The Research of Internet-based Robot Design Platform

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Abstract

A robot design platform is built to integrate human resources and projects resources. It can achieve cooperative and parallel development. The platform includes project management, human resource management, requirement management and other modules. Framework proposed in this paper is that the foundation for the development platform.

Keywords: Robot design, Project management, Platform

1. Prefaces

The main parts of robot system include mechanical movement part, sensor control circuit parts and software program. The design of these parts combines mechanical, electronic, software and other subjects. With the increasing development of robot technology, and the continued popularity of industrial robot, the University is also gradually developing a variety of robot teaching subjects, and creative design activities of robots by students are on the rise. The design process of the robot is like the traditional mechanical and electrical products, as well as to normalization, standardization and matured.

As robot system involves many different disciplines, the design will be divided into a number of specific design problems. This requires different areas of knowledge and experience of staff. More importantly, we need a platform to coordinate the design tasks of different people. And in the traditional CAD, more people use the method of serial iteration, so can't effectively deal with the problem of parallel collaborative design for the designers of the different areas. Since coordination between the design procedures of the distribution implementation is not enough, it easily leads to design defects or the hidden trouble, making design changes late larger and longer development cycle. So it is necessary to co-design approach for robot system development process.

2. Overall System Architecture

Each module of the platform and their relationships are shown in figure 1. The project is a starting point on the platform. Creating the project must be approved. Then creator and administrators can recruit necessary members by searching human resource management system. Registered users of the platform can also search their interested projects and apply to join the team. This is interaction between project management module and human resource management module. So you can clearly know the project's members or which project someone joins in.

We should determine requirements of the project after it was created, such as size requirements, function and parameters of the robot or its parts. Also we need to make the schedule and description of the skill requirements for members.

According to the structure of the robot, the requirement will be resolved into three main parts: the robot's PDM, circuit Design and control Software. These three parts have their own management modules. The parameters and performance of these parts are further detail of requirements, and also preliminary design scheme. Manufacturing process is an important part for the robot from design to product. So we set is as a separate management module.

In the process of executing project and designing mechanism, circuits, control software, there will bring a series of document. These documents are unified classified, stored, and managed by the document management module. They can be called by every module in need.

The process of projects accumulation on the platform is also the process of accumulation of knowledge. Knowledge is contributed through induction and collation by project members during the process of executing project. This knowledge will form a knowledge base of the platform. The knowledge base services users on the platform, and then provides them with knowledge retrieval and access.

3 Function of Each Module

3.1 Project Management

As most current robot system design is organized by the project. So the platform provides a collaborative environment to each R & D team with project management approach. The modules of project management are shown in figure 2.

a) Member management of project: Relying on a project to achieve the integration of human resources.

b) Workflow and task management of project: Together to develop short-term tasks and milestones for robots R & D. The module can subdivide task and then assign, track and coordinate them.

c) Project progress tracking and rights management: It is easier for project managers and participants to see the progress in real time. Rights management can manage the openness of the contents of different projects.

3.2 Requirement Management

This module management robot design requirements. The relations are shown in figure 3. From the initial requirements content of the project, to the requirements changes during process, requirements content is connected with the appropriate projects or products, spare parts. It formed many demand-oriented components. The way of splitting the product into components is conducive for the robot R & D. It can improve the efficiency of robot development through requirements analysis and quick access to existing components.

After the task was split, project members can search the component database to find the same or similar function components and use them directly or for reference. Then they can reduce the development effort. During the process of project, the requirements changes will be recorded and tracked. These changes become feedback for task. So the managers can adjust the task content or release a new one.

3.3 Robot Product Data Management (PDM)

This module manages the robot system components, including mechanical systems, circuit control system, and the standard parts. The relations are shown in figure 4.

a) Parts data management: Including parts property configuration, related drawings or documents, and searching parts according to parameters.

b) Robot bill of materials management: According to the robot composition, its BOM list can set up in the system, and carry out version management.

c) Standard parts library management: Establishment of standard parts library can facilitate the selection of standard parts.

3.4 Manufacturing Process Management

This module manages the robot manufacturing processes. The relations are shown in figure 5.

a) The basic process establishment: Establishing the basic process for the robot parts manufacturing.

b) Process flow management: We use the basic process to create each process flow of the component. To build basic process, we need to confirm appropriate requirements of the process parameters. When the parts have been designed over, the system can export process files for the factory to make the parts.

3.5 Circuit Design Management

This module manages the drawings and function definitions of robot control circuit. The relations are shown in figure 6. According to function definitions, you should split a variety of robot circuit into modules by category.

The input, output, main electronic components used, module circuit drawings, and the detailed documentation of each module will be saved and accumulated on the platform, then they can be queried and called. If necessary, you can build the circuit BOM structure by management of module assembly.

Circuit design uses a similar approach to BOM structure of mechanical parts. Electronic components use the data of standard parts library. When you build basic circuit components, you should define input and output parameters and provide circuit drawings. Through these processes, we can later retrieve the circuit module by functions and parameters. This design approach by searching components database can reduce the design effort.

3.6 Control Software Management

The platform stores robot system control software by category on the base of function definition and manages the source codes by version control. The platform provides a unified source code library. So users can design program cooperating with others on the platform.

3.7 Drawings and Document Management

This module manages all the document of projects.

a) Version control of document: Through this module, you can access the historical versions of each file.

b) Browsing the document online: This module provides online browsing capabilities for document and drawings.

c) Access permissions control: The platform prevents document leakage by setting access permission to them.

3.8 Knowledge Management

This module manages robot knowledge with wiki form. Learning materials and experiences accumulated during the development of robot will be sorted. This knowledge is contributed by all members of the platform and shared free for everyone. The knowledge exchange can be enhanced through knowledge management, and then the platform will form multiple knowledge bases.

3.9 Human Resource Management

This module manages all human resources which are gathered on the platform.

a) The person's registration information: Registered users on the platform can maintain their registration information by this module. This information is the base of platform human resource.

b) Human resource excavation: As the projects continue to run on the platform, the ability information of users and projects information will be accumulated.

4. Conclusions

The robot design platform will integrate all the necessary resources together to achieve efficient resource utilization, and allows people in different regions together with a platform for robotics research and development to complete the project. Platform to meet operating needs for a long time to complete, this framework only from the platform to discuss, there are more details to consider.

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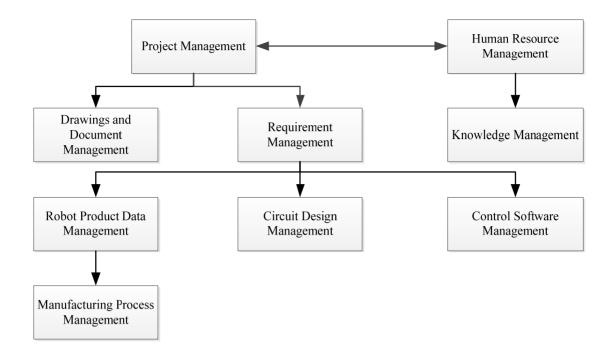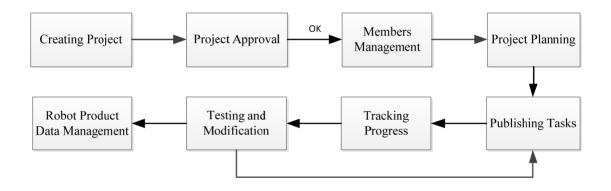
Figure 1. The modules and their relationships

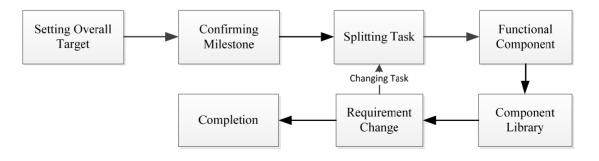Figure 2. Content of project management
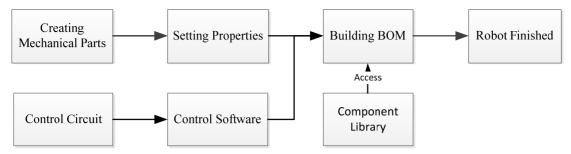

Figure 3. Content of requirement management

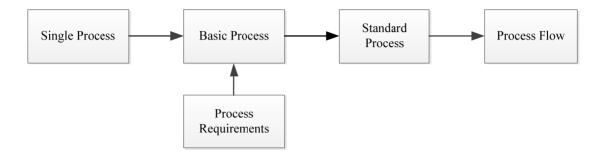Figure 4. Content of robot product data management (PDM)
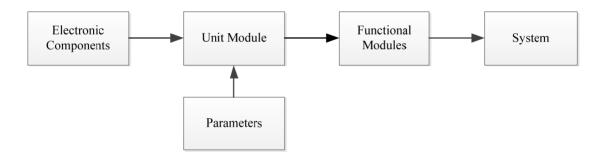
Figure 5. Content of manufacturing process management

Figure 6. Content of circuit design management