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DEVELOPMENT OF AN EXPLORING ROBOT TO SOLVE MAZES

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Abstract*- Now-a-days exploring robot is being used to solve maze using obstacle avoiding mechanism. To solve the maze is not the only purpose of this kind of explorer robot; also it can be used for some purposes which might be very dangerous for human. Recently in Afghanistan this type of robots are using to detect land-mine. Considering the fact robot is made. The main objective of the study is to design and develop an exploring robot which solves mazes. The robot performed well as programmed and navigated through the maze. It moved from starting point to the end point of the maze without conflicting with the walls. IR sensor were used in this project, instead of IR sensors here ultrasonic sensors, image sensors of black and white or color sensors can be used. A video camera and image processing software can be used to sense the color if any particular obstacle and the robot will become more intelligent. The significance of this effort is in the increased understanding of obstacle avoidance for robot control and the applications of autonomous guided vehicle technology for industry, defense and medicine.*

Keywords: Maze, Mobile Robot, Intelligence, Infrared sensors, OAmps

1. INTRODUCTION

A maze is a tour puzzle in the form of a complex branching passage through which the solver must find a route. In everyday speech, both maze and labyrinth denote a complex and confusing series of pathways, but technically the maze is distinguished from the labyrinth, as the labyrinth has a single through-route with twists and turns but without branches, and is not designed to be as difficult to navigate[1]. The pathways and walls in a maze or labyrinth are fixed (pre-determined) – puzzles where the walls and paths can change during the game are categorized as tour puzzles. Now-a-days explore mobile robot is being used to solve maze using obstacle avoiding mechanism. To solve the maze is not the only purpose of this kind of explorer robot; also we can use it for mankind. We can use it in some purposes which might be very dangerous for human. Recently in Afghanistan this type of robots is using to detect land-mine. Taking this matter under consideration the project is made[4].

Autonomous mobile explorer robots seem a very suitable application for searching anti-personnel landmines[2]. However, several factors make this application very difficult: the terrain is often impracticable for wheeled robots (such as tall vegetation on abandoned fields), there are not yet powerful mine sensors available, and an almost systematic search is required to guarantee that no landmines are left behind. Recently[3], a legged water-proof robot has been developed for landmines positioned on the surf zone, which is a rather regular and terrain[5].

A dynamic approach to behavior-based robotics proposed in [7], [8], models the behavior of a mobile robot as a non-linear dynamic system. The direction to the goal is set as a stable equilibrium point of this system while the obstacles impose an unstable equilibrium point of this non-linear dynamics. The combination of both steers the robot to the goal while avoiding obstacles.

2. DEVELOPMENT OF THE MAZE

The total maze was built by using cork sheets. Each piece of the maze structure was cut from cork sheet of 20 cm height and length as needed (Fig. 1). Then those pieces of cork sheet were connected using mask tape. Masking tape is a type of pressure sensitive tape made of a thin and easy-to-tear paper, and an easily released pressure sensitive adhesive.

Fig. 1: Structure of the Maze

Two walls were gapped about 40 cm, so the robot can easily navigate through it. Though two walls were made of cork sheets and it was very light, so both walls were needed to be fixed on the floor. For this reason mask tape was used to fix two walls on the floor. IR sensors are very sensitive with color, so white cork sheets were used for better refection.

3. CONSTRUCTION OF THE ROBOT

The robot consists of two systems: Electrical and mechanical.

3.1 Electrical System

Mother of motion is electrical and electronic systems. Robotics means motion and information about environment and decision making about the situation. The motion produced by electrical equipment, which are, in this case controlled by electronic system and introduction between motion system and environment is done by sensors.

3.2 Mechanical System

The physical system is the base of the robot which uses DC motor with wheels. DC motors are specially situated with gears, so external gears are not needed. A wheel is fitted on the shaft of the gear. Two wheels are not attached with each other, so they can easily move with their own rotation. Gears are only attached to increase torque.

During robot moving, the obstacle is detected by the four sensors, infrared sensor. Here these sensors give input signal to the controlling unit (i.e., PIC16F73 microcontroller). According to the input signal coming from these sensors, the controller unit interrupts the drive unit. Drive unit is fitted in the vehicle to drive the mobile platform. The driving unit works according to the signal form the controller unit. Then the vehicle moves left, right, front or back based on the obstacle detected by the sensor.

3.3 Development of the Robot

First a plastic sheet was chosen to build the structure of the robot. The plastic sheet was cut into a rectangular shape, 15 cm length and 10 cm width, for the base of the body. Then two DC motors with gear and wheel is attached to both sides of the front portion and a caster is placed at the back portion of the base. Two sensors attached base made of plastic sheet, one is front side sensors base and another back side sensors base, is placed at the front and back portion of the base respectively.

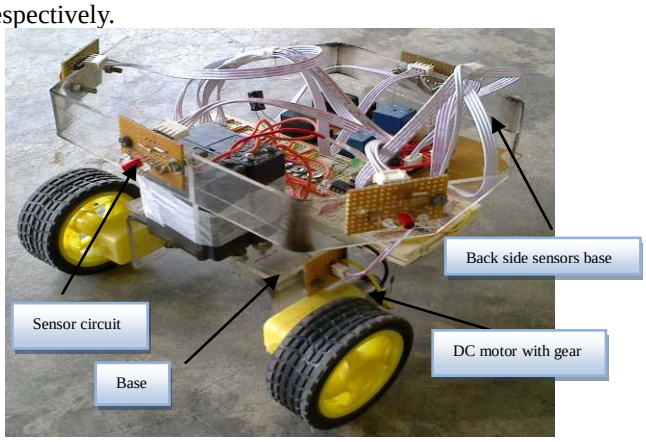

Fig.2: total robot setup

Front side sensors base contains three sensor circuits and back side sensor base contains one sensor circuit. Each sensor circuit contains two IR emitters on both side and one IR receiver at the middle. When two main circuits were built, it was placed on the base. Then two main circuits, sensor circuits and DC motors were connected through connectors. Batteries were also placed on the base to supply power to the total circuit as shown in Fig 2.

3.4 Circuit Diagram

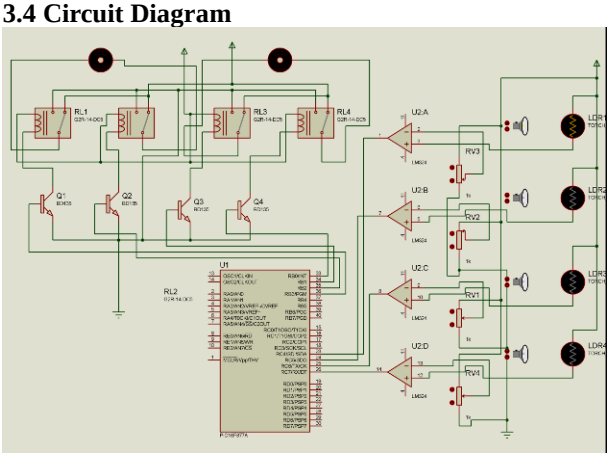

Fig.4 : Total Circuit diagram

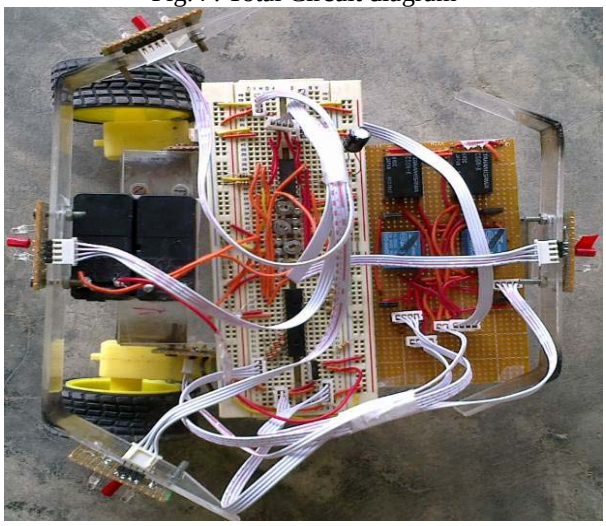

Fig.5 : Circuit Setup

4. RESULT AND DISCUSSION

The final result was quite satisfactory. The IR sensors

worked well and it was able to detect obstacle and change its direction on right, left, back and front side. It was able to detect obstacle up to 10 cm from the sensors i.e. the range of the sensors are around 10 cm. It rotates or changes its direction continuously until the obstacle is clear from its path and then goes to its preprogrammed path. DC motors with gears were used to get increased torque for the movement of the vehicle. External power supply was used instead of two batteries to overcome excess load on the robot and increase the speed of the vehicle. The robot performed well as programmed and navigated through the maze. It moved from starting point to the end point of the maze without conflicting with the walls.

It may seem easy to design a robotic structure, but its proper functioning after joining the circuits and components are quite challenging, especially for handmade robots. Lots of problem occurred and it had to trouble shoot and solve the problems. While running the vehicle some problems were faced, which were solved by following steps:

>> The rpm of the two different motors were different. It caused some problems in moving straight. This problem was solved by putting weight of the batteries on the faster rotating motors side.

>> Each motor was producing huge back emf, which was disengaging the action of the relay. So capacitors were used to overcome back emf.

>> The weight of the total setup was a little bit high with respect to the motor rpm. So two batteries were replaced by using direct connection from power supply and balanced the load on the two wheels accurately.

>> It needs a certain time for a sensor to respond to a change, for this there was a high possibility to have clash with obstacle. So range of the sensor was changed using variable resistor.

>> First the structure of the front side sensor was different in shape (two sides were perpendicular to the middle portion), but that design did not give accurate result. So two sides were angled 450, which gave the accurate result.

>> The robot did not work well in the daylight because there are infrared rays in the sunlight and the photodiode receives IR rays. So tape was used to cover IR receiver.

>> There were some problems of turning. It was solved by different pulse combination in programming.

5. CONCLUSION

One of the major challenges in designing intelligent robot capable of autonomous travel on any place is reliable obstacle avoidance. The significance of this work is in the increased understanding of obstacle avoidance for robot control and the applications of autonomous guided vehicle technology for industry, defense and medicine. This experiment is to develop a robot to be used for exploring that may form a basis for the development of an autonomous system for navigating through unmapped and changing urban environments. A maze is just used to show the ability of the robot to explore any place. Overall this project has proven successful and is able to provide an effective base for further projects and continued development.

6. ACKOWLEDGEMENT

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