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Research Article

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An intelligent flight chess robot design and implementation

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ABSTRACT

The field of education and entertainment for robotic applications, in order to better take into account the robot teaching and entertaining, intelligent flight chess developed a robot system. The system consists of two robots and a dice composition for the control of robot AT89S52 microcontroller core, using NRF24L01 wireless module for communication between the robot and the dice, dice AT89S52 through detection ADXL345 three-axis sensor module to control the corresponding points robot motion. Experimental results show that at a given flight chess drawings, two robots are able to move according to the dice points to the corresponding position, to achieve the ultimate game, the system can be applied to areas such as education and entertainment and so on.

Key words: Robot, Flight Chess, Three-axis Acceleration

INTRODUCTION

Dual function of both study and entertainment electronic toys popular with the children, today's science and technology as yesterday's rock and roll: Most of the parents, even their claim is cool, also can't keep up with the trend. Nowadays, people have found a balance between technology and entertainment in the new technology products. Many high-tech products are particularly popular with children and young people, as they adapt to their lifestyle, needs, and teach them how to integrate with the growing electronic world [1]. However we are familiar with this kind of toy of flight chess. So we can broaden thinking, combined with the existing single chip microcomputer technology, voice broadcast technology, wireless communication technology to make this game into electronic toys. There are such high demand of product, for example, football robot, intelligent chess robot, go bang robot etc. Not only need image recognition, processing, algorithm, and the cost is very high. In the field of current education and entertainment is difficult to get promotion and popularization [2,4]. Not only need to design simple smart board device, but also the development of low price. This design can also carry voice module simulation dialogue scenes when people play chess. Therefore, how to do intelligent chess robot can give attention to both teaching and entertainment become the intelligent robot is an important research direction in the field of study.

THE SYSTEM DESIGN

Intelligent flight chess robot system consists of two robots and a dice. System block diagram is shown in Fig.1. The robot is mainly composed of AT89S52 controller, WT588D voice module, NRF24L01 wireless module,5v and 3.3v regulated power supply module, steering gear module. Flight chess board drawings as shown in Fig.2, two robots after power are separated on the diagonal of the "starting", within the dice by AT89S52 single chip microcomputer reading three-axis accelerometer data and converting into six-sided values, and then through the wireless module is sent to the robot, two robots in turn receive dice data automatically after walking is the number of corresponding board and send the dice numerical to another robot. Throw the dice again, another robot then receive dice data. The robot is a black line between the tube by infrared detection grid to calculate the number. Robot know each other's position, if a robot in the "stop", has made a robot throw two dice and walk two steps. When the robot walking in the

grid, constantly testing on both sides of the black line and adjusting the robot walks on the grid. Until there is a robot to reach the finish line first.

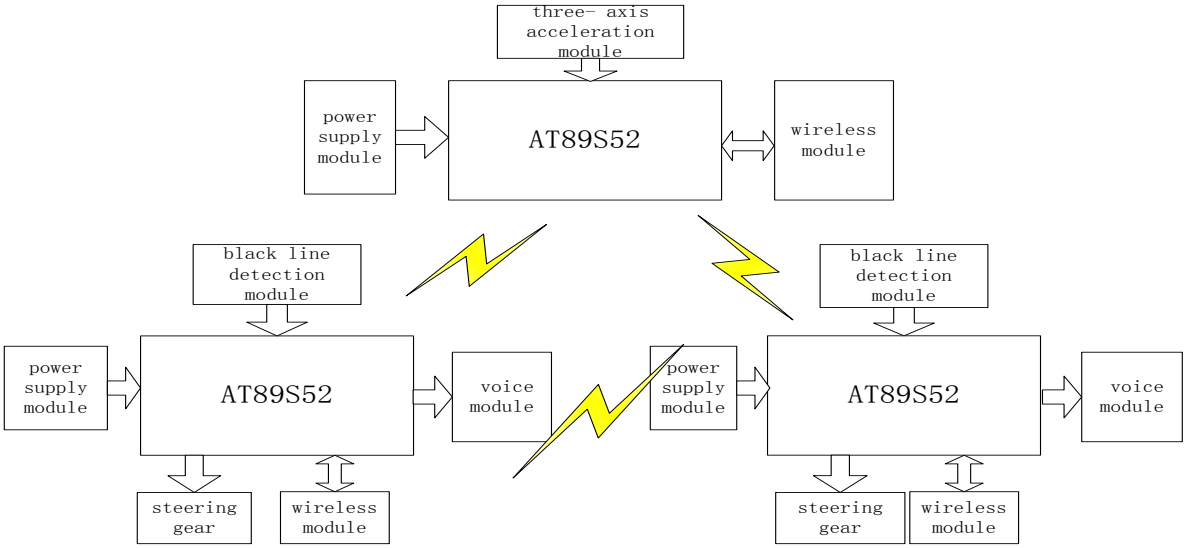

Fig. 1. System Structure

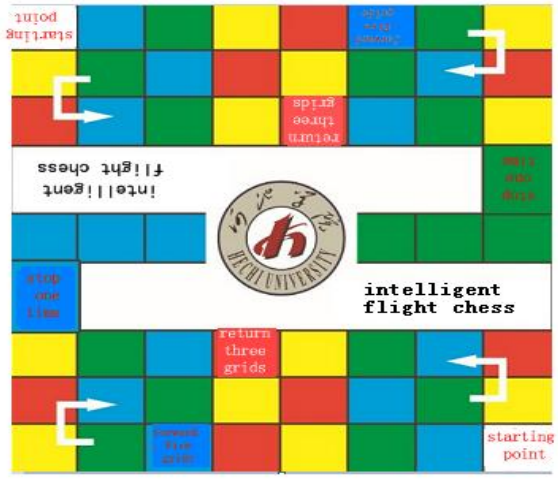

Fig. 2. Flight Chess Board

HARDWARE DESIGN

Whether the system can operate steadily or not is based on the hardware design. The robot part is designed by using AT89S52 as its master controller, NRF24L01 as the communication interface, WT588D module to conduct voice broadcast, NE555 to modulate 38KHZ signal for transmitting circuits and HS-38B for receiving circuits to detect the black line, and using a servo as the drive. In order to detect the six faces of the dice, the dice part should be made up of AT89S52 as master controller, NRF24L01 as the communication interface, and three-axis acceleration sensor.

The Robot Hardware Design

Taking the cost of the robot into account, the robot can be designed with a piece of CCL (copper-clad plate) as the car-frame, and two servos and a universal wheel as the car-body. In order to make the robot rotate 90 degrees around the corner, a servo should be chosen, instead of a DC motor. And a 7.4V lithium battery should be as power supply, because it is small in size and can continue to be used after changing. The schematic of the circuit is shown in Fig. 3.

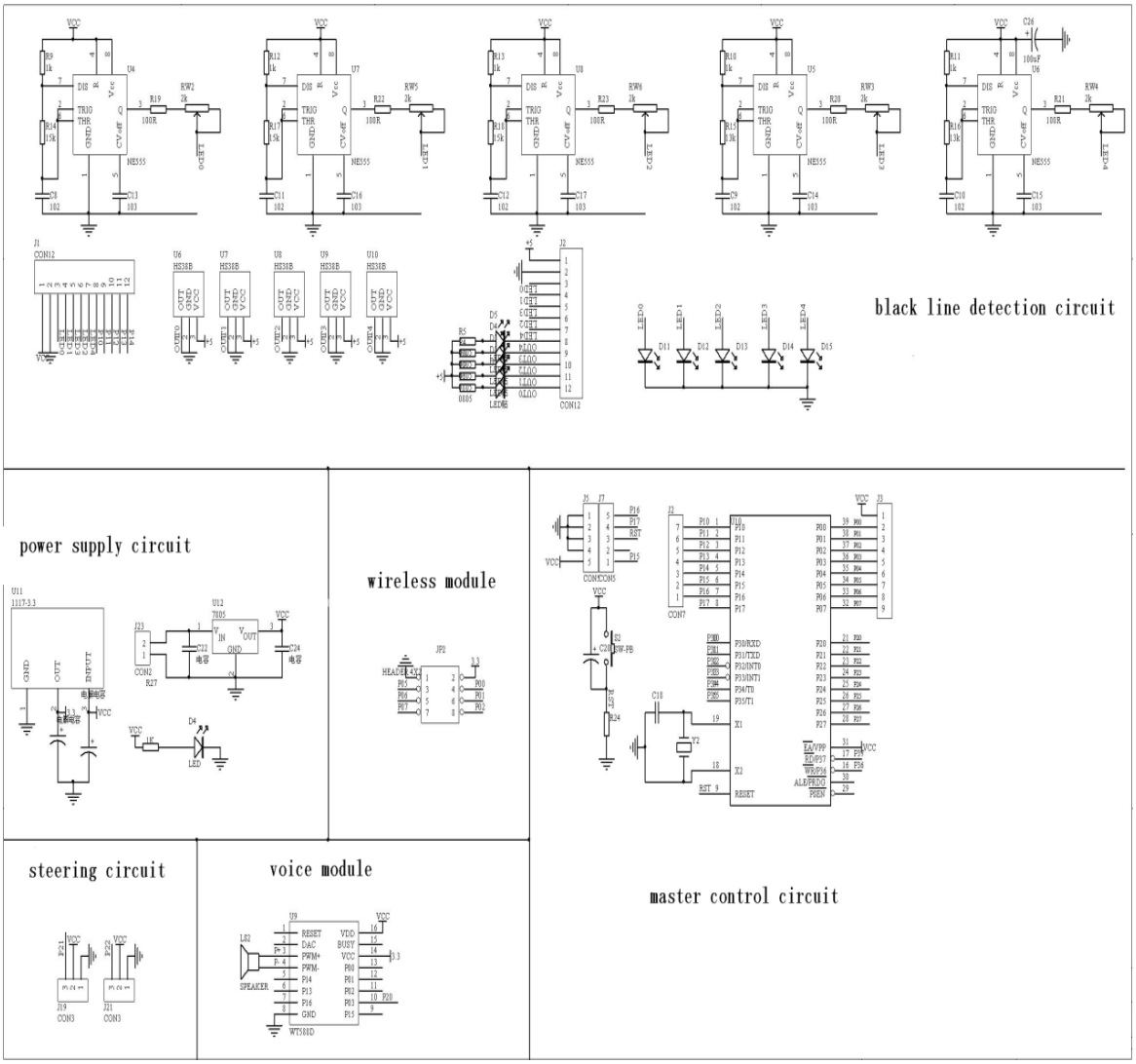

Fig. 3. The Whole Principle Diagram of Robot

Black line Detection Circuit

The circuit mainly works by NE555 producing about 38KHZ premature beat to infrared emission tube D15. If HS-38B receives infrared light, OUT pin will be of high level. However, the transmitted infrared light will be absorbed when the robot meets the black line. Thus, HS-38B can not receive signal, and OUT pin changes into low level. Accordingly, the black line can be detected. The Schematic diagram is shown in Fig.3. The distribution of infrared sensor is shown in Fig.4, among which the first sensor and second sensor are mainly responsible for detecting the black line of two sides (left and right) and making sure that the robot will always stay within the bound when moving forward. While the major function of the third sensor is to detect bars, and the fourth and fifth sensor is to detect the black line of both sides when drawing back.

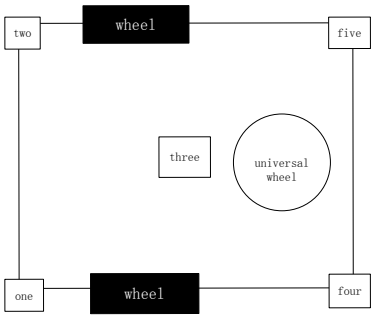

Fig. 4. Sensor Distribution Diagram

Power Supply Design

The voltage regulator circuitry uses a 7.4v lithium polymer battery, the 5V output voltage from 7805 is supplied to the single chip, the servo, and the infrared transceiver circuit, and the 3.3V output voltage from LM1117-3.3 to the voice module and the wireless module .The schematic of the power module is shown in Fig.3.

Wireless Module

NRF24L01 is a 2.4G band wireless module, which is characterized with low cost, low power consumption, high transmission rate, its simple software design, and the stable and reliable communication [5]. The wireless module circuit is shown in Fig. 3.

Voice Module

WT588D is a kind of a single voice chip, produced by Guangzhou Wei chong electronic co., LTD. It is powerful in functions and can be repeatedly erasable and programmed. With WT588D, a voice chip is no need to find any peripheral single-chip circuits as its controlled manner, for the highly integrated single-chip technology can be sufficient to replace the complex peripheral control circuit [6]. One-line serial mode is used for the design, so only a data cable can conduct the operation. The voice module circuit is shown in Fig. 3.

Dice Hardware Design

Dice use ADXL345 triaxial acceleration sensor to identify which face up. ADXL345 is the three-axis digital acceleration sensor of ADI company, is mainly used in consumer electronic micro inertial device, perceived 16g maximum acceleration,sensing accuracy up to 3.9mg/LSB, Angle measurement typical error is less than 1 degree [7]. The principle of dice is that AT89S52 read the value of X, Y, Z axis in which ADXL345 master controller module, dice number is 1 when defining the X, Y, Z values of the acceleration is 1g, 0,0, dice number is 2 when defining the X, Y, Z values of the acceleration is 0,1g,0, dice number is 3 when defining the X, Y, Z values of the acceleration is 0,0,1g, dice number is 4 when defining the X, Y, Z values of the acceleration is 0,0,-1g, dice number is 5 when defining the X, Y, Z values of the acceleration is 0,-1g,0, dice number is 6 when defining the X, Y, Z values of the acceleration is -1g,0,0, thus, the dice corresponds to one of 1 to 6 when going to a positive value, then sending the data through wireless module. The overall schematic diagram of dice shown in Fig. 5.

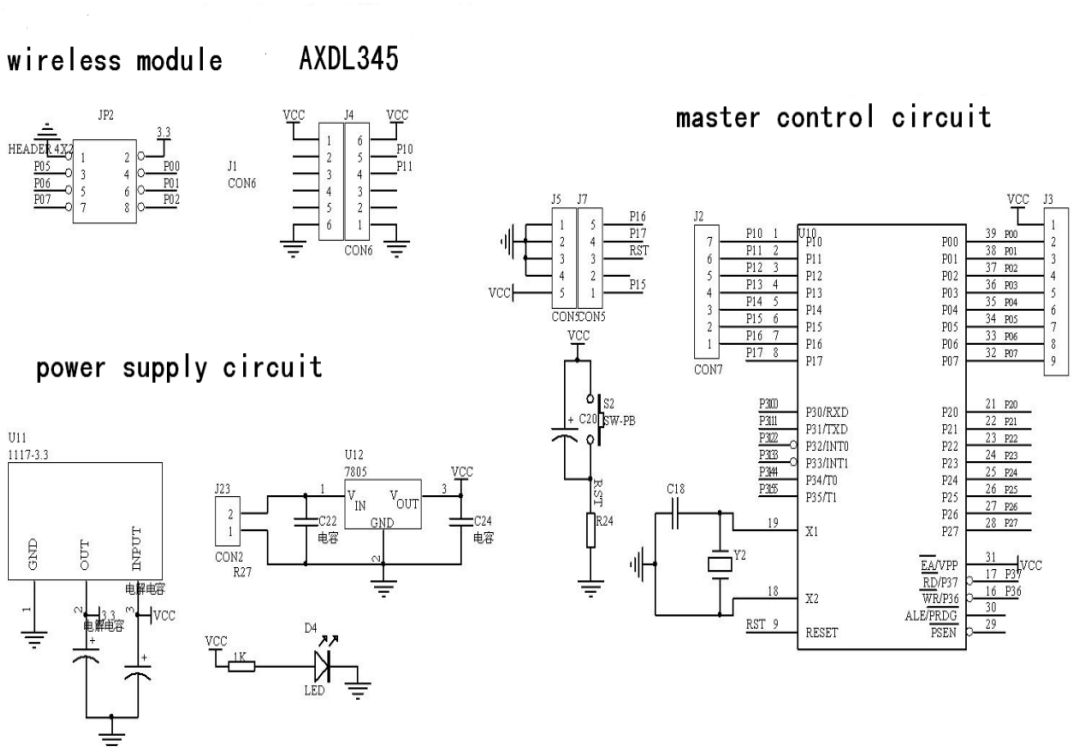

Fig. 5. The Overall Schematic of Dice

SOFTWARE DESIGN

(1) Robot A programming mainly implements : initialization module, After receiving dice number voice broadcast dice the number corresponding to the number of cells and then walking, during walking continuously detect and adjust the position of the black line, and then sending the dice data to the robot B, then wait for robot B to send data back. Until the side walk to the end. Robot A program flow chart shown in Fig. 6.

(2) Robot B programming mainly implements: initialize the wireless module, and then wait for robot A to send data to come over, then wait for coming data after people throwing dice, after how much voice broadcast, walking to the corresponding position of the board, and then send data to robot A, waiting for robot A to send data back, until one coming to an end when ending. Robot B program flow chart shown in Fig. 6.

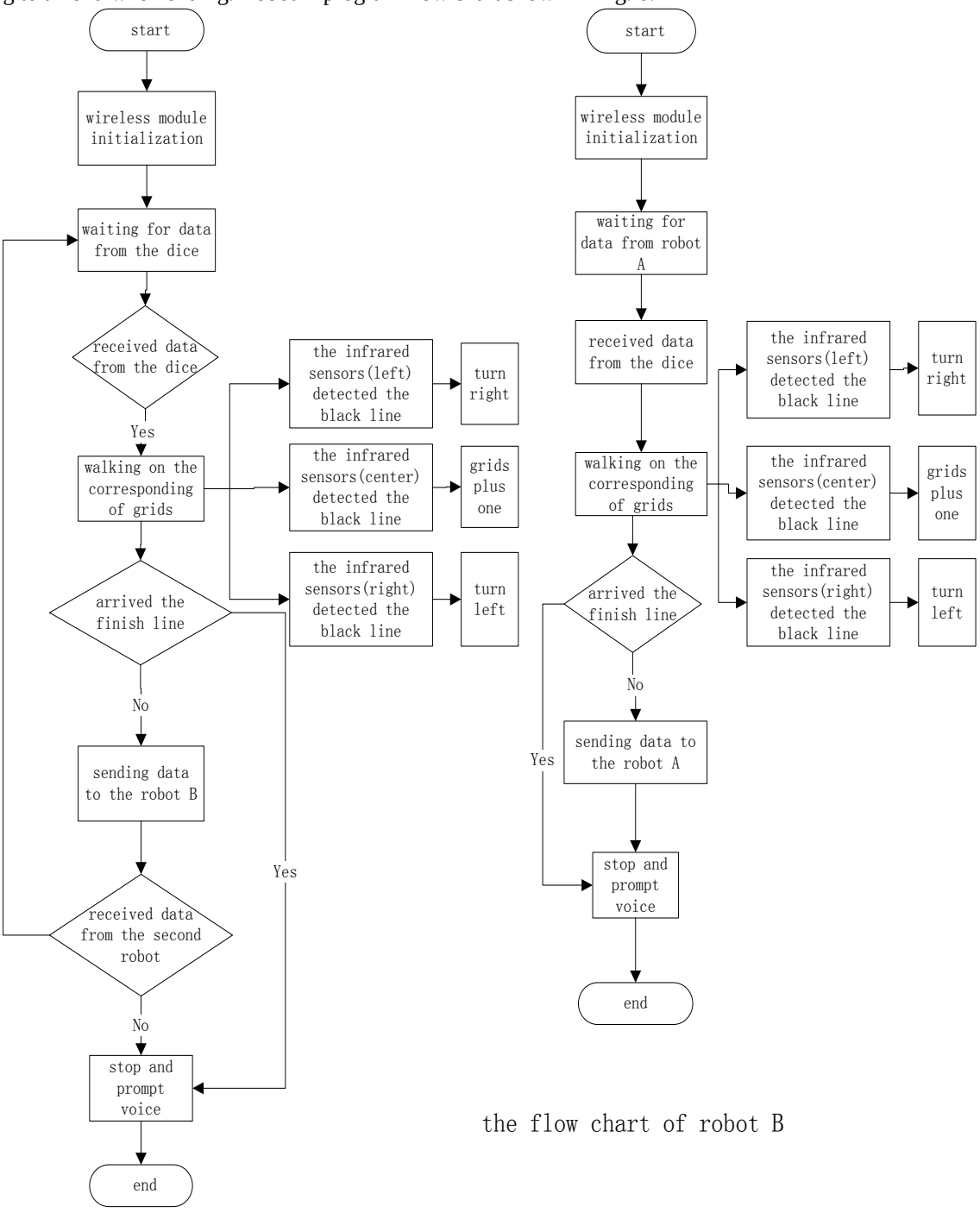

Fig. 6. Robot Program Flow Chart

(3) Dice programming mainly implements : Initialization ADXL345 sensor, and then constantly read values from the ADXL345 triaxial accelerometer, determining whether dice is a face-up and then sent out from the wireless module to the robot A and B. Dice program flow chart shown in Fig. 7.

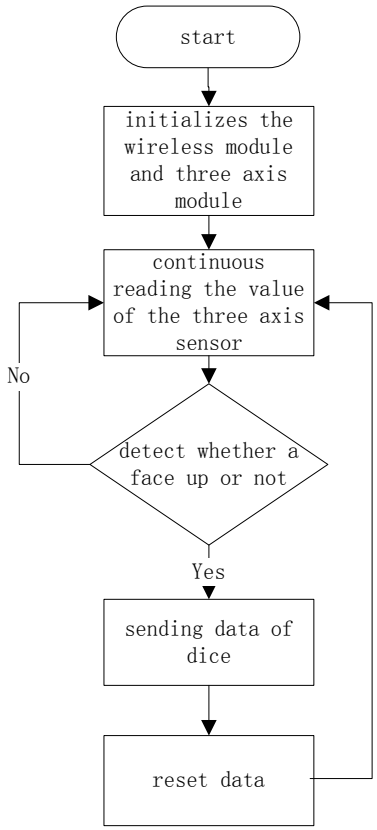

Fig. 7. Dice Program Flow Chart

TESTING RESULTS AND ANALYSIS

It is found that the robot cannot receive data and step out of the grid sometimes after having tested several times, and now the analytical and countermeasure will be offered as follows.

(1) In the aspect of wireless telecommunications. Data were found missing during the experimental process, which can be solved by sending two NRF24L01 modules frequently or avoiding sending them simultaneously.

(2) In the aspect of testing the black wire. As the robot moves forward, the black wire can be sensed by the left infrared sensor ,if the robot turns right slightly,picture8will be the movement of the robot from A to B; when the black wire comes into the field of the infrared sensor in the right with the robot moving to the left a little bit, C to D is the movement of the robot in picture8;and if the Middle sensor can detect the black wire, at this time, shows that the robot has already moved to the next grid ,illustrated by D in picture 8.Besides, the interference of the outside light will result in the inaccuracy of the test. While this can be solved by using opaque objects to keep away the penetration of the outside light and adjusting the efficiency of the launching conduit .In order to keep the robot to walk steadily within the grid and avoid such problems as it will turn left and right frequently ,we can adjust the electronic pulse of the actuator so as to make the robot to turn ninety angle as much as possible when it comes to the turning and keep the two actuators working at the same speed. All of these will make sure that the robot is not so easily to step out of the field in which it ought to be. And the test and the adjustment of the black wire can be well illustrated by Fig. 8.

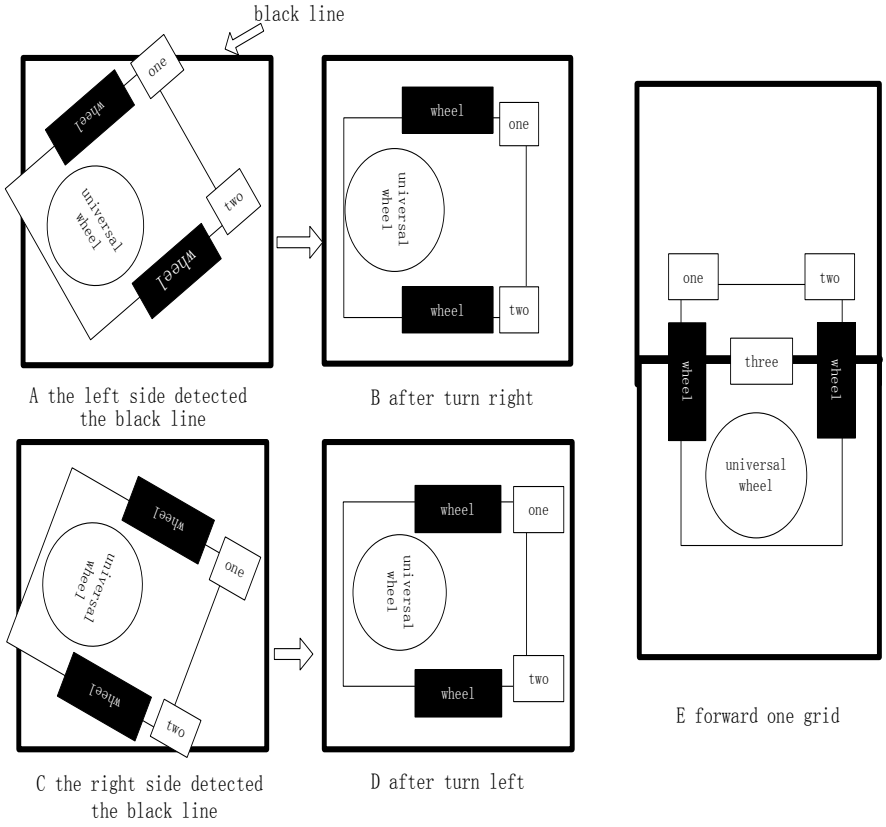

Fig. 8. Black Line Detection and Adjusting Map

CONCLUSION

All the functions of the design are implemented, can stability walk on the grid, stability to send and receive data, automatically detect whether dice had been thrown. Robot should be combined with real life, let it do more for us, we need more such interesting designs to arouse our interest in robots. Not only design can be used in children's educational toys, but also can be used in the direction of the electronic teaching platform, DIY design, etc.

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