103.7kB/s S 35(4914)	34.7kB/s S 36(2848)	54.0kB/s S 31(2814)	109.1kB/s S 70(4914)	110.9kB/s S 33(2670)	113.0kB/s S 46(2670)	111.4kB/s S 45(2687)	113.4kB/s S 41(2687)	117.0kB/s S 28(6920)	114.4kB/s S 32(6920)	112.4kB/s S 36(6920)	110.7kB/s S 36(6920)

	P 5(429)	P 34(6282)	P 44(6204)	P 4(429)	P 3(239)	P 1(238)	P 0(240)	P 0(240)	P 1(711)	P 1(711)	P 1(711)	P 1(711)
Saturday	109.7kB/s S 49(3822) P 2(313)	111.2kB/s S 47(3822) P 1(313)	109.6kB/s S 48(3853) P 2(313)	108.5kB/s S 73(3875) P 2(309)	109.3kB/s S 60(3876) P 1(306)	111.0kB/s S 72(3886) P 0(307)	107.8kB/s S 71(3874) P 2(306)	108.0kB/s S 67(3888) P 1(301)	108.4kB/s S 33(6915) P 2(720)	67.4kB/s S 30(2721) P 44(5374)	108.8kB/s S 35(6915) P 2(720)	109.1kB/s S 31(6915) P 2(720)
Sunday	106.1kB/s S 73(3898) P 1(299)	109.0kB/s S 73(3907) P 2(294)	112.5kB/s S 27(2850) P 0(211)	112.5kB/s S 29(2873) P 1(203)	35.2kB/s S 38(3002) P 26(5109)	109.5kB/s S 37(6925) P 0(712)	109.8kB/s S 35(6927) P 0(707)	108.0kB/s S 38(6927) P 0(707)	111.7kB/s S 37(6935) P 0(704)	110.6kB/s S 37(6935) P 0(704)	111.1kB/s S 36(6935) P 0(704)	113.7kB/s S 37(6935) P 0(704)

Note:

1. The download speed is in kByte/s

2. S n1(n2) where n1 is the number of seed which is currently connected, while n2 is the number of seed which is active globally

3. P n1(n2) where n1 is the number of peer which is currently connected, while n2 is the number of peer which is active globally

Table 5. Remedial observation on the specific days and time

Day	Time		
Monday	8 am 98.1kB/s S 25(6092) / P 0(679)	10 am 114.2kB/s S 36(6092) / P 0(679)	12 pm 112.2kB/s S 36(6092) / P 0(679)
Thursday	8 am 110.0kB/s S 32(6092) / P 0(679)	10 am 105.1kB/s S 36(6092) / P 1(679)	6 am 120.8kB/s S 34(2419) / P 1(243)
Friday	10 am 108.3kB/s S 24(6092) / P 1(679)	12 pm 104.9kB/s S 36(2419) / P 1(243)	2 pm 107.8kB/s S 36(6092) / P 1(679)
Saturday	12 am 108.7kB/s S 36(6092) / P 1(679)	2 am 108.5kB/s S 36(6092) / P 1(679)	4 am 111.3kB/s S 36(6092) / P 1(679)
Sunday	2 pm 104.1kB/s S 36(6092) / P 1(679)	4 pm 111.0kB/s S 36(6092) / P 1(679)	6 pm 108.7kB/s S 35(6092) / P 1(679)

Table 6. The new modifies random files download performance with VPN for 24/7

Time / Day	8 am	10 am	12 noon	2 pm	4 pm	6 pm	8 pm	10 pm	12 midnight	2 am	4 am	6 am
Monday	98.1kB/s S 25(6092) P 0(679)	114.2kB/s S 36(6092) P 0(679)	106.9kB/s S 33(3816) P 1(303)	110.1kB/s S 63(3822) P 3(305)	109.1kB/s S 66(3821) P 0(304)	108.5kB/s S 75(3811) P 0(299)	110.6kB/s S 73(3815) P 1(293)	110.3kB/s S 70(3818) P 1(295)	107.0kB/s S 28(2392) P 2(182)	113.7kB/s S 35(2392) P 2(182)	113.1kB/s S 35(2392) P 2(182)	119.8kB/s S 34(2392) P 2(182)
Tuesday	110.7kB/s S 34(2392) P 3(182)	113.1kB/s S 33(2392) P 3(182)	110.9kB/s S 34(2392) P 2(182)	115.2kB/s S 35(2392) P 2(182)	114.4kB/s S 36(2392) P 1(182)	120.6kB/s S 31(2387) P 3(184)	111.0kB/s S 74(3806) P 0(299)	110.6kB/s S 75(3809) P 0(296)	113.0kB/s S 23(2406) P 5(211)	109.0kB/s S 36(3839) P 2(323)	109.8kB/s S 35(3839) P 2(323)	106.6kB/s S 34(3814) P 2(323)
Wednesday	107.3kB/s S 54(3807)	107.4kB/s S 35(2688)	107.0kB/s S 53(2683)	107.8kB/s S 66(2692)	110.0kB/s S 34(3831)	109.4kB/s S 33(3847)	112.6kB/s S 73(2691)	107.9kB/s S 70(2688)	115.5kB/s S 31(3847)	105.1kB/s S 37(3847)	105.6kB/s S 33(3847)	108.7kB/s S 37(3847)

	P 2(297)	P 1(210)	P 4(213)	P 4(215)	P 2(324)	P 2(322)	P 3(219)	P 2(217)	P 2(322)	P 0(322)	P 0(322)	P 0(322)
Thursday	111.3kB/s S 71(2695) P 1(216)	105.1kB/s S 36(6092) P 1(679)	111.8kB/s S 56(2700) P 3(217)	111.7kB/s S 69(2700) P 2(215)	108.1kB/s S 60(4914) P 2(429)	108.0kB/s S 74(4914) P 1(429)	111.4kB/s S 69(4914) P 2(429)	106.3kB/s S 73(5057) P 2(427)	111.0kB/s S 37(3819) P 0(353)	111.8kB/s S 37(3819) P 0(353)	111.7kB/s S 37(3819) P 0(353)	120.8kB/s S 34(2419) P 1(243)
Friday	103.7kB/s S 35(4914) P 5(429)	108.3kB/s S 24(6092) P 1(679)	104.9kB/s S 36(2419) P 1(243)	109.1kB/s S 70(4914) P 4(429)	110.9kB/s S 33(2670) P 3(239)	113.0kB/s S 46(2670) P 1(238)	111.4kB/s S 45(2687) P 0(240)	113.4kB/s S 41(2687) P 0(240)	117.0kB/s S 28(6920) P 1(711)	114.4kB/s S 32(6920) P 1(711)	112.4kB/s S 36(6920) P 1(711)	110.7kB/s S 36(6920) P 1(711)
Saturday	109.7kB/s S 49(3822) P 2(313)	111.2kB/s S 47(3822) P 1(313)	109.6kB/s S 48(3853) P 2(313)	108.5kB/s S 73(3875) P 2(309)	109.3kB/s S 60(3876) P 1(306)	111.0kB/s S 72(3886) P 0(307)	107.8kB/s S 71(3874) P 2(306)	108.0kB/s S 67(3888) P 1(301)	108.4kB/s S 33(6915) P 2(720)	108.5kB/s S 36(6092) / P 1(679)	108.8kB/s S 35(6915) P 2(720)	109.1kB/s S 31(6915) P 2(720)
Sunday	106.1kB/s S 73(3898) P 1(299)	109.0kB/s S 73(3907) P 2(294)	112.5kB/s S 27(2850) P 0(211)	112.5kB/s S 29(2873) P 1(203)	111.0kB/s S 36(6092) / P 1(679)	109.5kB/s S 37(6925) P 0(712)	109.8kB/s S 35(6927) P 0(707)	108.0kB/s S 38(6927) P 0(707)	111.7kB/s S 37(6935) P 0(704)	110.6kB/s S 37(6935) P 0(704)	111.1kB/s S 36(6935) P 0(704)	113.7kB/s S 37(6935) P 0(704)

Note:

1. The download speed is in kByte/s

2. S n1(n2) where n1 is the number of seed which is currently connected, while n2 is the number of seed which is active globally

3. P n1(n2) where n1 is the number of peer which is currently connected, while n2 is the number of peer which is active globally

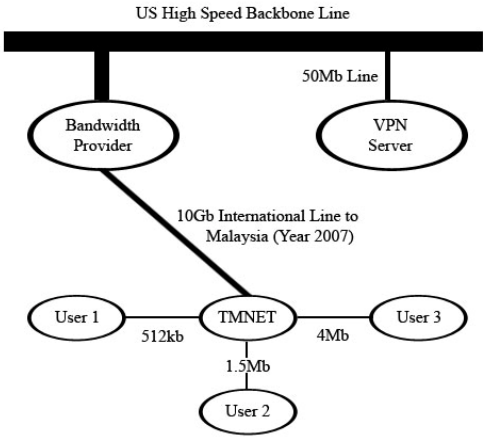


Figure 1. Location of VPN server

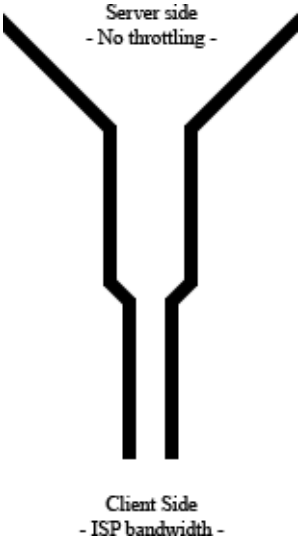


Figure 2. The arbitrary tunnel created by VPN

Figure 3. Streamyx speedometer speed test
(Source: http://202.188.95.52:8080/speedometer/)

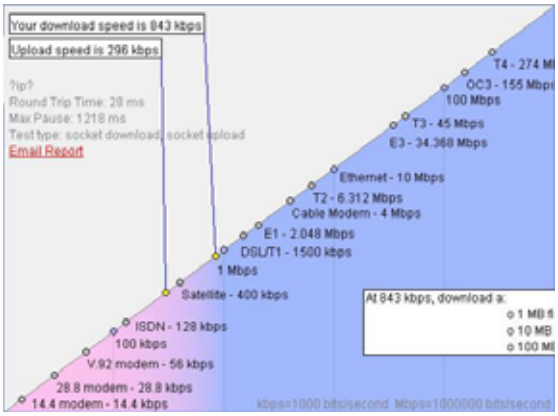


Figure 4. Speed test result given by Jaring ISP on Streamyx line.
(Source: http://www.jaring.my/service/broadband/index.cfm?cont=bandwidth_business)

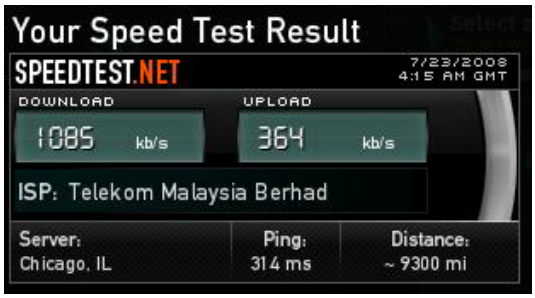


Figure 5. Line speed from VPN server to Malaysia
(Source: http://www.speedtest.net/)

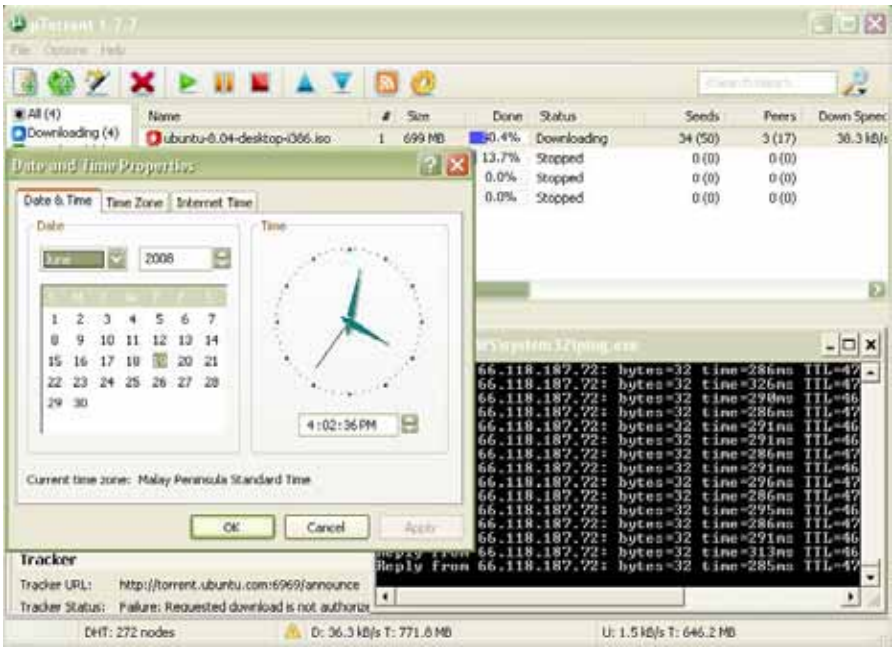


Figure 6. uTorrent downloading ubuntu without VPN

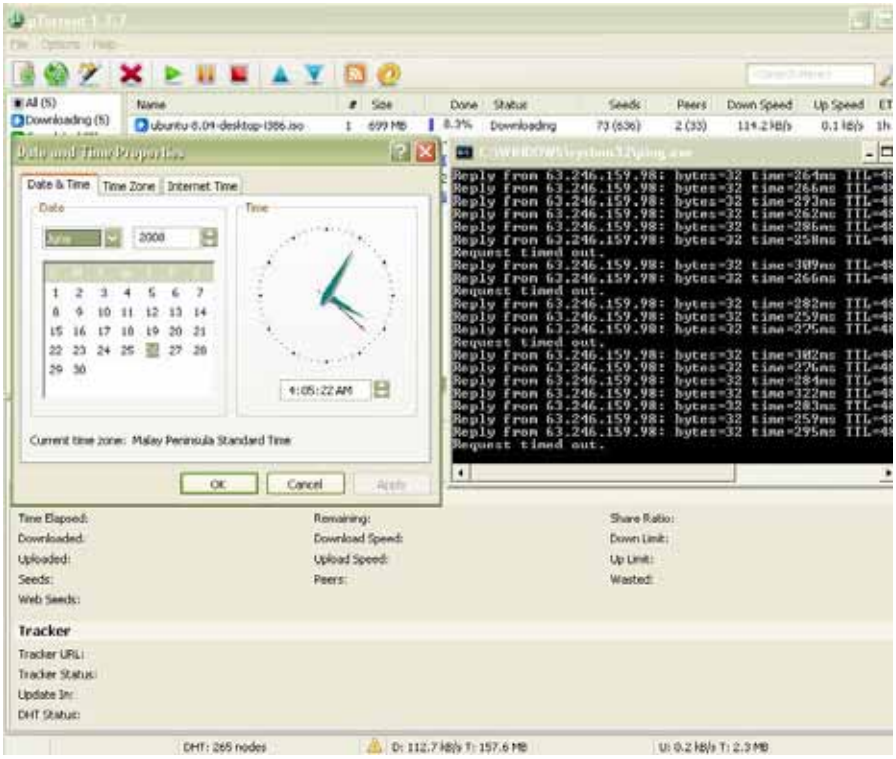


Figure 7. uTorrent downloading ubuntu with VPN

Figure 8. uTorrent downloading random files without VPN

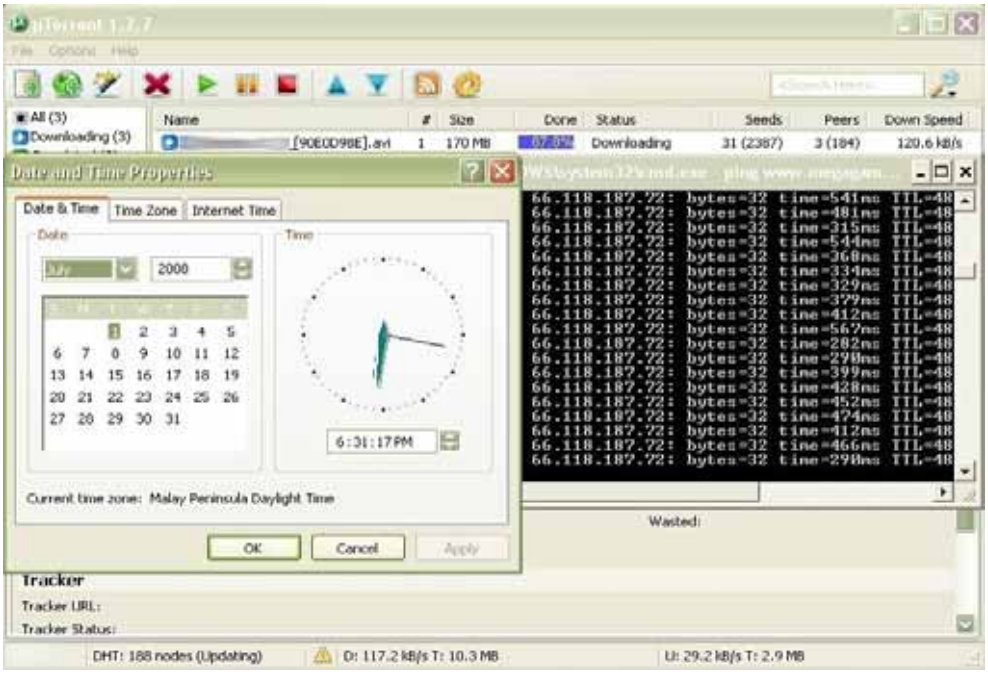
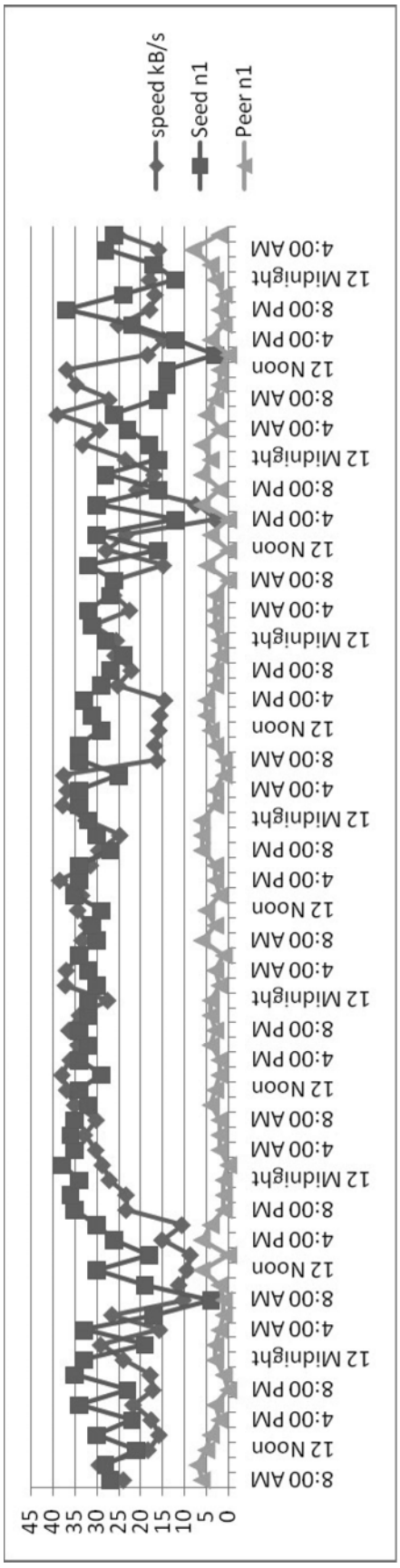
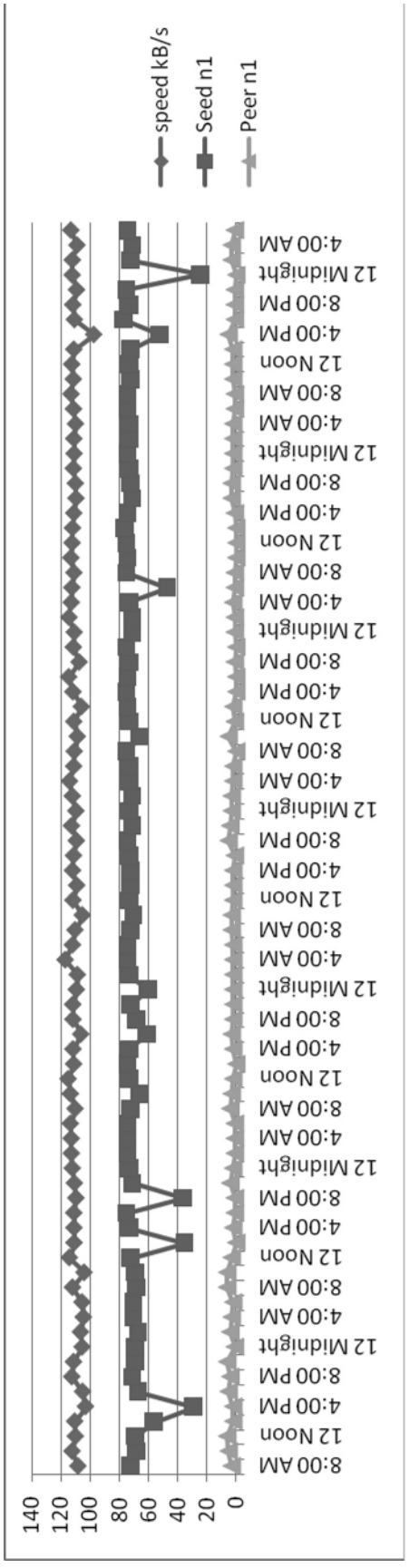


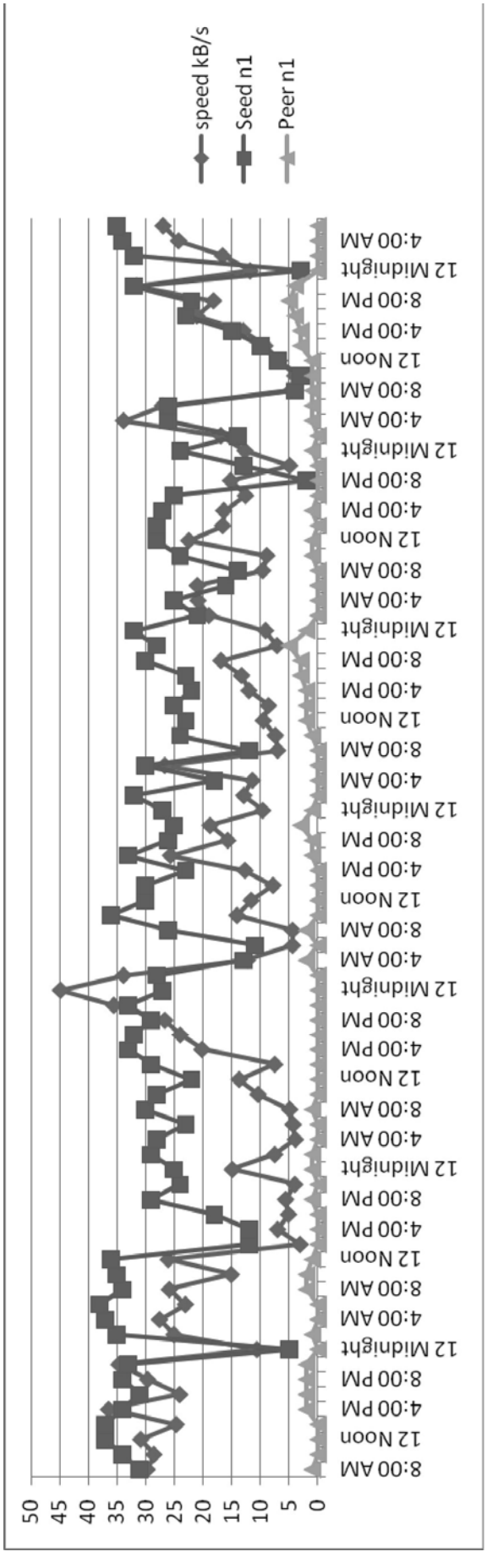
Figure 9. uTorrent downloading random files with VPN



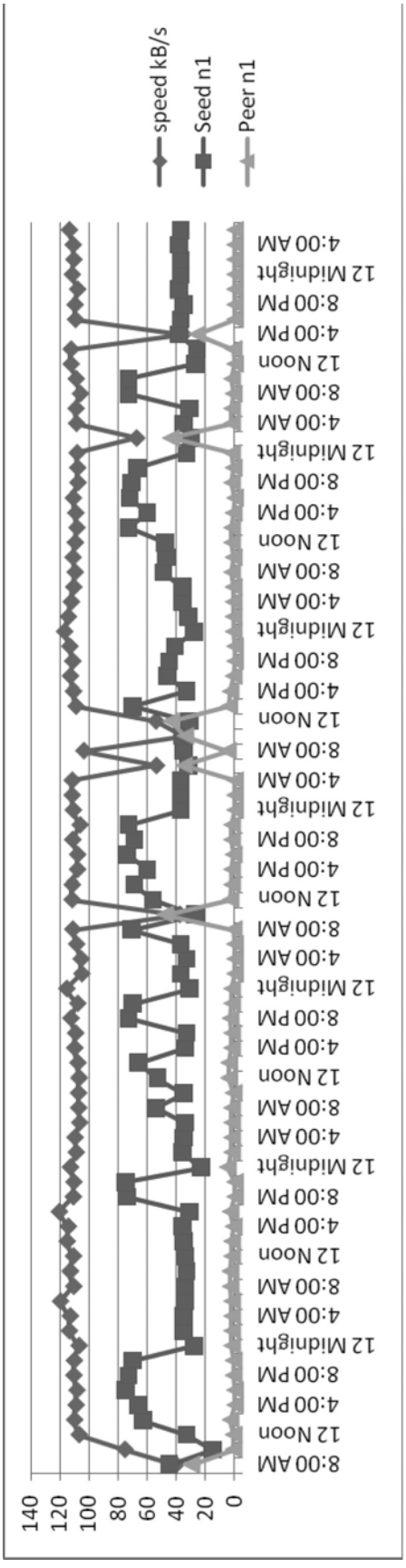
Graph 1. Ubuntu download speed without VPN for 24/7



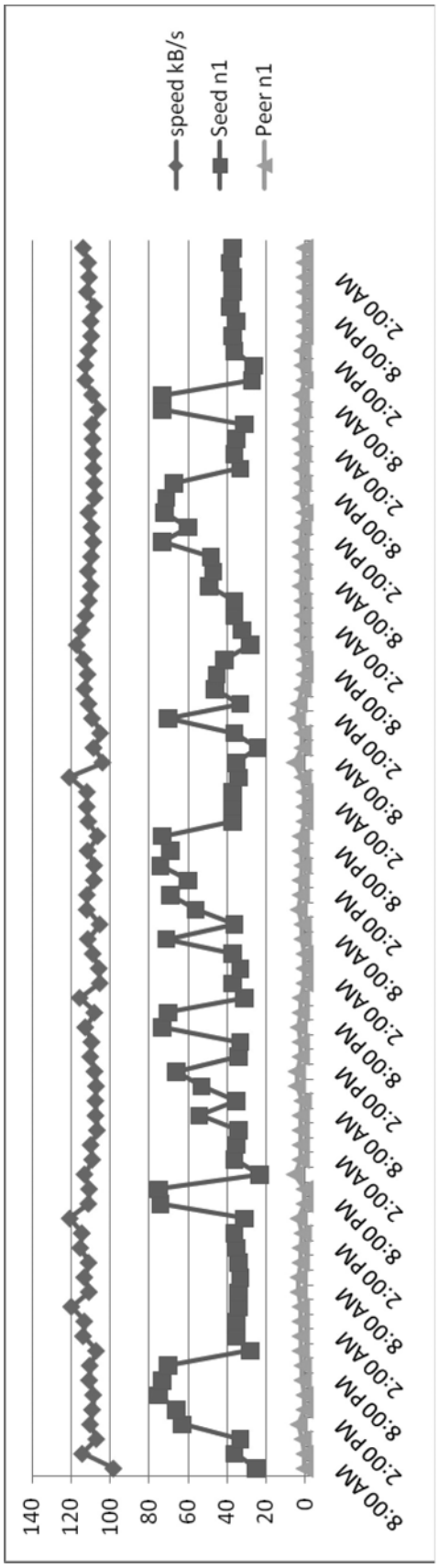
Graph 2. Ubuntu download speed with VPN for 24/7



Graph 3. Random files download speed without VPN for 24/7



Graph 4. Random files download speed with VPN for 24/7



Graph 5. The new modified random files download with VPN for 24/7

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Generating a Simple Fractal Graphics in Computer

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Abstract

In this article, we briefly discussed the definition of fractal, several important characters of fractal and the computation method of fractal dimensions with self-similarity. We also used the recursion algorithm to design a multi-colored fractal tree which was generated in computer by VB (Visual Basic) language, and formed a fractal tree user interface based on that. In addition, various forms of fractal tree could be realized by modifying initial values such as trunk length, the included angle among three ramifications and recursion times.

Keywords: Fractal, Fractal dimensions, Recursion algorithm, VB language

1. Introduction

Fractal geometry is a new subject which is arisen in recent thirty years, and it mainly describes unsmoothed and anomalistic geometric forms and structures in nature and nonlinear system. The fractal theory has been applied in various domains such as mathematics, physics, chemistry, material science, biology and medicine, geology and computer science (Wu, 2005, P.365-366). The fractal graphs generated by the computer can be applied in many industries including decoration, advertisement, textile, porcelain and press, and they have wider foreground (Chen, 2001, P.116-117).

2. Fractal geometry

The word of "fractal" was first put forward by Benoit B. Mandelbrot who was the researcher of IBM Research Center Physical Department and the professor of Mathematical Department of Harvard University in 1975, and its original meaning is "anomalistic, fractional, bitty" object. The word is built by consulting Latin "Fractus", and it is not only English but French, and it is a noun and an adjective (Zhang, 1995). In 1997, the publication his first book "Fractal: Form, Chance and Dimension" (Mandelbrot, 2002) indicated the formal naissance of the fractal theory. Like the definition to life, the fractal has definite definition, and it only judge whether the graph is the fractal by whether it fulfills some basic characters. The fractal possesses following characters including the scrambling of form, the fineness of structure, the self-similarity between local and whole, the non-integer nature of dimension and the iterative nature of generation. The fractal geometry is very closely associated with fractal forms in the nature, such as the cloud in the air, the nervure of plant and the shape of coastline, and we can see that the fractal form is very anomalistic, and it possesses very refined structure. For example, for the famous Koch curve, whether we magnify it any times, we can see the comparability and fineness between local and whole (Xu, 2005, P.4-5).

Though the fractal graph has so complex structure, how can we measure the fractal? The fractal dimension is one of important aspects. Generally, for a self-similar object with N parts, every part is amplified by R times from the whole, so the fractal similar dimension D can be denoted as $D = \frac{\lg N}{\lg(1/R)}$, and for the dimension computation method about complex fractal graph, Lijie's article gives very detail introduction (Li, 2002, P.71-78).

Though most fractal dimensions are fractions, but some fractal dimensions are integers, so whether the dimension is fraction is not the standard to judge whether a graph is fractal.

3. Computer implementation of fractal graph

The principle of recursion algorithm is to give the basic graph generation unit, then let the computer to plot the graph on every layer repeatedly according to the plotting rule of basic generation unit until achieving the pre-setting condition, and it is to use the function of pressing register and outing register in the computer and repeatedly utilize some rules to produce nested result. These fractal characters such as self-similarity, self-copy and self-nesting could be used to realize the fractal graph by the recursion algorithm (Yao, 2007, P.888-889).

In the article, we take Visual Basic 6.0 (Song, 1999) as the development platform to research the generation of fractal graph in the computer. And the initial generation value is seen in Figure 1.

Plot three branches growing up on every branch of three branches on the generation unit, keep the included angle among them unchangeable, shorten the length as three fourth of original length, and the obtained result is seen in Figure 2. The second step is to plot new branches in the new plotted branches according to the former rules. In the same way, we can obtain the fractal tree (Sun, 2004, No.51-53).

3.1 Algorithm design

(1) Suppose the coordinates of five points of A, B, C, D, E respectively are (x, y), (x_0, y_0), (x_1, y_1), (x_2, y_2) and (x_3, y_3), which are the heights of trunk, and ϕ is the included angle among three branches growing up.

(2) Plot the trunk AB, $(x, y) - (x_0, y_0)$.

(3) Compute the coordinate of C, $H = (3/4)H$, and define the rule by the default coordinate in VB. To convenient for compiling program, write x_1 and y_1 as $x_1 = x_0 + H \times \cos(\pi/2 + \phi)$ and $y_1 = y_0 - H \times \sin(\pi/2 + \phi)$.

(4) Compute the coordinate of D, $H = (3/4)H$, $x_2 = x_0 + H \times \cos(\pi/2 - \phi)$ and $y_2 = y_0 - H \times \sin(\pi/2 - \phi)$.

(5) Compute the coordinate of E, $H = (3/4)H$, $x_1 = x_1$ and $y_1 = y_0 - H$.

(6) Make $x_0 \to x$, $y_0 \to y$, $x_1 \to x_0$ and $y_1 \to y_0$, and use order to plot the beeline BC.

(7) In the same way of (6), plot the beeline BD and the beeline BE.

(8) Repeatedly execute approaches (3) to (6) until the recursion times are completed.

3.2 VB core program pseudocode and explanation (initial setting is omitted)

```
Private Function fractal tree (x, y, angle, length, n)
{
If n > 0 Then
{
   a = x + Cos(angle) * length: b = y - Sin(angle) * length    // compute a, b
Me.Line(x,y)-(a,b),RGB(Val(Rnd * 256),Val(Rnd * 256),Val(Rnd*256)) // plot the trunk
alpha←angle - ϕ              // compute the included angle between the branch BD and the axis x
    beita←angle + ϕ          // compute the included angle between the branch BC and the axis x
    alh←angle                // compute the included angle between the branch BE and the axis x
    leng←3 * length / 4      // the length of branch is 3/4 of the original length
    Call fractaltree(a, b, alpha, leng, n - 1) // nested transfer
    Call fractaltree(a, b, beita, leng, n - 1)
    Call fractaltree(a, b, alh, leng, n - 1)
}
End If
End Function
}
```

Run above program, we can obtain the multi-colored fractal tree growing up, and based on that, we can suppose to compile the fractal tree software which could obtain multi-colored fractal tree with different forms only if modifying one or several data in the frame of selection when running the software.

4. Software design of fractal tree

4.1 Design interface

Build a new project, lay one picture box control Picture1 on the forms, three command buttons Command1- Command3, three label controls Label 1- Label 3 and three textbox controls Text1- Text3, and the position and attribute setting of controls are seen in Figure 3.

4.2 Generated result of fractal tree

Setting different initial values, we can obtain different fractal trees, and Figure 4 is the fractal tree with different forms from different initial values.

The recursion time is higher, the obtained fractal tree is more complex and the branches are more flourish, and when the time achieves 12, the generation time in the computer is very long, and some computers with low collocation may end up. That also indicates the recursion time is higher, the complexity increase by geometric index, for example, the fractal tree which increases the included angle of three branches is more flourish, and the trunk length increases, the fractal tree will be higher. So we can see the fineness of the fractal graph. To make the generated fractal tree more like the form of a tree, we limit the included angle among three branches, and regulate its values only in 15~30. To make it store in the computer, we also make a button of "save", and we use the sentence of "Save Picture" to store the graph in the disk of the computer by special format.

5. Conclusions

The development of computer offers very good tool for the research of fractal graph. To the above fractal tree, we can improve it, increase the branch number of initial unit and make it become more complex, and we can also change the form of initial unit branch to simulate the tree is blown by the wind. If we utilize some picture processing software such as Photoshop and 3ds Max, we can make the generated fractal graph possess better effect (Zhou, 2004, P.138-139), so we can see that the research of fractal graph has large space, and its application is much wider.

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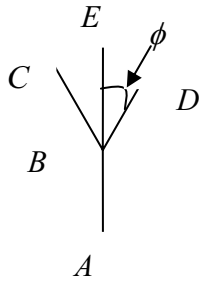

Figure 1. Initial Value

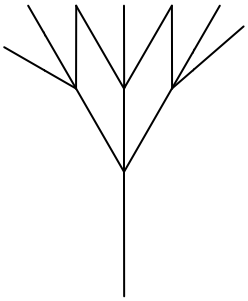

Figure 2. The Result after the First Step Recursion

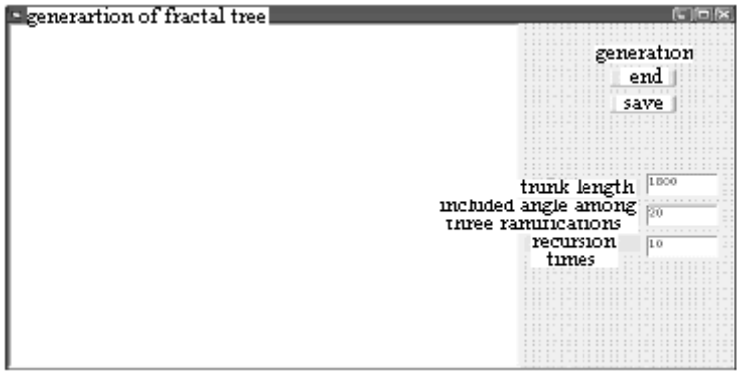

Figure 3. User Interface of Fractal Tree

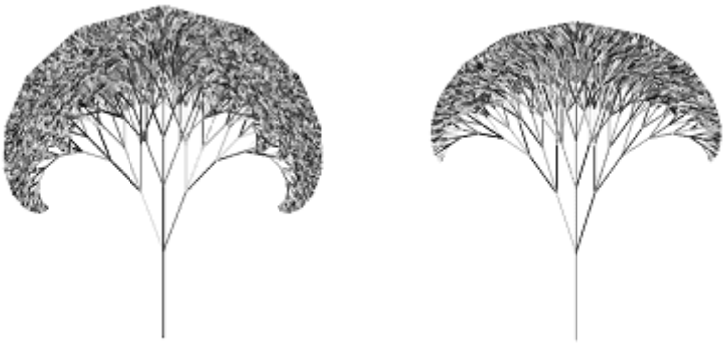

Figure 4. Two Fractal Trees with Different Forms

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Stochastic Programming Models and Hybrid Intelligent Algorithm for Unbalanced Bidding Problem

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Abstract

The expected value model and the chance-constrained programming model for unbalanced bidding problem are established on the condition that quantities of each activity are stochastic variables and the total project is finished smoothly in this paper. These models can make the unbalanced bidding price more reasonable and applicable. In order to solve these models, stochastic simulation, neural network and genetic algorithm are integrated to produce a hybrid intelligent algorithm. Finally, a numerical example is given to illustrate its effectiveness.

Keywords: Unbalanced bidding, Stochastic variable, Stochastic programming, Hybrid intelligent algorithm

1. Introduction

With the further development of the bid mechanism, the engineering item invitation has already become more and more standardized. How to master the strategy of invitation, increaseing the efficiency of bids is very important for the bidders. In order to make the bid price more competitive and obtain sufficient profits in engineering bids, they can use many kinds of methods to calculate the bid price, including unbalanced bidding, unexpected markdown, loss-first-profit-later quotation, multiple alternative quotation, etc. On the whole, unbalanced bidding is the most widely used tactic.

Unbalanced bids is opposite to the conventional balanced bids, which is a wide-used method in the optimization of unit

price internationally. It can be described as follows: after the contractors carry on the resource distribution , the cost analysis and the research of bidding skills according to bills of quantities provided by the owners, they enhance some comprehensive unit price in bills of quantities consciously and reduce other comprehensive unit price simultaneously in order to obtain more economic benefits without raising the total price.

Unbalanced bids is divided into two types of "earlier receiving money" and "more receiving money". However, how to realize these two types lacks quantitative optimization models and efficient algorithms, so it can bring randomness and blindness in process of bidding. In order to solve this problem, many researchers at home or abroad have carried on careful exploration and research. Dayanand and Padman(1997, p.906 & 2001, p.197) initially established optimal models of the project payment scheduling problem from contractor′s and client′s viewpoints respectively, also presented a heuristic algorithm to find the payment schedule of maximizing project profits. Afterwards Ulusoy et al. (2000, p.262) introduced a method of seeking the equal payment scheduling from both sides of contractor and client. In our country, the research of this problem is still on the beginning period, and most researches were presented theoretically. Xu(1990)'s research result in the field of project cost management has laid a solid theoretical foundation for other researchers; After that, Zhang et al. (2005, p.595) studied bids strategy via the game theory, using the characteristics of engineering quality list in the market economy. Chen et al. (2005, p.118) built linear programming models with objective of maximizing surplus profits according to the fundamental principles and the conditions of unbalanced bids; He and Xu (2007, p.474) set up nonlinear mixed integer programming models from contractor′s and client′s viewpoints respectively, also designed the two-module simulated annealing heuristics algorithm to solve these models. Generally speaking, most of these researches were built in certain environments, and the results showed that it could be optimized to give the best present value of actual payment without raising the total price when the unit price of front activities were enhanced by 10% and the unit prices of following activities were reduced by 10%.

In the real-world situation, unbalanced bids is a complex problem. If contractors overuse unbalaned unit price , it can not only bring the loss to contractors or influence winning a bid, but also result in the serious trouble and increase the investment risk to clients during the project management process. Therefore, there is a need to study unbalanced bidding problem in uncertain environments so as to make the contractor's bid price more competitive and improve the practical application value of unbalanced bids. Due to the budget engineering quantities uncertainty and substitution of main components in each activity, engineering quantities of each activity are stochastic variables within certain limits.

In this paper, we will discuss unbalanced bidding problem with stochastic bidding engineering quantities based on operations research and uncertain programming theory. First, the expected value model and the chance-constrained programming model with objective of maximizing the present value of actual payment without raising the total price for unbalanced bids will be established respectively on the condition that the bidding engineering quantities of each activity are stochastic variables and the total project is finished smoothly. Then stochastic simulation, neural network and genetic algorithm will be integrated to produce a hybrid intelligent algorithm for solving these models. Finally, a numerical example will be given to illustrate the effectiveness of the algorithm. The numerical result is successful, which can make the unbalanced bidding price more reasonable and applicable.

2. Problem Description

Before we begin to study unbalanced bidding problem with stochastic bidding engineering quantities, we first make some assumptions as:

(a) the contractor's anticipated starting time and duration time of each activity are the same as owner's;

(b) the interest rate doesn't change during the period of the project;

(c)each activity should be processed without interruption;

(d)the owner decides payment according to the construction schedule of each activity;

(e) the last paymen must be arranged when the total project is finished.

For simplicity, we assume that bill of quantity(BOQ) consists of n bidding activities, and the ith bidding activities have m main components, $i = 1,2,\cdots,n$, respectively.

Next, in order to model unbalanced bids problem, we must introduce the following indices and parameters:

t_{si}: the starting time of the ith activities;

t_i: the duration time of the ith activities;

r: the interest rate;

k_i: the discounting coefficient of construction cost needed for the ith bidding activities, and it can be calculated by

the following equation, $k_i = \dfrac{(1+r)^{t_i} - 1}{t_i \cdot r \cdot (1+r)^{t_{si}+t_i}}$

P_i : the budget price for the ith activities;

$\overline{P_i}$: the bidding price for the ith activities;

q_{ij} : the budget engineering quantities for the jth components in the ith activities, $j = 1,2,\cdots,m$;

ξ_{ij} : the uncertain bidding engineering quantities for the jth components in the ith activities;

p_{ij} : the budget unit price of the client for the jth components in the ith activities;

x_{ij} : the bidding unit price of the contractor for the jth components in the ith activities;

According to the assumptions, the budget price of the client for the total project should be $P = \sum_{i=1}^{n} P_i$.

The bidding price of the contractor for the total project is $\overline{P} = \sum_{i=1}^{n} \overline{P_i}$.

The budget engineering quantities of the client for the ith activities should be $q_i = \sum_{j=1}^{m} q_{ij}$.

The uncertain bidding engineering quantities of the contractor for the ith activities should be $\xi_i = \sum_{j=1}^{m} \xi_{ij}$.

The budget price for the total project is $P_i = \sum_{j=1}^{m} q_{ij} p_{ij}$.

The bidding price for the total project is $\overline{P_i} = \sum_{j=1}^{m} \xi_{ij} x_{ij}$.

Therefore, the present value of the client's budget price for the total project can be written as $f = \sum_{i=1}^{n} k_i P_i$.

The present value of the contractor's bidding price for the total project can be written as $\overline{f} = \sum_{i=1}^{n} k_i \overline{P_i}$.

As these parameters and basic formulas have been given in the above section, we can establish different stochastic programming models to satisfy different goals.

3. Stochastic models of unbalanced bidding problem

3.1 Expected value model

The first type of stochastic programming is the expected value model(EVM), which optimizes the expected objective function subject to a set of expected constraints. The expected value model has been applied in a wide variety of real-world problems. In practice, the bidding engineering quantity ξ_{ij} is usually a stochastic variable, so is the present value function $\overline{f}$ of contractor's bidding price for the total project. Since we can't predict the present value of contractor's bidding price for the total project accurately, a natural idea is to employ the expected present value $E[\overline{f}]$. Because we want to find the decision with maximum expected return subject to some expected constraints, then we have the following EVM:

$$\begin{cases} \max E[\overline{f}] = E[\sum_{i=1}^{n} k_i \overline{P_i}] & (1) \\ subject\ \ to: \\ E[\sum_{i=1}^{n} \overline{P_i} - \sum_{i=1}^{n} P_i] \le 0 & (2) \\ E[\sum_{i=1}^{n}\sum_{j=1}^{m} \xi_{ij} - \sum_{i=1}^{n}\sum_{j=1}^{m} q_{ij}] \le 0 & (3) \\ 0.9p_{ij} \le x_{ij} \le 1.1p_{ij}, \quad i = 1,2,\cdots,n; j = 1,2,\cdots,m. & (4) \end{cases}$$

where x_{ij} is the decision variable, ξ_{ij} is the stochastic variable, the form (2) and the form (3) express expected constraints, the form (4) expresses the limits of contractor's bidding unit price in order to avoid suspicion of unbalanced bidding according to many practical cases.

3.2 Chance-constrained model

The second type of stochastic programming is chance-constrained programming (CCP), which was initialized by Charnes and Cooper(1959, p.73). Its outstanding feature characteristic is that the stochastic constraints will hold at least some given confidence levels. For the same reason, we assume that x_{ij} is the decision variable, ξ_{ij} is the stochastic variable, and the present value function $\overline{f}$ of the contractor's bidding price for the total project is the return function. Then in order to maximize the present value of the contractor's bidding price with a given confidence level subject to some chance constraints, we build the following chance-constrained model based on stochastic CCP:

$$\begin{cases} \max \overline{f} \\ subject\ \ to: \\ \Pr\{\sum_{i=1}^{n} k_i \overline{P_i} \ge \overline{f}\} \ge \alpha & (5) \\ \Pr\{\sum_{i=1}^{n} \overline{P_i} \le \sum_{i=1}^{n} P_i\} \ge \beta & (6) \\ \Pr\{\sum_{i=1}^{n}\sum_{j=1}^{m} \xi_{ij} \le \sum_{i=1}^{n}\sum_{j=1}^{m} q_{ij}\} \ge \gamma & (7) \\ 0.9p_{ij} \le x_{ij} \le 1.1p_{ij}, \quad i = 1,2,\cdots,n; j = 1,2,\cdots,m. \end{cases}$$

where α, β, γ are the predetermined confidence levels, the form (5), the form (6) and the form (7) express chance constraints, the other forms' meanings are similar to the analysis of the expected value model.

4. Hybrid intelligent algorithm

Generally speaking, it is difficult to solve uncertain programming models. In this paper, a hybrid intelligent algorithm integrating stochastic simulation, neural network and genetic algorithm is designed to solve the above two types of stochastic models.We take the chance-constrained model as the example to introduce the hybrid intelligent algorithm.

Firstly, we apply stochastic simulations to simulate functions with random variables. The stochastic simulation is one of the most widely used techniques in stochastic system modeling , which has been applied in many fields. Although the stochastic simulation can't give the accurate results and it is also a time-consuming process, it is possibly the only effective method for complex questions which haven't analysis results(1959, p.73).

In order to solve the model, we generate training input-output data for the uncertain function $U: x \to (U_1(x), U_2(x), U_3(x))$, where

$$U_1(x) = \max\left\{\overline{f} \,\middle|\, \Pr\{\sum_{i=1}^{n} k_i \overline{P_i} \ge \overline{f}\} \ge \alpha\right\},$$

$$U_2(x) = \Pr\{\sum_{i=1}^{n} \overline{P_i} \le \sum_{i=1}^{n} P_i\},$$

$$U_3(x) = \Pr\{\sum_{i=1}^{n}\sum_{j=1}^{m}\xi_{ij} \le \sum_{i=1}^{n}\sum_{j=1}^{m}q_{ij}\},$$

by the stochastic simulation. Then we train a neural network to approximate the uncertain function U.

Finally, the trained neural network is embedded into a genetic algorithm to produce a hybrid intelligent algorithm. The procedure can be summarized generally as follows:

Step 1. Generate training intput-output data for the above uncertain function U by the stochastic simulation and then train a neural network to approximate the uncertain function U.

Step 2. Initialize pop_size chromosomes whose feasibility may be checked by the trained neural work.

Step 3. Update the chromosomes by crossover and mutation operations.

Step 4. Calculate the objective values for all chromosomes by the trained neural network and compute the fitness of each chromosome according to the objective values.

Step 5. Select the chromosomes by spinning the roulette wheel according to the different fitness values.

Step 6. Repeat the third to fifth steps for a given number of cycles.

Step 7. Report the best chromosome as the optimal solution of unbalanced bidding problem.

5. Numerical experiment

Now let us consider an unbalanced bidding problem. Assume that the client's BOQ consists of five bidding activities and each activity has six components which are man-power cost, material cost, mechanical cost, administrative charge, profit, risk cost in turn. The unit prices of man-power cost and administrative charge remain unchanged, but others change during the period of total project according to some practical cases. The budget unit prices and engineering quantities of the client for activities are presented in Table 1 and Table 2, respectively. The monthly interest rate r is given as 1%.

Obviously, the budget engineering quantities are decided by the owner's careful analysis. But in the real project problem, the engineering quantities should fluctuate randomly near the owner's budget due to uncertainty and substitution of main components in each activity. So the engineering quantities must be adjusted by the contract according to the actual situation. Note that the bidding engineering quantities are assumed as random variables with uniform distributions denoted by $U(a,b)$ shown in Table 3.

5.1 Chance-constrained model

For example, the contractor decides to bid the project, in which the starting times and the duration times of activities are given in Table 4.

With the idea of maximizing the present value of contractor's bidding price for the total project at the predetermined confidence level subject to some chance constraints, we consider the following chance-constrained model:

$$\begin{cases} \max \overline{f} \\ \textit{subject to}: \\ \Pr\{\sum_{i=1}^{5} k_i \overline{P_i} \ge \overline{f}\} \ge 0.95 \\ \Pr\{\sum_{i=1}^{5} \overline{P_i} \le \sum_{i=1}^{5} P_i\} \ge 0.95 \\ P_i = \sum_{j=1}^{6} q_{ij} p_{ij}, \qquad i = 1,2,3,4,5 \\ \overline{P_i} = \sum_{j=1}^{6} \xi_{ij} x_{ij}, \qquad i = 1,2,3,4,5 \\ \Pr\{\sum_{i=1}^{5}\sum_{j=1}^{6} \xi_{ij} \le \sum_{i=1}^{5}\sum_{j=1}^{6} q_{ij}\} \ge 0.95 \\ 0.9 p_{ij} \le x_{ij} \le 1.1 p_{ij}, \quad i = 1,2,3,4,5; j = 1,2,3,4,5,6. \end{cases}$$

5.2 Model solution

We uses Visual C++ software to realize the hybrid intelligent algorithm of stochastic chance-constrained model with the following parameters: the pop_size is 30, the $p\_crossover$ is 0.2, the $p\_mutation$ is 0.2. After a run of the hybrid intelligent algorithm (5000 cycles in simulation, 1000 training data in neural network, 1000 generations in

genetic algorithm), we obtain the optimal solution which is given in Table 5, whose objective value $\overline{f}$ =2738500.3 .

The result shows that the present value of bidding price for the total project is 2738500.3 Yuan when the contractor uses the unbalanced bidding strategy with stochastic bidding engineering quantities. But the the budget price for the total project is 3168000 Yuan when the owner adopts the method of linear programming. Then the present value of the budget price is 2706506.77 Yuan via conversion. In this way , the contractor can obtain surplus profit 31993.53 Yuan. The proof-test proves that this bidding strategy tallies with the actual situation completely. Therefore, the numerical result is persuasive and successful.

6. Conclusion

In this paper, we attempted to solve the unbalanced bidding problem with stochastic bidding engineering quantities, which is to maximze the present value of contractor's bidding price for the total project under unbalanced bidding limits and has not been studied ever before. Two types of stochastic models, including the expected value model and the chance-constrained programming model were built to meet different requirements. Then stochastic simulation, neural network and genetic algorithm were integrated to produce a hybrid intelligent algorithm to solve the numerical example. From the numerical result, we could clearly see that the hybrid intelligent algorithm could effectively solve the unbalanced bidding problem. Furthermore, this paper provided a good applied case for the practice of uncertain programming, and it also put forward a new approach for the promotion of uncertainty theory.

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Table 1. the budget unit price of the client (unit:Yuan)

p_{ij}	1	2	3	4	5	6
1	60	30	50	80	10	10
2	60	15	15	80	5	5
3	60	190	160	80	60	50
4	60	60	50	80	20	30
5	60	70	50	80	80	20

Table 2. the budget engineering quantities of the client

q_{ij}	1	2	3	4	5	6	Sum.
1	3000	2000	3000	2000	3000	2000	15000
2	2000	1200	1300	2200	2600	2700	12000
3	1100	1000	1000	900	1200	800	6000
4	10000	8000	1700	1500	4900	3900	30000
5	200	200	100	350	500	450	1800

Table 3. the bidding engineering quantities of the contractor

ξ_{ij}	1	2	3	4	5	6
1	$U(2700,3300)$	$U(1900,2100)$	$U(2700,3300)$	$U(1800,2200)$	$U(2750,3250)$	$U(1900,2100)$
2	$U(1800,2200)$	$U(1150,1250)$	$U(1200,1400)$	$U(2000,2400)$	$U(2400,2800)$	$U(2600,2800)$
3	$U(1000,1200)$	$U(950,1050)$	$U(900,1100)$	$U(800,1000)$	$U(1100,1300)$	$U(750,850)$
4	$U(8100,9900)$	$U(8550,9450)$	$U(1500,1900)$	$U(1350,1650)$	$U(4500,5300)$	$U(3700,4100)$
5	$U(180,220)$	$U(190,210)$	$U(90,110)$	$U(300,400)$	$U(450,550)$	$U(420,480)$

Table 4. the starting times and the duration times of activities

the ith activity	t_{si}	$t_i(month)$
1	Jan. 2009	13
2	Oct.2009	6
3	Nov.2009	5
4	Mar.2010	9
5	Sep.2010	4

Table 5. the bidding unit price of the contractor (unit:Yuan)

x_{ij}	1	2	3	4	5	6
1	54.568	28.88	52.927	86.884	9.134	10.354
2	57.337	14.128	15.406	86.761	4.693	4.5
3	55.606	172.41	154.849	73.918	54.778	53.257
4	64.564	63.98	52.528	84.835	19.205	27.633
5	60.69	74.204	46.97	77.881	73.06	21.846

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People Portraits and Cartoon Algorithm Study

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Abstract

This paper is to use the positive face to automatically generate a photo realist style, or has the effect of exaggerated cartoons. It includes two aspects: First, face the portrait photos automatically into production; Second, face deformed to generate cartoon effect. AAM model is a statistical model, can be well applied to the facial characteristics of location. In this paper, by improving the traditional AAM ways to overcome its lack of color information processing, design a more effective figure portraits Generation System. Then, take the initiative to shape a model feature extraction and characteristics of the method of combining the human face of the main features of automatic deformation, the cartoon characters generated portrait.

Keywords: Portrait photos, AAM model, Deformation, Cartoon

1. Introduction

In recent years, digital media technology is gradually integrated into daily life, greatly affecting people's lives and work methods. Use of computer-generated cartoon figure portraits in many areas with a wide range of applications such as video conferencing, online games, mobile digital entertainment.

In a variety of applications in the area of a typical portrait of the characters is generated automatically, but mainly in the form of comic books, including painting lines and Oil cartoons. Painting lines in the area, MIT's Brennan was first proposed a comic exaggeration of the interactive generation system. Murakami(1997, p.1), who proposed a template-based production lines painting methods and the development of the PICASSO system, in this method, the comic exaggeration of the extent to adjust. Rein-Lien Hsu(2003, p.2) proposed an interactive model of the Snake adults face the next life painting lines (without exaggeration effect), and it applied to the face in the match. Li, who made an automatic Face painting lines Generation System, the main use of symmetry operator, rectangular outline of filters and features to Face detection and location of the feature points. And various other methods, Microsoft's Chen Hong(2004, p.3), who proposed a case-based method of generating the lines painted. Through the study of the artist's works are photographs Face painting lines to the relationship, when studying the works include exaggerated effect, the formation of the lines are painted with exaggerated effect. Comic lines with the formation of different paintings, Pei-Ying Chiang, who put on an MPEG 4 color portraits of comic exaggeration of the self-generation system. Their systems to have a portrait of comic prototype works, through exaggeration and distortion so as to be processed and the face match, which are the human face of the comics. Through the use of different styles of work as a prototype, could be the result of different styles.

With the previous technology is different, mainly in the improvement of the AAM model based on the design and realization of a figure portraits generation system. That is, not using an interactive model of the Snake did not use symmetry operator, rectangular outline of filters and features to Face detection and location of the feature points way but to use the model based on colour AAM model Face positioning methods access to various features of Facial At the precise location. And the system is a common face for the photo rather than using the prototype has a portrait of comic prototype works to be face cartoons.

2. System Overview

This is the main objective is to achieve portraits of the characters automatically generated and exaggeration, to have a cartoon effect, it formed mainly by three steps: The first step is to face the automatic positioning. Here, we used to improve the AAM method. AAM traditional method of its output does not include the nine characteristics of the forehead, improved, people can get the whole face shape. The second step is painting a portrait illustrations. We use

Unsharp Mask sharpening handling of the color scale computing method, this approach not only take into account mobile device users on the requirements of computing speed, but also to retain the vast majority of people face characteristics, thus more effective in adults face a portrait of Health Illustrations painting. The third step is painting a portrait illustrations deformation generate a certain entertainment humor comics.

3. Face automatically generated portrait

People generated portraits of the structure as shown in Figure 1.

Shown in Figure 1 face portraits structure of the generation system. That is to enter a positive face of color photos, and then in accordance with this picture, respectively, to find the appropriate regional and facial hair organs such as eyes, nose and lips, then its final composition of the figures we are portraits system.

In this system, the whole head was divided into regional and facial hair region in two parts. The text of the main difficulties is to determine how accurate and effective regional hair extracted from hair outline and reasonable and in the face of regional coordination of the various feature points. Below will be first introduced hair region and its outline of the extraction method.

3.1 hair treatment

As dark hair color has a special nature, that is, the hair pixels Y, the value to meet: $Y \leq Y0$, Y0 is a constant. Therefore, we can not satisfied of this nature will be removed pixels, the hair will inevitably fall on the remaining area, from where the hair will be extracted from the region, tracking the region's profile to be the outline of the hair. Concrete steps are as follows:

1) Face Image in the calculation of the various pixels Y, values, does not meet the conditions for removal of pixels, the value of the plans are assumed to be G..

2) G for mathematical morphology in the closing operation, the hair of the noise (white hole) filtered by the value of the map.

3) Can be used mathematical morphology of the method, the value of the corrosion plans to conduct two operations. Through corrosion computing, image width of a line of connectivity will be cut off.

4) Tracking the value of the contour map, one for each contour rectangular region ri, with a regional list of R = (r1, r2 ,..., rm), rm is the number of outline.

5) According to ri determine the contours of regional hair.

6) The outline of the region by the hair line, using seed filling method of filling the hair of the region.

3.2 Face organ dealing with

The use of a series of facial images AAM model. In the AAM model, Face the characteristics of a total of 84 points. Active in the shape model (ASM) - On the foundation, T. F. Cootes(1995, p.5&1998, p.6), who in 1998 proposed the initiative apparent model (AAM). AAM model can be effective use of information and the shape of the object gray change information for the positioning feature points, but the color images feature points Positioning undoubtedly overlook the color information for. Based on the model adopted by the human eye colour location method to determine the human eye rough location and direction, as people face the pattern of distribution of facial features, which can determine the location and who Face direction, which can search for AAM to provide a model Better initial position and size, and can reduce the size of AAM search window, thus reducing the search time AAM. The following was the eye as an example to describe the method of concrete steps:

① determine the use of colour model facial image in the eyes of the position;

② pupil under the eyes of the connection point and length to determine the initial AAM model size and direction. As long as AAM model known face in the eyes of that special

Levy points of reference to the model zoom and rotate so that they will reach a better initial position;

③ under the eyes and facial region, identified AAM model search window. The eyes and facial regional relations through more than 20 people from the face image analysis, we will position these images under the eyes of alignment, and then for the average person faces and get the average person in the eyes and face of the geometric face of regional relations.

④ use AAM model search, facial features, are the exact location.

4. Deformation exaggerated

4.1 deformation

There are many ways can be used for facial image deformation, and facial animation, more commonly used method for the deformation of the two mesh deformation methods(1998, p.7) and methods based on the characteristics of the

deformation(1992, p.8). Grid-based technology is deformed image deformation technology in the first one of the ways. Based on the characteristics of the deformation method in the image selected features of the corresponding point line right, the use of the source image in the feature points in the image and objectives of the characteristics of the corresponding point, the characteristics of the region around the pixels are subject to different levels of impact The method can be deformed in high-level control of the process. From the perspective of computing speed in terms of grid computing deformation faster.

The algorithm has been exaggerated deformation often neglected and the length of three Court of facial, which is exaggerated cartoonist for the important factors. The literature [6] is in the face of Grid Group, a large number of feature points to change the coordinates. Feature points are divided into lead, with the correction from the point and three points. Three types of mutual influence between the positioning process is rather complicated. To simplify the process of deformation, this form of the deformation of classification, based on deformation and deformation step-by-step approach to achieve the simplified grid model of purpose. Grid under the automatically generated key feature points, layered automatically exaggerated deformation, and to consider the three Chambers, such as the art of facial exaggeration. Exaggeration deformation is the main form of compression and tension Larger fish eyes squeezed.

Intuitive, the facial features (facial, the three Chambers, the people) of deformation through the stretch or compressed form, and local features (the overall distribution of facial features, eyes, nose, mouth) of the deformation is the use of fish eyes Larger or extrusion of the way. According to an exaggeration of different ways, using two kinds of deformation grid, divided into a Step 2.

4.2 the first step deformation - facial, the three Chambers, the people of exaggeration

In order to facilitate the contours of the face, the three Chambers, the people in the tensile and compression, a grid model defined as shown in Figure 2. Grid will be key features of the coordinates of points automatically generated.

Face by calculating the ratio can determine if the facial. Facial can be divided into a long face, wide face and facial standards. If a specific human face aspect ratio in the standard human face aspect ratio difference between the normal range, that is the standard facial is not an exaggeration; Otherwise, the judgement in accordance with aspect ratio for wide or face a long face. For different types of facial, with the proportion of the Third Chamber, the deformation of different ways, according to people in the length and the length of the court to determine whether the proportion of people in the exaggerated length.

For the aspect ratio in the face of the normal standard facial differences within the scope of the face of wide unchanged, according to the length of three Court of exaggeration, that is to change the corresponding grid coordinates of points. Facial for the wide face, the face of the whole squash, narrow vertical. Long face the situation more complicated, if the three meet the standards of the Court, on the face of vertical rectangular uniform tension if the court longer, vertical ladder to face (at the end of a long) stretch if the court longer, The vertical ladder to face (at the end of a long) stretch if the Court in relatively long, the face of the "Shanghai" shaped deformation, that is, on the Court of vertical ladder (at the end of a long) stretch, in the Court of vertical rectangle stretching, under the Court of vertical Trapezoid (at the end of a long) stretch. Divisions based on the proportion of specific tensile Face of the Third Court of proportion.

Three people in the Chamber and the deformation of the grid, as shown in table 1.

Grid coordinates of the points of adjustment for specific standards and who Face the face value of the difference with a random value of the product b, b in the range of three Chambers averaged between face-to a certain degree of effect The randomness.

4.3 The second step deformation - the exaggerated facial features

This paper used in the deformation method to enlarge the fish eyes and squeeze. According to the Observer cartoonist works, the effect of fish eyes Larger than in the past used to enlarge the effect of a more linear ideal.

First consider the overall effect of facial features, Meixin points from the calculation of the need to face the focal point for long distance and the proportion of the face, that is, in the Court of length and the length of the people and the proportion of long faces. Chinese aesthetic standards Face the corresponding ratio of 7:10, if a particular human face of this ratio exceeded the standard proportions of the human face of the normal differences, the need for facial features whole fish eyes zoom in or out. And then consider the eyes, nose and mouth size. Have been adopted before the three percentage compared with the standard ratio of the notable features of the judgement, here only exaggerated significant feature.

Step 1. Generation as shown in Figure 5 of the finer grid square.

Step 2. And the need to exaggerate the characteristics of the surrounding grid position deformed fish eyes.

Comic portraits are usually below the narrow neck of this paper, mouth and chin following a specific regional centre of the grid points squeeze deformation. Fish eyes and squeeze algorithm is a specific region of the geometric grid point

deformation. First default overall impact of facial features, eyes, nose and mouth of their respective rectangular region, the regional deformation rectangular area for the largest circular area, the grid coordinates of points from the Cartesian coordinate system conversion to a coordinate system. After the overall characteristics and local features step-by-step deformation, the result is that the basic drawing comic exaggeration effect.

5. Conclusion

Through analysis of exaggerated comic portrait of the painting, made in stages based on the deformation of the comic style portraits of human faces generated algorithms, users can be given in accordance with the face photo, through the key features of the interaction point calibration with automatic generation of the exaggerated effects Face positive portrait comic. This algorithm only user interaction to achieve 14 feature points of calibration and drawing style of choice, easy to operate and generate results have a certain randomness, is simple and more efficient. In a deep understanding of drawing comic books, on the basis of a reasonable use of deformation, deformation stages exaggerated, and achieved good results close to the hand-painted. The next step of work including the use of face recognition research results to the corresponding automatically generated key feature points instead of the user's interaction; achieve more image rendering style to meet the individual needs of users; study how to generate arbitrary attitude and perspective of a portrait of comic books, With photos and further improve the exaggerated side effects.

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Table 1. Figure 2 deformation of the grid points

Features	Impact on the grid points
In court	2,3 points to the grid spacing
Atrium	4,5 points to the grid spacing
The Chamber	7,8 points to the grid spacing
People	6,7 points to the grid spacing

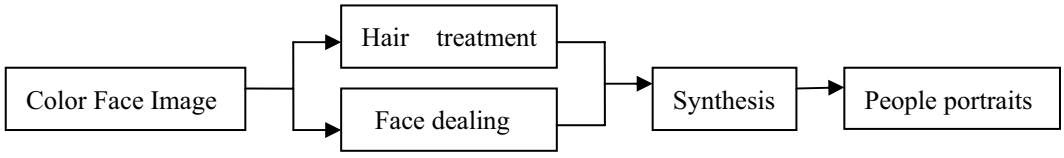

Figure 1. face portraits of the generation system

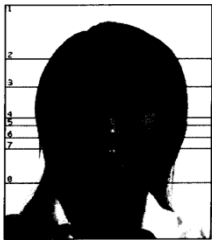

Figure 2. grid model 1

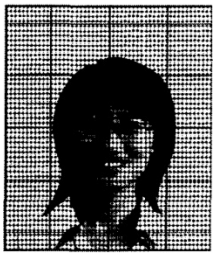

Figure 3. grid model 2

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A Summary Sentence Decomposition Algorithm for Summarizing Strategies Identification

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Abstract

Expert summarizers employ a number of strategies to produce summaries. Teachers need to identify which strategies are used by students to help them improve their summary writing. However, the task is time consuming. This paper reports on our effort to develop an algorithm to identify the summarizing strategies employed by students using summary sentence decomposition. The summarizing strategies used by experts are identified and translated into a set of heuristic rules. A summary sentence decomposition algorithm is then developed based on the heuristic rules. A preliminary test was carried out and the results are discussed.

Keywords: Summary writing, Summarizing strategies, Summary sentence decomposition, Heuristic rules

1. Introduction

Summary writing is an important skill which involves multiple cognitive activities such as reading and understanding of text, identifying relevant theme, and generating a shorter version of it. As opposed to other types of writing such as writing a story or a report, the production of a summary is dependent on existing texts (Hidi & Anderson, 1986). In addition, the skill required some strategies to determine what to include and eliminate, how to reorganize information extracted and how to ensure that the final version captures the key messages of the original text without simply doing a cut and paste job on the original text. Thus, students needs to employ the summary writing skill not only for navigating learning successfully at college and university level but also enables them to work independently.

The task of summary writing can be useful to evaluate students' comprehension about the text (Zipitria, Arruarte, Elorriaga, & Díaz de Ilarraza, 2004). Hence, automated summarization assessment has drawn a lot of interests in recent years. There are a few systems developed for this purpose, e.g. *Summary Street*® (Franzke, Kintsch, Caccamise, Johnson, & Dooley, 2005; Wade-Stein & Kintsch, 2004) *Laburpen Ebaluaka Automatikoa* or *LEA* (Zipitria et al., 2004) and Summarization Assessment Strategies Model (Lemaire, Mandin, Dessus, & Denhière, 2005).

Summary Street® is a computer-based assessment system that provides an environment where students can get feedback about the content of their written summary. It employs *Latent Semantic Analysis (LSA),* a machine learning method to construct the semantic representations that mirrors the structure of human knowledge. The system compares the student's summary and the original text to determine how similar they are. It gives immediate visual feedback based on measures such as content knowledge, writing mechanics, length, redundancy, and plagiarism.

LEA is an automatic summary evaluation environment which takes evaluation decision based on human expertise modeling, to train students in summarization skills and also to assess human summary evaluation. It gives feedback on the coherence, content coverage and cohesion, the use of language and adequacy of the summary. Like Summary Street, *LEA* also employs LSA as a tool to measure domain knowledge and summarization skills.

Another example is modeling summarization assessment strategies using LSA, which models the way teachers assess students' summaries. The model is based on automatic detection of five macrorules in summarization which are implemented in the LSA framework. In this model, each summary sentence is compared with every sentence in the original text.

Although previous works (e.g. as in (Franzke et al., 2005; Wade-Stein & Kintsch, 2004; Zipitria et al., 2004)) have contributed towards the development of the summarization assessment system, their focus is only on the quality of the summary whereby the summary has to be concise, include only main ideas and avoid redundancy,. Few if any, automated summarization assessment systems have been developed for identifying and assessing students' use of a systematic strategy for accomplishing the summary writing task. Since summary writing required some strategies and currently there is no tool for identifying the strategies employed by students, we proposed a computer-based summarization assessment system that assesses a summary by looking into the strategies used. This tool can be used to give information to teachers about the specific strategies used by students to produce their summaries and consequently, help students to hone their summarizing strategies in summary writing.

2. Problem in Summary Writing

Summary writing has been part of the English language syllabus for many years (Zurina, 2003). It is to equip students with the summarization skills needed during tertiary education of after leaving schools. Although the skills can be developed naturally, most students require much help to produce a reasonable summary. In addition, previous research has shown that proper teaching of summary writing will positively influence student's use of summarization strategies and the quality of their summaries (Kaur, 1997). Students are taught how to summarize using a sequence of instructional rules as shown in Figure 1 (a) which are similar to the basic summarization rules shown in Figure 1 (b).

An earlier study has shown that student's difficulties in summarizing were linked to the students' use of strategic skills (Winograd, 1984). In addition, an analysis of students' summaries shows that the performances of the students do not reflect directly the students' strategies in summarizing (Norisma et al., 2007). In other words, students who received good marks in summary writing do not necessarily possess good summarizing skills. Unfortunately, in assessing a summary writing, only the quality of the summary is evaluated, not the strategies used to produce the summary itself. This is quite a common practice amongst teachers in schools since identifying student's summarizing strategies is a very time consuming process. Thus, teachers do not know for sure about the specific summarizing strategies used by the students to process information. In addition, the students have to learn and apply the strategies of summarization. Only then will they improve their summarizing skills. Because of that, we proposed a sentence decomposition algorithm that can identify the strategies used by students in summary writing. The development of the algorithm involves a set of heuristic rules formulated from a careful analysis of the experts' summaries using summary sentence decomposition.

3. Formulation of Heuristic Rules

To formulate the heuristic rules for identifying students' summarizing strategies, the teachers' strategies in summary writing can be used as rules to identify students' strategies. Thus, the formulation of the heuristic rules is based on the expert summarizing strategies which are acquired mainly by studying the experts' summaries. The study was conducted to identify the experts' summarizing strategies and how they used the strategies to produce their summary sentences. From the study, we identified 8 types of strategies that are commonly used by the experts:

- Deletion - trivial or redundant information are eliminated from the sentence
- Sentence combination – two or more original sentences is combined to construct a summary sentence

- Topic sentence selection - only one important sentence is chosen to represent the main idea of the whole paragraph.
- Paraphrase – similar phrase or word is used to replace the original phrase or word
- Generalization - a list of words or items is replaced by a more general word in the same class.
- Syntactic transformation – the order of the words in a sentence is changed.
- Sentence reordering – the order of the sentences in the original text is changed.
- Invention – new but more concise sentences are used to replace the original one.

To represent the sentences and words in a text, we propose the notation below for our discussion.

If T is a text consisting of m sentences, t_i where $i = 1, 2, 3, \ldots m$, then,

$T = \{ t_i \};\ i = 1, 2, 3, \ldots\ldots, m$ (1)

Hence, for sentence t_i, comprising a string of n_i words, t_{ij}, *where* $j = 1, 2, 3, \ldots . n_i$, then, t_i can be written as,

$$t_i = \{ t_{ij} \} \qquad j = 1, 2, 3, \ldots \ldots, n_i \quad (2)$$

Similarly for summary text, S, where every summary sentence, s_i, comprises a string of words as represented as,

$$s_i = \{ s_{ij} \}, \quad i = 1, 2, 3, \ldots \ldots, m \ \ and \ \ j = 1, 2, 3, \ldots \ldots, n_i \qquad (3)$$

The summarizing strategies of the experts were analyzed and translated into a set of heuristic rules on how to identify the summarizing strategies as shown in Table 1. Not all strategies are presented in the rules since we used *position-based method* in our algorithm which is only applicable to some of the rules which are deletion, sentence combination, syntactic transformation and sentence reordering. Copy-paste, a strategy where a summary sentence is produced by copying the original sentence without making any changes, is included in the rules although it is not part of the summarization rules and the experts' strategies. It is important to identify the usage of this strategy in students' summary writing since it is not a good strategy and it promotes students to plagiarism.

4. Summary sentence decomposition algorithm

4.1 Problem Description

The main focus of our work is to develop a program to identify students' summarizing strategies using summary sentence decomposition which is a process to determine whether a summary sentence is generated from the original text and to identify the position of the words in the original text (Jing & McKeown, 1999). The task of the decomposition program is to analyze the construction of summary sentences in students' summaries. It deals with the following problem:

Given a student's summary sentence,

- *What words in the summary sentence come from the original document?*
- *Where are the words located in the original document?*
- *Which is the best sequence used to represent the words in the summary sentence?*
- *What is the original sentence of the best sequence?*
- *How is the summary sentence constructed from the original sentence?*

The position of a word in the original text is represented by the sentence position and the word position: *(q,r).* Thus, an input summary sentence, s_i can be represented as a word sequence, $\{s_{ij}\}$. If a word, s_{ij}, is found in T, and the word is t_{qr}, then, $s_{ij} \equiv t_{qr}$.

For every word in a summary sentence, the location of the same word is found in the original text. When the locations of all words have been identified in the original text, a sequence of word positions is obtained. However, some common words in the summary sentence like *a, an* and *the* may occur more than once in the original text and in different sentences in the original text. Hence, a set of sequence of locations of words in original text corresponding to the different sentences are found. For example, the second summary sentence in a summary text, *"I like the movie",* can be represented as $s_2 = \{(2\ 1)\ (2\ 2)\ (2\ 3)\ (2\ 4)\}$ which indicates that $(2,1), (2,2), (2,3), (2,4)$ are the positions of the summary words respectively. These words are found in the original text, T, and word like "*I*" has multiple occurrences in T. Thus,

$$s_{21} \equiv t_{13} \equiv t_{41} \equiv t_{52} \equiv t_{63} \equiv t_{91}$$

This rule is applied to all summary words and the positions of these words in T, are presented in Figure 2. Each position of a word is link to the position of the next word until the last word to produce a sequence of word positions. By referring to Figure 2, the first possible sequence can be {(1, 3), (4, 2), (4, 3), (4, 4)}, another sequence can be {(1, 3), (8, 7), (4, 3), (4, 4)}, and so on. Since the word *I* occurs 5 times in the original text, *like* occurs twice, *the* occurs once and *movie* was found in 4 locations, then, the total number of possible sequences of positions is 40 (5 x 2 x 1 x 4). Therefore, it is important to

determine which is the sequence best used among all the possible sequences before we can determine how this sequence was used to construct the summary sentence.

4.2 Summary sentence decomposition algorithm

Summary sentence decomposition algorithm is developed to:

- determine whether the words in the summary sentence are from the original text,
- locate the locations of the words in the original text using position-based method
- find the best sequence of locations of words used to represent a phrase in the summary sentence,
- identify the strategies used to produced the summary sentence.

This algorithm consists of two sub-algorithms which are:

4.2.1 Best sequence selection algorithm

As described in the previous section, some words in the summary sentence may occur more than once in the original text and in different sentences in the original text. Hence, a set of sequence of locations of words in original text corresponding to the different sentences are found. Therefore, it is important to determine which is the best sequence used to represent a phrase of words in the summary sentence. Best sequence selection is a process to locate the locations of words in the original text and to identify the best sequence which represents phrases in the summary sentence. To reduce the number of possible sequences of words locations found in a text, we used a technique called *sequencing* in our algorithm. The technique sequences the words locations according to their sentence positions since a phrase (a group of words) usually comes from the same sentence in a text. Thus, reducing the number of space search in finding the best sequence to represent a phrase.

The algorithm of the process is as follows:

For each s_i,

1) Let m *be the number of words in* s_i.

2) Let p be the number of phrase in the s_i. *For p = 1,*

i. *For* s_{ij} *the* j^{th} *word in sentence* s_i, *locate the positions* (q_{ij_k}, r_{ij_k}) *of the same word in T; where* q_{ij_k} *is the sentence position and* r_{ij_k} *is the word position in T;* $k = 1(1)l$; x^l *- the number of times the same word is repeated in* T.

ii. *From these positions, determine the best sequence of locations of words to represent a phrase in* s_i:

a. *Sequencing the locations of words into sequences,* seq, *according to their sentence positions.*

b. *For each* seq,

i. *Let* n *be the number of words in the sequence.*

ii. *Compare the number of words,* m *in* s_i, *with the number of words,* n *in the sequence and calculate the difference between them where,*

$$diff = m - n$$

$$(if\ diff = 0\ then\ m = n;\ all\ the\ words\ in\ s_i\ are\ found\ in\ the\ sequence)$$

iii. *Calculate the average distance,* d, *among words in the sequence where,*

$$d = \sum_{j=1}^{n-1} (r_{ij+1} - r_{ij})/(n-1)$$

iv. *Categorize the sequence to word category,* w_{cat}, *according to their distance based on the finding (from the experiments on 29 summary sentences produced using deletion strategy) that a phrase is a group of words that acts as a unit in a sentence where the best distance is between 1.0 and 3.0:*

- $If\ d = 1, then\ w_{cat} = 0$

(The words are in adjacent positions)

- $If\ 1 < d \leq 3, then\ w_{cat} = 1$

(The words are closed and retain their orders as in the original document)

- $If\ -3 \leq d < 1, then\ w_{cat} = 2$

(The words are closed by but the order is reversed)

- $If\ d > 3\ or\ d < -3, then\ w_{cat} = 3$

(The words are far from each other)

3) Select the sequence with the smallest value for $diff$ *and* w_{cat} *to be the best sequence in* T *used to produce the phrase in the summary sentence.*
4) Using the best sequence, search the sentence, t_i*, in the original text that is used to produce* s_i*. Let l be the number of words in* t_i*.*
5) A summary sentence comprises one or multiple phrases which extracted from different sentences. Thus, check the value of diff. If $diff \neq 0$ *then from the positions of the remain words in the summary sentence, repeat Step 2 to determine the best sequence of words positions for the next phrase.*
6) Calculate the distance, d, between the sentence of the phrase found earlier with the sentence of each sequence to find the next phrase where,

$$d = q_{i+1j} - q_{ij}$$

7) Categorize the distance to sentence category, s_{cat}*, according to the finding (from the experiments on 47 summary sentences produced using sentence combination strategy) that a summary sentence is produced by sentences which are near to each other where the best distance is between 1.0 to 3.0:*

- $If\ d = 1, then\ s_{cat} = 0$

(The sentences are in adjacent positions)

- $If\ 1 < d \leq 3, then\ s_{cat} = 1$

(The sentences are near to each other and retain their orders as in the original document)

- $If\ -3 \leq d < 0,\ then\ s_{cat} = 2$

(The sentences are adjacent or near to each other but the order is reversed)

- $If\ d > 3\ or\ d < -3, then\ s_{cat} = 3$

(The sentences are far from each other)

8) Select the sequence with the smallest value for $diff$ *, w_category and s_category to be the best sequence used to produce the phrase in the summary sentence.*
9) If a phrase is found, increase the number of phrases where,

$$p = p + 1$$

10) Repeat Step 4 until $diff = 0$ *or no more phrase is found in* s_i*.*

4.2.2 Summarizing strategies identification algorithm

After the best sequence of words positions is selected, the next step is to identify the summarizing strategies used to produce the sequence. This process involved the use of the heuristic rules where these rules are transformed into an algorithm as presented below:

Let m be the number of words in s_i *and* l *the number of words in* t_i

Rule 1:

$If\ (m < l)\ and\ (w_{cat} = 0\ or\ 1)\ then$

Deletion strategy

Rule 2:

$If\ (m = l)\ and\ (w_{cat} = 2)\ then$

Syntactic transformation strategy

Rule 3:

$If\ (m < l)\ and\ (w_{cat} = 2)\ then$

Deletion + Syntactic transformation strategies

Rule 4:

$If\ (m = l)\ and\ (w_{cat} = 0)\ then$

Copy-paste strategy

Rule 5:

$If\ (s_{cat} = 0)\ or\ (s_{cat} = 1)\ then$

Sentence combination strategy

Rule 6:

$If\ (s_{cat} = 2)\ then$

Sentence reordering + sentence combination strategies

Given a summary sentence, s_i *where it comprises* p *phrases,*

If p = 1 then

Check for Rule 1, Rule 2, Rule 3 and Rule 4

If p > 1 then

Check for Rule 1, Rule 2, Rule 3, Rules 5 and Rule 6

5. Experiments

Consider a summary sentence consists of a phrase *"I started towards the shore"* where all the words are found in the original text which comprises 35 sentences. Each of the word is represented by their sentence position and word position, (q_{ij_k}, r_{ij_k}). However, most of the words occur more than once in the document as shown in Table 2 below. The common words like *'I'* was found in 30 locations and the word '*the'* occurs 29 times. The word *'shore'* was found in 6 locations while the words *'started'* and *'towards'* occur twice in the original text.

According to the possible sequence discussed in Section 4.1, the total number of the sequences for this summary sentence is 20880 (30 x 2 x 2 x 29 x 6). The best sequence is the sequence of the words positions in the original text which best used to represent the words in the summary sentence. To find the best sequence among all the possible sequences, sequencing method is used where the words locations are categorized according to their sentence positions, as shown in Table 3 below. Using the sequencing method, the number of possible sequences for this sentence, *k*, is 31 which has reduced the number of the search space to find the best sequence.

For each possible sequence, calculate the difference, *diff*, between the number of words in s_i, *m,* and the number of words in the sequence, *n,* where *m* is 5. Then, calculate the average distance, *d*, among words in the sequence and assign the *word category* according to their *d*, as shown in Table 4 below. However, some sequences like sequence 4, 6 and 7 have no distance since they only have one word position.

To select the best sequence among 31 sequences, choose the sequence which has the lowest *diff* and w_{cat}. In this example, the best sequence in *T* used to produce the phrase *"I started towards the shore"* is {(4 1) (4 2) (4 3) (4 4) (4 5)}. Using this sequence, the program searched the sentence in the original text used to produce the summary sentence. It indicates that the phrase is taken from the 4th sentence, *"I started towards the shore as I saw my father turned away"* in T where $\{s_{11}, s_{12}, s_{13}, s_{14}, s_{15}\} \equiv \{t_{41}, t_{42}, t_{43}, t_{44}, t_{45}\}$.

Since $\boldsymbol{diff = 0}$, the program stop searching for other phrase, thus, $\boldsymbol{p = 1}$. According to the algorithm, if $\boldsymbol{p = 1}$, then, the program checks for Rule 1, Rule 2, Rule 3 and Rule 4. However, before this can be done, the program needs to determine the number of words, $\boldsymbol{l}$, of the original sentence where in this case, $\boldsymbol{l = 12}$. Since it complies with Rule 1 where $\boldsymbol{m < l}$ and *w_cat = 0*, then it is found that the summary sentence *"I started towards the shore"* is produced from the original sentence *"I started towards the shore as I saw my father turned away*" using the deletion strategy.

6. Conclusion

This paper presents a development of an algorithm to identify students' summarizing strategies. The rules to identify the strategies are identified from the analysis of the experts' summaries and are translated into a set of heuristic rules. The result from the experiments shows that, the sentence decomposition algorithm can reduce the number of possible sequences using the sequencing method and consequently reduce the number of search space to find the best sequence. It also shows that the algorithm can be used to identify the summarizing strategy used to produce the summary sentence. This algorithm can be embedded in an educational application to help teachers identify the ability of their students in applying the strategies in summary writing.

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Table 1. A set of heuristic rules for identifying summarizing strategies

Strategy	**Heuristic Rules**
Deletion	s_i *is produced by deletion if:* • s_i *contains a phrase of words where these words,* ○ *are found in the same sentence,* t_k *in T* ○ *are located near to each other in T and retain their orders, where the average distance, d is* $1 \geq d \geq 3$ • *the number of words in* s_i *is less than* t_k
Sentence combination	s_i *is produced by sentence combination if:* • s_i *contains phrases of words which are found in different sentences in T where these sentences,* ○ *are adjacent or are located near to each other and retain their order where the distance between the sentences, d is* $1 \geq d \geq 3$ ○ *are combined using conjunction words or commas.*
Syntactic transformation	s_i *is produced by syntactic transformation if:* • s_i *contains a phrase where the words in the phrase,* ○ *are found in the same sentence,* t_k *in T* ○ *are located near but the order of the word position is reversed where the average distance, d is* $-3 \leq d < 1$
Sentence reordering	s_i *is produced by sentence reordering if:* • s_i *contains phrases of words which are found in different sentences in T where these sentences,* ○ *are adjacent or are located near to each other but the order of the sentence position is reversed where the distance between the sentences, d is* $-2 \leq d \leq -1$
Copy-paste	s_i *is produced by copy-paste if:* • *the words in* s_i *are found in the same sentence,* t_k *in T* • *the positions of the words in* s_i *are the same as in* t_k • *the number of word in* s_i *are equal to* t_k

Table 2. Words location in T

Words	*I*	*started*	*towards*	*the*	*shore*
(q_{ij}, r_{ij})	(1 3)	(4 2)	(4 3)	(1 9)	(1 15)
	(4 1)	(22 7)	(6 7)	(1 14)	(3 9)
	(4 7)			(3 8)	(4 5)
	(5 3)			(3 17)	(17 22)
	(6 1)			(4 4)	(22 5)
	(7 1)			(6 10)	(33 10)
	(8 1)			(6 14)	
	(9 5)			(9 19)	
	(10 2)			(10 7)	
	(10 19)			(10 13)	
	(11 1)			(12 12)	
	(12 2)			(13 2)	
	(14 5)			(13 8)	
	(15 1)			(14 10)	
	(16 2)			(17 6)	
	(18 15)			(17 16)	
	(23 2)			(17 21)	
	(23 4)			(18 12)	
	(24 1)			(19 5)	
	(25 6)			(21 10)	
	(25 11)			(25 2)	
	(28 3)			(25 16)	
	(28 7)			(26 6)	
	(30 2)			(27 7)	
	(31 1)			(27 10)	
	(31 9)			(29 2)	
	(33 1)			(30 18)	
	(34 1)			(31 4)	
	(35 7)			(33 4)	
	(35 9)				

Table 3. Sequencing the words locations according to sentences

k	q_{ij}	(q_{ij}, r_{ij})					n
1	1	(1 3)	(1 9)	(1 15)			3
2	4	(4 1)	(4 2)	(4 3)	(4 4)	(4 5)	5
3	4	(4 7)	(4 2)	(4 3)	(4 4)	(4 5)	5
4	5	(5 3)					1
5	6	(6 1)	(6 7)	(6 10)			3
6	7	(7 1)					1
7	8	(8 1)					1
8	9	(9 5)	(9 19)				2
9	10	(10 2)	(10 7)				2
10	10	(10 19)	(10 7)				2
11	11	(11 1)					1
12	12	(12 2)	(12 12)				2
13	14	(14 5)	(14 10)				2
14	15	(15 1)					1
15	16	(16 2)					1
16	18	(18 15)	(18 12)				2
17	23	(23 2)					1
18	23	(23 4)					1
19	24	(24 1)					1
20	25	(25 6)	(25 2)				2
21	25	(25 11)	(25 2)				2
22	28	(28 3)					1
23	28	(28 7)					1
24	30	(30 2)	(30 18)				2
25	31	(31 1)	(31 4)				2
26	31	(31 9)	(31 4)				2
27	32	(32 1)					1
28	33	(33 1)	(33 4)	(33 10)			3
29	34	(34 1)					1
30	35	(35 7)					1
31	35	(35 9)					1

Table 4. Classifying the sequences according to the *distance* and selecting the sequence according to the *diff* and *w_cat*

k	q_{ij}	(q_{ij}, r_{ij})					*diff* $(m-n)$	d	w_{cat}
1	1	(1 3)	(1 9)	(1 15)			2	6	3
2	4	(4 1)	(4 2)	(4 3)	(4 4)	(4 5)	0	1	0
3	4	(4 7)	(4 2)	(4 3)	(4 4)	(4 5)	0	-0.5	2
4	5	(5 3)					4	-	-
5	6	(6 1)	(6 7)	(6 10)			2	4.5	3
6	7	(7 1)					4	-	-
7	8	(8 1)					4	-	-
8	9	(9 5)	(9 19)				3	14	3
9	10	(10 2)	(10 7)				3	5	3
10	10	(10 19)	(10 7)				3	-12	3
11	11	(11 1)					4	-	-
12	12	(12 2)	(12 12)				3	10	3
13	14	(14 5)	(14 10)				3	5	3
14	15	(15 1)					4	-	-
15	16	(16 2)					4	-	-
16	18	(18 15)	(18 12)				3	-3	2
17	23	(23 2)					4	-	-
18	23	(23 4)					4	-	-
19	24	(24 1)					4	-	-
20	25	(25 6)	(25 2)				3	-4	3
21	25	(25 11)	(25 2)				3	-9	3
22	28	(28 3)					4	-	-
23	28	(28 7)					4	-	-
24	30	(30 2)	(30 18)				3	16	3
25	31	(31 1)	(31 4)				3	3	1
26	31	(31 9)	(31 4)				3	-5	3
27	32	(32 1)					4	-	-
28	33	(33 1)	(33 4)	(33 10)			2	4.5	3
29	34	(34 1)					4	-	-
30	35	(35 7)					4	-	-
31	35	(35 9)					4	-	-

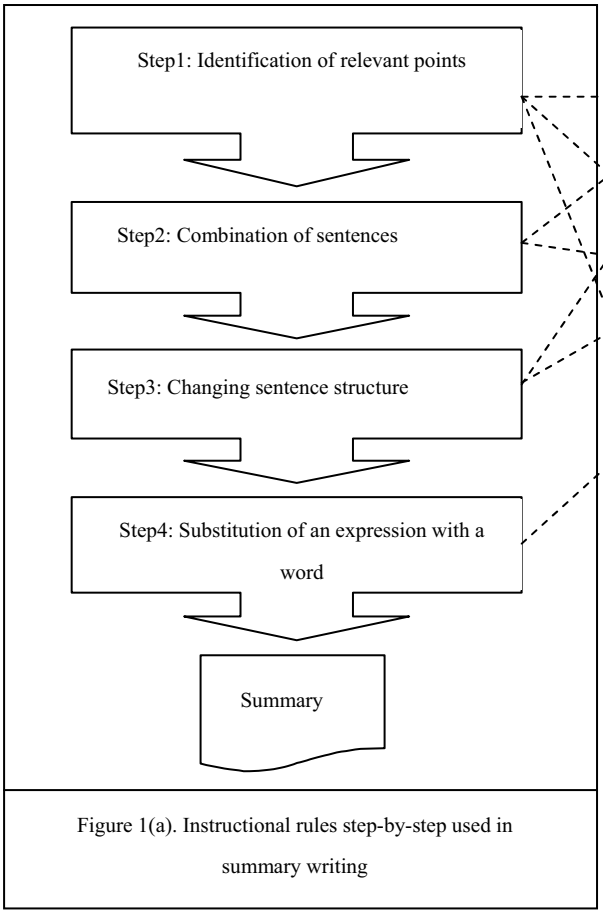

Figure 1(a). Instructional rules step-by-step used in summary writing

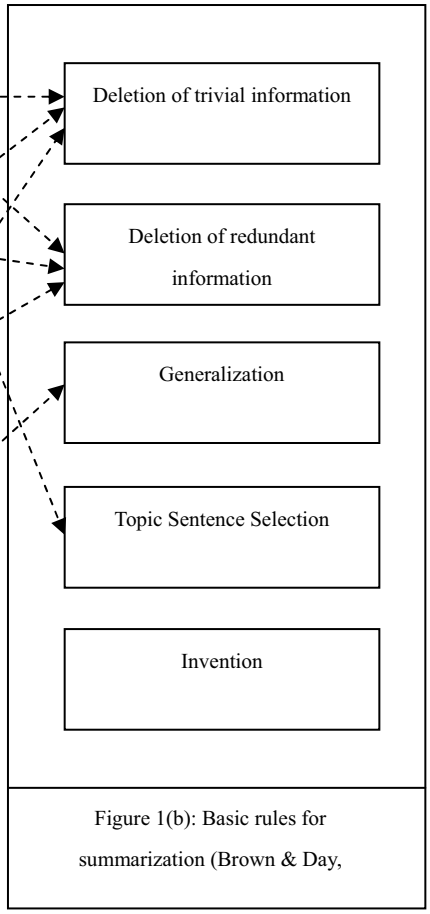

Figure 1(b): Basic rules for summarization (Brown & Day,

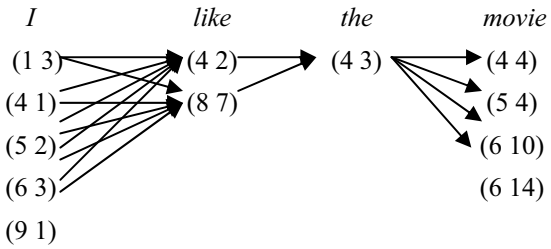

Figure 2. All possible sequences of words positions

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The Design of Intelligent Home Alarming System Based on Wireless Sensor Network Technology

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Abstract

Aiming at the characters of wireless sensor network and intelligent home alarming system, this article studied a sort of intelligent home alarming system based on wireless sensor network. Through establishing the structure frame of alarming system, in this article, we designed the sensor nodes of alarming system, put forward the hardware design methods of sensor nodes for the alarming system, designed the software of alarming system through the combination of software and hardware, adopted the license technology to enhance the security and veracity of the transmission of alarming information. The experiment indicated that the system had certain practical value because of its convenient operation and reliable stability.

Keywords: Wireless sensor network, Intelligent home, Alarming system, Nodes, CC2420

1. Introduction

Wireless sensor network centralizes the sensor technology, wireless communication technology and embedded computation technology, and it can perceive, supervise and collect information of perceptive object under various environments, and obtain exact information of perceptive object through the treatment of information. The wireless sensor network expands human ability to acquire information and connects physical information of objective world with transfer network, and it is applied not only in traditional network, but more in the occasions that the wire connection is unserviceable and the environment that people can not arrive. It has very extensive application foreground in many domains such as scientific research, environment supervision, intelligent home, medical supervision and control, traffic transfer, supervision of special goods, weapon equipment, agricultural breeding and industrial control (Huang, 2006, P. 621-624). With continual enhancement of human living level and the gradual increase of safety and prevention consciousness, people begin to put forward higher requirements for the home intelligence and security. As one important composing part of the intelligent home system, the performance of the alarming system directly influences the whole intelligent home system. To apply the wireless sensor network into the intelligent home alarming system and collect the environmental information of home through various sensors and transmit information to the home control center by the wireless mode could compensate the deficiency of wire equipment, and the wireless sensor network has many advantages such as cheap price, high reliability and easy emendation.

According to the characters of wireless sensor network and intelligent home, in this article, we put forward the project of the intelligent home alarming system based on wireless sensor network, and adopt the design of modularization to make it possess better transplanted property and expansibility.

2. Basic structure of intelligent home alarming system

Wireless sensor network (Egan, 2005, P. 14-19, Edgar, 2003, Zheng, 2005, P. 86-88, Wang, 2005, P. 59-62) is the network compose by many sensor nodes through the self-organization of wireless communication technology, and in the wireless sensor network system, every sensor node possesses the function of wireless communication, and the sensor unit of various measure points measures the parameter at the position and composes a wireless network and transmit the measured data to the monitor center by the wireless mode. The intelligent home alarming system based on wireless sensor network forms a wireless sensor network system composed by many sensor nodes including door magnetic switch, infrared sensor, fog sensor, gas leakage sensor and glass breaking alarm. In the alarming network, we adopt the star LAN structure which takes the wireless communication module connected with computer as the center node of the

network, and communicates with any one sensor node in the network, and the sensor node could measure and sample various parameters in the home environment and transmit the collected data to the center node, and analyze and treat the data and orders from center node, then complete corresponding operation. The basic structure of the intelligent home alarming system is seen in Figure 1.

The alarming system adopt star LAN structure which could better extend the combination, easily increase the node of sensor, fulfill the uncertainty of sensor node distribution in the home, avoid wireless interference and uncertainty of alarming area because the sensor could be placed in room and isolation places, and comprehensively treat the data transmitted by various sensor nodes to analyze whether to send out alarming signals. The system could reduce the misinformation of alarming system to some extent and enhance the reliability of wireless alarming system. In the alarming system network, the main function of sensor node is to collect data, and transmit the data to the center node of the network by the wireless mode, then the center node comprehensively disposals the data and decides whether to give an alarm.

3. Node design of sensor

The node of sensor is the basic unit and the basic platform to compose the intelligent home alarming system. In the design process of sensor node, we adopt following design principles. We adopt common apparatus to select the components and consider the compatibility and currency at the same time. And we analyze the structure of node and adopt the design of modularization to divide the function of various modules. The nodes of sensor is composed by four parts including data collection module, data processing module, wireless communication module and power supply module (Sun, 2005, P.245), and it structure is seen in Figure 2.

3.1 Module of data collection

The module of data collection is composed by a group of sensors and corresponding A/D converters, and it is in charge of the information collection of supervision area and the corresponding data conversion.

3.2 Module of data processing

The module of data processing is in charge of the control of all sensor nodes, and it is the core component of the wireless alarming sensor node. The sensor node needs to use a processor with low power and strong function, and it could implement data exchange with wireless communication module, realize the collection and disposal of data, save energy for the power supply, and manage the operation status and inspection of the whole sensor nodes. In the design of sensor node, the selection of processor is very important. The selection of the processor with low power mainly considers the work pressure of SCM, the low power mode and the decrease of exterior circuits. In this article, we select the SCM of MSP430 series made by TI Company (Lu, 2006, 130-133). The work pressure of MSP430 SCM is very wide, and it is in 1.8~3.6V, but the work pressure of most SCM is 5V, and the range is narrow, and SCM of MSP430 offers five sort of low power consumption modes to realize the low power consumption under various conditions. For the exterior apparatus, many chips of MSP430 integrate 12bits A/D modules and Flash memory units which could reduce the complexity of exterior circuit and the power consumption of the system. The processor of MSP430F149 is one typical processor in the series, and it possesses low consumption, and its pressure is in 1.8~3.6V, and it could run under the condition of 1MHz clock, and the current consumption is in 0.1~400mA. The power consumption of RAM is only 0.1mA under the power saving mode, and only 0.7mA under the waiting mode. It adopts 16RISC structure, and its abundant addressing modes, compact kernel order, higher processing speed, large numbers of registers and data memories make it possess strong processing ability, and abundant chip interior and exterior interfaces simplify the whole circuit and reduce the power consumption and volume of sensor nodes, and it is very fit for the nodes of wireless alarming sensor.

3.3 Module of wireless communication

The module of wireless communication is to implement wireless communication with other nodes, exchange control information and receive collected data, and the consumed energy of wireless communication is the main part of the whole power consumption of the wireless alarming network, so the selection of this module is very important for the design of low power consumption. The tuning mode, data rate, emission power and operation cycle adopted by the wireless receiving component are key factors to influence the energy consumption of communication. And when we select the wireless receiving chip, we should consider power consumption, emission power, receiver sensibility, quantity of exterior component needed by receiving chips and chip cost. CC2420 (Wang, 2005, P. 59-62) adopted in this article is the chip which is highly integrated by low cost and low power SCM according to the standard of IEEE802.15.4, and it works in the ISM frequency band of 2.4GHz, and it possesses 2MChips/s direct spread spectrum basic band modulator, 250kb/s effective data speed, and low current consumption, and it accords with the requirement of low power supply pressure which receiving pressure is 19.7mA and the transmitting pressure is 17.4mA. It could export power through programming and emit independent 128bits. The battery capacity of the data receiver buffer could be monitored, and the chip possesses good performance, and especially its very low current consumption could fulfill

characters such as small volume, low power consumption and low cost of wireless alarming sensor nodes.

3.4 Outline and consideration of sensor node design

The part of wireless communication is the emphasis and difficulty of sensor node design and it is the key to design the alarming system. Main problems and solutions in the design process of sensor node include that the carrier waver frequency of CC2420 is 2.4GHz, and when increasing a channel in every 5MHz, the accuracy of crystal oscillator will influence the frequency of carrier wave and the establishment and stability of communication. CC2420 requires the precision of clock source is in ±40×10. If the exterior crystal oscillator is used, we should try to use four-foot parcel crystal oscillator with high precision and stable performance. The radio-circuit of CC2420 works in the high frequency band of 2.4000~ 2.4835GHz and the design of anti-jamming directly influences the radio-frequency and the running of all sensor nodes. When implementing wiring for the wireless communication, it is necessary to adopt reasonable wiring and multiplayer, and it is also the effective measure to enhance the ability of anti-jamming and reduce the electromagnetic jamming. The wiring needs concerning that the area that the wireless communication circuit which is not used for wiring should be filled by coppers and connected to the earth in order to offer RF screen and achieve the attention of effective anti-jamming, and the bottom of CC2420chip should connect with the earth, and many earthing poles should be used to connect with the bottom of CC2420 and the earth layer in order to reduce the delay series-wound interference and ensure the transmission of high frequency signal, and the apparatus should be distributed surround CC2420 and use small encapsulation to reduce series-wound interference and the influence of distribution parameters possibly.

4. Design of system software

In the intelligent home alarming system, we adopt the mechanisms of center node cycle inquiry and prominent event report. The center node will emit the parameter orders to every sensor node in certain time, and after the sensor node receives the parameter orders, they will emit data to the central node back. If emergent event happens, the sensor node could actively send report to the central node which will disposal the report and send out corresponding alarming information. The center node could set up the threshold value of sensor node to fulfill different users' requirements. In the intelligent home alarming system, every sensor node has a fixed address, and most transfer data are short messages, the formats of information include frame head, destination address, data size, data content and parity bit. The sensor node opens the power supply, initialize, establish the link and directly enter into the mode of dormancy, and when the center node receives the alarming intermitting request of sensor nodes, it will touch off the intermission, activate the sensor node to receive the bag of alarming information, then continue to enter into the dormancy after disposal, and wait to activate the sensor node again when the alarming intermitting request occurs. If there are many sensor nodes send alarming intermitting requests at the same time to the center node, and the center node will lose some requests because it is too late to treat, and after few seconds that the sensor node finds its request is not responded, it will send the request again until the center node responds. The sensor node adopts the series-communication mode. In the design of program, we mainly adopt the method of intermission to complete the receiving and sending of data, and the program flow of sensor nodes is seen in Figure 3.

The alarming information of the intelligent home alarming system easily makes mistakes in the process of transmission, and because there are many interference sources in the home, so the transmission of information is easy to be interfered, and the key to ensure the reliable running of intelligent home alarming network is the exact transmission of alarming information. In the intelligent home alarming system, two dangers will occur when nodes transfer information each other and one is how the receiver confirms whether the information is from the exact transmitter, and the other is how the transmitter confirms whether the information arrive to exact receiver, and doesn't be received by other nodes. According to the characters of wireless sensor network, we adopt the license technology to ensure the exact transmission of information (Wu, 2005, P. 753-755 & Gong, 2004, P. 15-18). License is a data structure, and it includes the information, limitation, class, keys and other information of sensor node, and it is used to confirm the ID information, operation limitation, and necessary keys for the sensor node. There are three parts including the creation of license, the resolution and usage of license, and the memory and management of license for the usage of license. The alarming information transfer process in the intelligent home alarming system network adopting the license technology includes three approaches.

(1) The sensor node sends information with the information of the equipment to the center node.

(2) After the center node receives information, it memorizes the information and the equipment information of sensor node in a buffer area first, then compares the node information of sensor node with the interview limitation in the local memory to confirm whether the sensor node have right to send information to the center node.

(3) If the sensor node is the node which has right to send information, so the center node receives the information form the sensor node, and sends the feedback information of "exact receiving" to the sensor node. If the sensor node is the sending node without authorization, the center node will reject receiving the information and empty the buffer area. The

license technology could ensure that the alarming information arrive the center node safely and effectively.

5. Conclusions

According to the characters of wireless sensor network and intelligent home, we design a sort of wireless alarming system based on wireless sensor network in this article. The wireless alarming system could supervise the safety environment of the whole home real time, and the range of the supervision includes room guard against theft, fire alarming, gas leakage, water pipe cracking and a series of unsafe factors. Once above accidents happen, the alarming system will send out corresponding alarming information, and the householder could immediately adopt effective emergency measures to treat the accident when he obtains alarming information. We establish a little alarming system to make the experiment, and the result indicates that the alarming system based on wireless sensor network possesses higher communication efficiency and better stable reliability.

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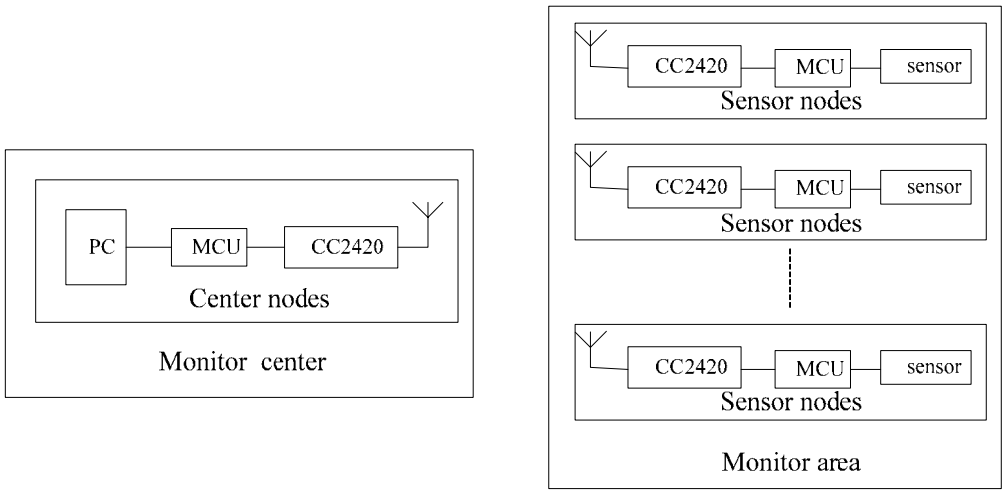

Figure 1. Intelligent Home Alarming System

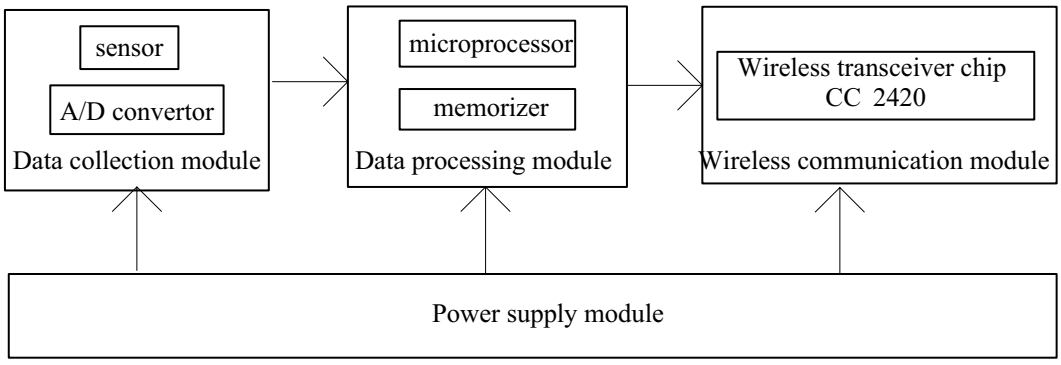

Figure 2. Structure of Sensor Nodes

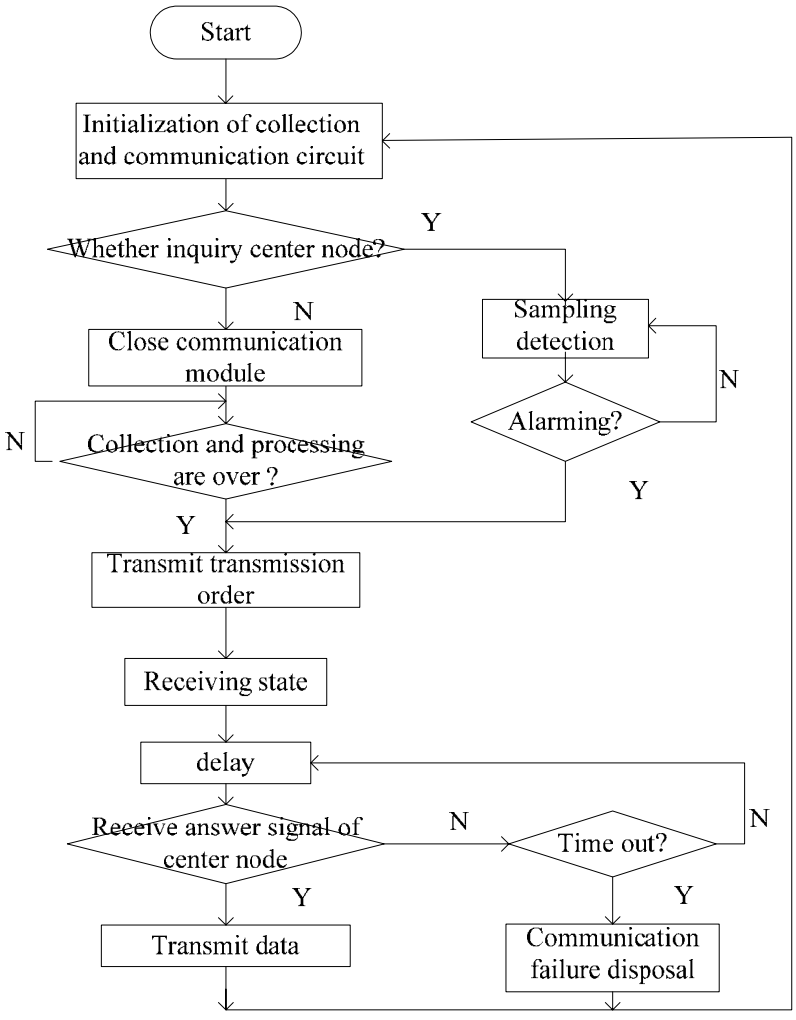

Figure 3. Flow of Sensor Nodes

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