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Design and Implementation of Visual Robot Mission Planning

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Abstract. The mission planning system (MPS) has become more prevalent as a high-level reasoning tool in real robotic systems. This paper analyzes the research prospects of MPS and presents the implementation of the core functions of MPS including Socket communication module, client module, server module, program construction method and mission planning module. This paper uses java based socket communication model to achieve two-way communication robot functions, robot task resolution, scheduling and exception handling. This paper also implements a task planner for an instance of shutting down the lights. After the simulation and testing of the system, it reveals that the robots are able to complete the mission and perform task decomposition and scheduling very effectively.

1. Introduction

AI intelligent robots are the hottest topic in the scientific and technological world and the future development direction of the country. Many Internet technology companies such as Baidu, Google and Tencent have joined the AI intelligent robot competition [1]. Its core function is to realize the interactive communication between humans and robots, so that the robot can plan and execute the missions it issues. For artificial intelligence, there is a great deal of support for the future. Whether in smart cars, smart homes or smart services have a lot of room for development [2] [8]. Perhaps in the near future, artificial intelligence will become the object that people rely on, just as the Chinese rely on WeChat communication, it will be an indispensable part. As the most important thing at this stage is the development environment. The government can strongly support to promote the development of artificial intelligence, speed up the implementation of relevant policies and for the testing environment. Fortunately, artificial intelligence robots have been written into government work reports for several consecutive years and have become a national strategic development direction [3]. Countries in the future will also strengthen the research and applications of artificial intelligence, and the progress of service industry, financial industry, education, cultural and sports development.

From the perspective of interactive communication, Socket communication module is used to complete the robot's mission planning, thus achieving interactive communication of the robot, i.e., reading, scheduling, and processing tasks. The task environment is set in the home, similar to domestic service. According to the robot structure, a perception module, a movement module, and a joint module are constructed. The perception module is equivalent to the human eye and directs the route planning. The movement module is equivalent to the human thigh. The sensor module guides the robot to the designated location. The joint module is equivalent to the human arm and is the core module for performing tasks [4] [5].

The programming tool used in the Socket communication module is Eclipse and the Java development environment is JDK1.8. Because Eclipse is a java-based scalable multi-development platform, it is easy to use and uses less computer resources. And because it has a high degree of development, developers are free to change the current development environment through plug-ins. Java is used as a development language because it is a comprehensive command-control language, has a complete data type and provides mechanisms for encapsulating and hiding information on the objects of the class. Java is widely used in the program circle, which is conducive to the future expansion and improvement of the system.

In 2014, China exceeded the US with citation of the journal articles mentioning “deep learning” or “deep neural networks”. In 2015, 43% of AI related papers were published with one or more Chinese Authors. Some leading Chinese companies such as Baidu, Tencent, DiDi Chuxing are responsible for the much of the research progress in AI. Furthermore, China has become the second largest AI network in the world. AI intelligent robots are the hottest topic in the scientific and technological world and the future development direction of the country. Many Internet technology companies such as Baidu, Google and Tencent have joined the AI intelligent robot competition. Artificial intelligence robots have been written into government work reports for several consecutive years and have become a national strategic development direction [6].

China is competing itself much more ahead in AI. Now from agriculture to healthcare to commerce everywhere, Artificial Intelligence is making the basic structure better and better.

2. System design

In this system, the Socket communication module is used to make the server to wait until it is started, until the client's TCP sends a communication request and it receives a communication request using ServerSocket.accept() [7]. Once the TCP signal is captured, the client service thread is assigned to the TCP connection using the ServerSocket.accept () function. After the connection is established, the server and the client can communicate with each other. Fig. 1 shows the flow of the connection between the client and server.

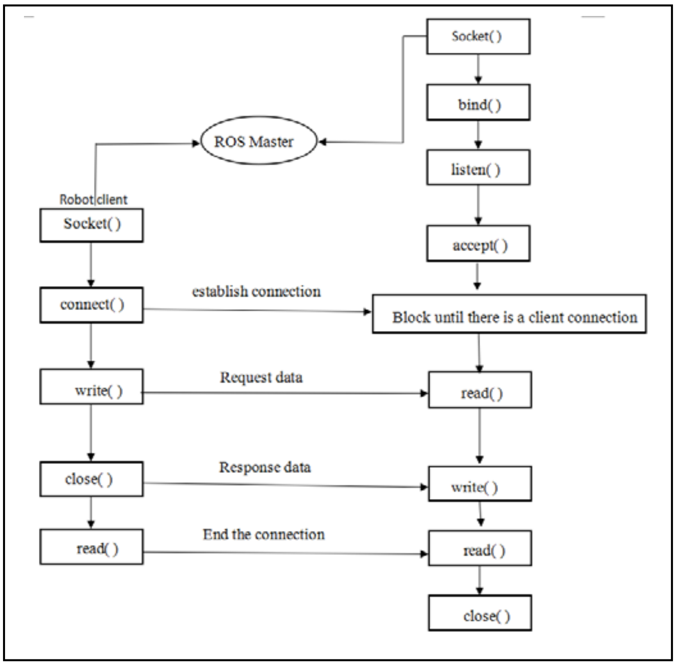

Figure 1. Program simulation

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In the entire system, there are human-machine interaction modules, task planning modules, client modules and a server. First, the server module connects the IP address and the server communication port. After all the modules are started, the human-machine interaction module sends commands to the task planning module. The task planning module breaks the task into multiple sub-tasks. After that, the task planning module sends the sub-task to the client that will perform this sub-task (in this system, the first sub-task is sent to the sensing module uniformly). After the perception module receives the task, it begins to execute the task. Once the task is successfully executed, it is fed back to the task planning module “sub-task execution is successful”. Then, the task planning module sends the second sub-task to the client that will perform the task, and repeats the above process until all the sub-tasks are executed successfully, and "OK!" is displayed. During the entire process, the server module will receive all the task execution status. If an exception occurs during the execution of the task, it will feedback the abnormal condition.

3. Experiments and analysis

The three main methods used in this system are getInputStream, getOutputStream, and InputStreamReader. Through task decomposition, the task sequence is resolved and the number of required sub-tasks is recorded. After all sub-tasks are resolved, the first sub-task is issued.

Then the human-computer interaction module sends the command to the task planning module through task scheduling as shown in Fig. 2.

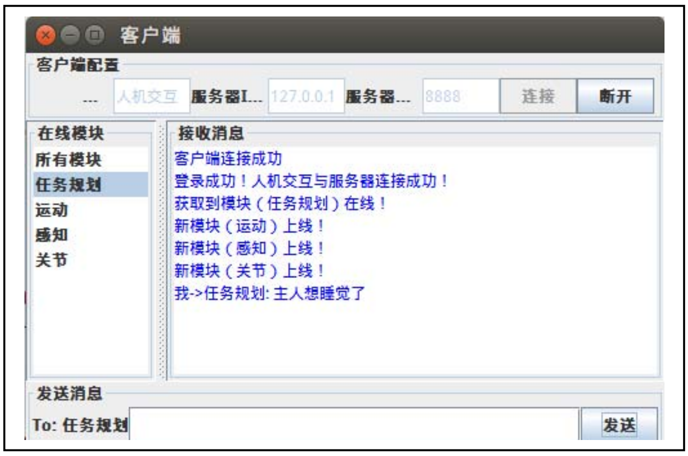

Figure 2. Issuing a task command

The task planning module breaks down the received task into multiple sub-tasks as shown in Fig. 3.

Figure 3. Task decomposition

After that, the task planning module sends the sub-task to the client that will perform this sub-task (in this system, the first sub-task is sent to the sensing module uniformly). After the perception module receives the task, it begins to execute the task as shown in Fig. 4.

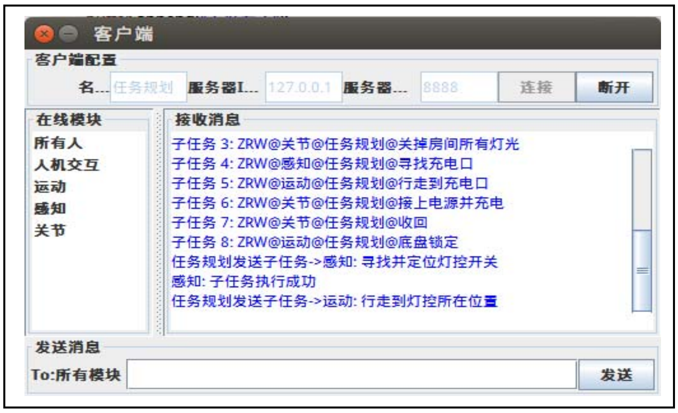

Figure 4. Task scheduling feedback

Once the task is successfully executed, it is fed back to the task planning module “sub-task execution is successful” as shown in Fig. 5.

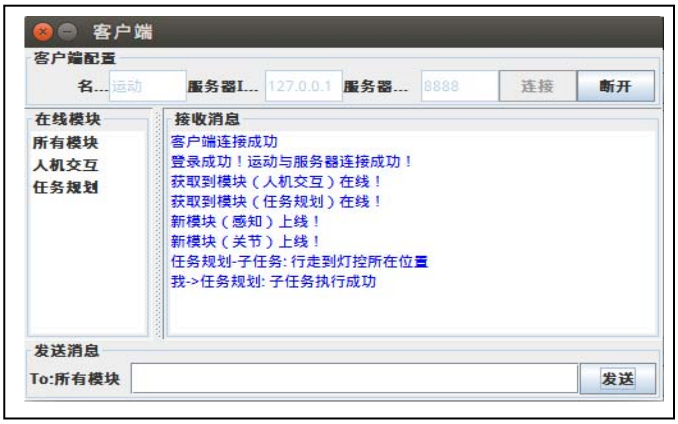

Figure 5. Sub-task executed successfully

Then, the task planning module sends the second sub-task to the client that will perform the task, and repeats the above process until all the sub-tasks are executed successfully as shown in Fig. 6 (a, b).

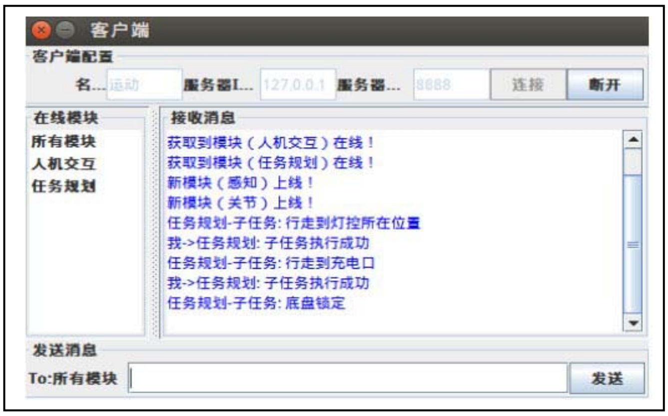

Figure 6. (A) Sub-task execution

Figure 6. (B) Sub-task execution

Fig. 7 shows the end of task feedback with the “OK!” status.

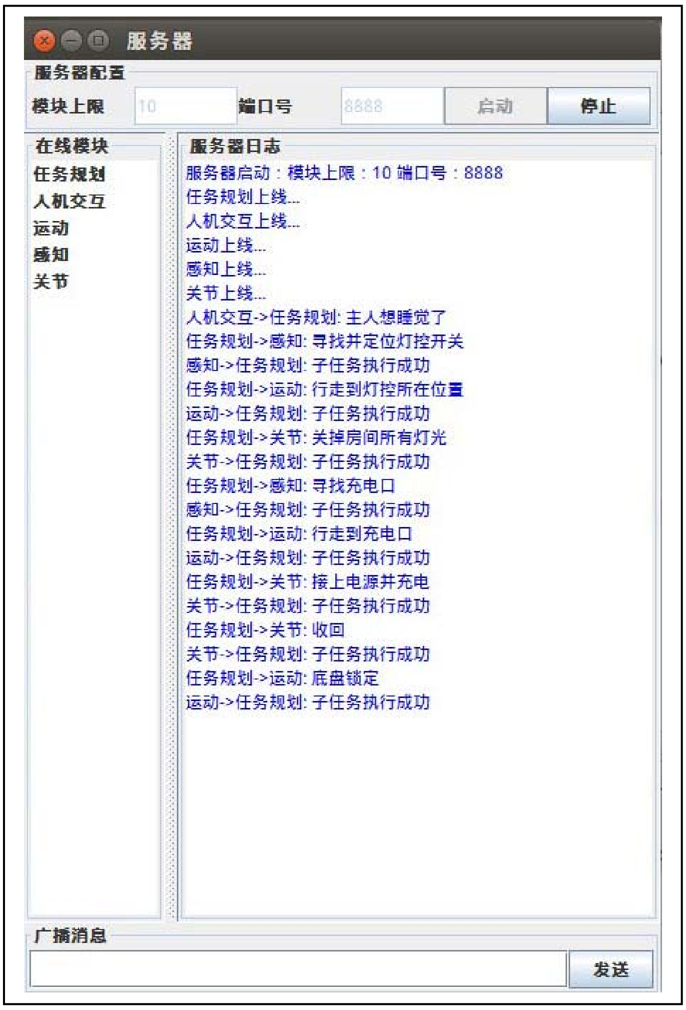

Figure 7. End of task feedback

4. Conclusion

Robot's mission planning has always been one of the core contents of robot research. This paper presents a mission planner for shutting down the lights through the implementation of the core functions of MPS including Socket communication module, client module, server module, program construction method and mission planning module. The experiments successfully verify that mission for shutting down lights is well completed.

Acknowledgments

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