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# Design of Identifying and Provision System of Chess Playing Robot

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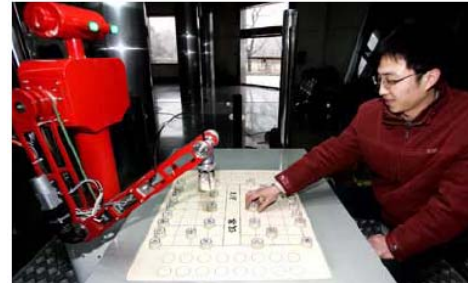
**Abstract.** More and more research on the chess playing robot carried out currently, which focus on the Renju and Chinese chess and so on, a new humanoid chess playing robot constructed in this paper differ from the traditional industrial robot based simple structure chess playing robot, it can deal with two Renju game and one Chinese chess game together, position of chess on the chessboard confirmed by vision identify. Automatic chess identifying and provision system assembled on both Renju and Chinese chess system, after the game over, chessboard overturn firstly, division realized one by one through transmission device and color sensor, chess transmitted to the distribution square, regular array on level plane and vertical lift achieved with three transmission devices perpendicular to each other, chess send to chess playing platform one by one then. Function realization and working principle and construction design of the whole system described clearly by making use of flow chart and solid building, foundation established for later manufacturing and research.

## 1. Introduction

Game is a collective name of all kinds of chess games, such as Go Chess, Chinese Chess, Krieg spiel, Renju, Othello chess, and so on. People's research on game algorithm has been deepened and have developed many games with high "chess power" [1]. In May 1997, IBM's "deep blue" supercomputer first defeated the world champion Gary Kasparov at chess. But "deep blue" is just a supercomputer, which is only responsible for strategy calculation, not a robot. In recent years, there are mainly two kinds of chess robots: Many chesses playing robots designed for interest or competition are mainly based on students [2], as show in Fig. 1. This type of robot has a low intelligence and a simple mechanism design, another type of chess playing robot that aims to study artificial intelligence algorithms is mainly based on the development of universities and research institutions, as shown in Fig. 2. This kind of robot intelligence degree is relatively high, and the computer chess calculation algorithm is generally required, so the overall volume is generally relatively large, and it is generally used for exhibitions or science and technology museums. This paper designs an automatic chess identifying and provision system that can simultaneously deal with two Renju game and one Chinese



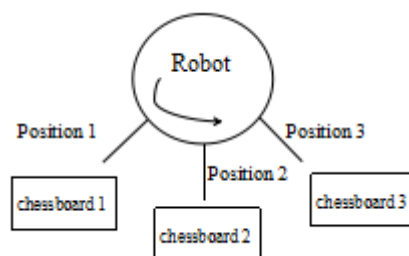
chess game. The purpose is to develop a chess playing robot product that can enter people's lives for the future. Function realization, working principle and construction design of the whole system are described in detail in this paper.



**Figure 1.** A Renju robot playing chess with people. **Figure 2.** A chess robot playing chess with people.

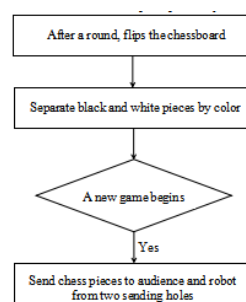
## 2. Design of Robot System

The robot plays chess with three audiences at the same time, as shown in Fig. 3, the chessboard 1 and the board 3 are arranged with Gobang chess, and the board 2 is played with Chinese chess. The robot uses one hand (right hand) to play chess simultaneously with one to three audiences and responds to the start request of three chess games in real time and switches the working status between one and three chess games.

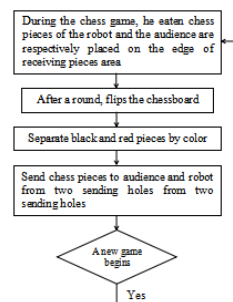


**Figure 3.** Three working positions of the robot.

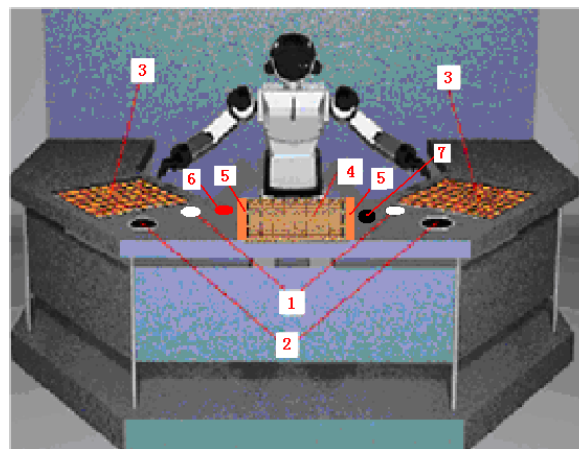
Robots rely on electromagnetic devices at the end of the arm to attract or drop pieces. Sending and receiving chess pieces of Gobang chess and Chinese chess are completed as shown in Fig. 4 and Fig. 5.



**Figure 4.** Sending and receiving chess pieces of Gobang chess



**Figure 5.** Sending and receiving chess pieces of Chinese chess



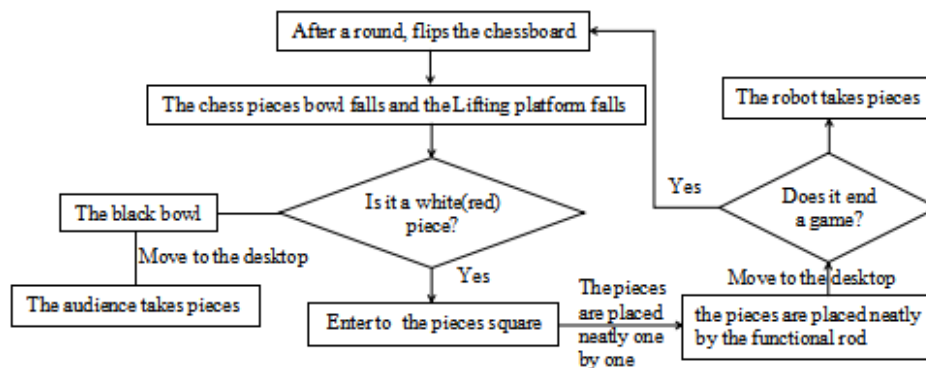
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|---|--|
| 1. The sending pieces hole of white chess pieces  | 2. The sending pieces hole of black chess pieces         |
| 3. The chessboard of Gobang chess                 | 4. The chessboard of Chinese chess                       |
| 5. The chessboard's edge of receiving pieces area | 6. The sending pieces hole of red Chinese chess pieces   |
|   | 7. The sending pieces hole of black Chinese chess pieces |

**Figure 6.** A final assembly diagram of the chess playing robot system.

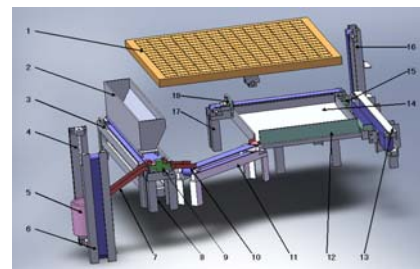
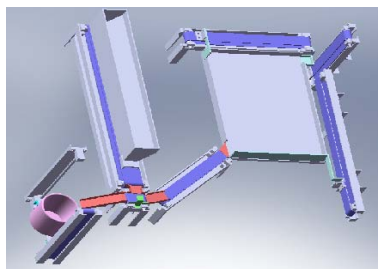
The robot has a cartoon shape, and its arms and body can move flexibly. The chess playing robot should have three key subsystems corresponding to it, namely visual identification, chess algorithm and manipulator, and complete three functions of “watching”, “thinking” and “moving” respectively. The schematic diagram of the final assembly of the chess playing robot is designed, as shown in Fig. 6.

### 3. Design of Identifying and Provision System

When the audience and the robot finish a game, the audience or the robot can press the identifying button [4]. The design process of the identifying and provision system are shown in Fig. 7 and Fig. 8.



**Figure 7.** The design process diagram of the identifying and provision system.



(a) The entity assembly drawing of identifying and provision (b) The entity assembly drawing of identifying and provision system and flipping the chessboard

1.Chessboard 2.Chessboard collection slot 3.The conveyor belt of chess pieces 4.The linear bearing bracket of pieces bowl 5.The pieces bowl 6.The conveyor belt of pieces bowl 7.Sliding board 8.The sorting conveyor belt 9.The bracket of color sensor 10.Sliding board 11.The conveyor belt of chess pieces 12.A functional rod that collate the pieces 13.The conveyor belt that collate the pieces 14.Chessboard Square 15.Chess pieces lifting platform 16.The conveyor belt of lifting platform 17.The conveyor belt of pushing pieces 18.The pushing functional rod 19.Sliding board

**Figure 8.** The entity composition diagram of identifying and provision system.

The process of identifying and provision system is as follows:

When a chess game is finished, press the identifying button and the chessboard tilts  $20^\circ$ , then it will pour all the black and white chessmen fall into the collection slot.

2. The conveyor belt 3 starts to run, and the pieces are transported out of the slot one by one. When transported to the conveyor belt 5, the conveyor belt sensor starts to detect whether it is the white (red) piece. If it is the white (red) piece, the piece will enter the right slide; if it is black, the piece will be sent to the left slide and the piece can fall directly into the chess piece bowl.

3. The white (red) piece is sent into the conveyor belt 6, and the pieces will enter the chessboard square one by one, after all the pieces enter, the shovel plate 7 shovels all the pieces to the innermost side, so the pieces are arranged neatly in the chessboard square.

4. After the chess is neatly placed, If the robot needs a chess piece, the shovel plate 10 can shovels the chess pieces into the lifting platform one by one. After a row of pieces is used up, the shovel plate 7 advances the pieces by the length of one piece, and the white (red) pieces are sent to the desktop one by one.

#### 4. Conclusion

This paper presents the design of identifying and provision system for the complex three-simultaneous chess playing robot systems, it has realized the functions of automatic rewinding, automatic sorting, and automatic transmission, ensuring that the chess playing robot can entertain and play with the audience in an orderly manner. The robot developed by this project can complete the entire process from reading chess to calculating chess to fetching and playing chess. It is a gambling robot that can play chess face to face with people in real sense. There are still some problems in the production process, reliability and appearance of the system, which will be gradually solved in the next step. In the future, we will focus on the deeply research on game algorithms to develop more interactive and highly intelligent game robots. With the continuous development of such subjects as computers, artificial intelligence and robotics, the development of more chess robots that can be used for course teaching, live demonstrations, and entertainment companionship will have a broad space, and also have certain market demands and research values.

#### Acknowledgments

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