DESIGN AND REALIZATION OF SHORTEST DISTANCE MAZE SOLVING ROBOT

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Abstract: In this Paper, design of a maze solution robot capable of automatically surviving in an unknown area according to his decision is presented. The required design algorithm is used. The robot introduced the rotation sensor encoder and infrared wheel rotation, and decided to resolve the labyrinth. It has the ability to solve the maze by taking the shortest path and also stores the details for later reference. A designed robot can learn any maze and find the shortest route to solve it. The best application of this robot can be designed for Navigational purpose.

Keywords: Autonomous navigation, MCU, Sensor, LSRB and RSLB algorithm, Maze, Robot.

INTRODUCTION

Robots can be defined as programmable, self-controlled devices consisting of electrical, electrical or mechanical units. More generally, it is a machine that works instead of a live agent. Unlike humans, robots do not get tired, so robots are particularly desirable in work. They can work even in uncomfortable, dangerous, physical conditions. They can operate under empty conditions. They are not boring by repetition. They cannot distract from work at hand [8].

The maze is a network of pathways designed like mysteries that need to find a way. Another labyrinth-like puzzle is a maze that is a unicursal. In other words, there is only one branching path. Solving a maze is more complicated and difficult than solving a maze. Different algorithms have been proposed to solve the labyrinth, but the same algorithm does not work effectively to solve the maze [1]. The maze solver must move from one end of the labyrinth to the other, that is, the start point, the end point, of the other end of the labyrinth. On the way, he has to make important decisions at intersections and dead places. The robot that solves the labyrinth is programmed to find that way without hitting the wall. This is a two step process. The first step is to walk through the labyrinth, find the endpoint, then optimize the path of the robot so that you can go through the labyrinth the dead end. To date, many tasks have been done on autonomous labyrinth solution robots. Special robots are also designed for this purpose. These robots can solve the maze very effectively. But the only drawback is that the designed robot can solve the maze in one way and the path is not the same each time the robot solves the same maze [2].

The route taken by the robot is not fixed. In other words, it takes longer. So far, the shortest labyrinth robot has not been studied. However, in order to save time and distance, it is important that the robot moves along the shortest route. Based on this, we propose a robot design that can solve the labyrinth in several directions, and as a result we traverse all the paths that find the shortest path. This robot can measure the distance of the route. In this manner, by measuring the distance of the path, the designed robot finds and stores the shortest remote route. When the shortest remote route is saved, it always moves the shortest route when it is designed to solve the same maze. The designed robot uses two algorithms: left-right algorithm (LSRB) and right-left algorithm (RSLB) [3]. The basic application of the designed robot can be a navigation in which a robot that has moved in all directions automatically traces the shortest route [4]. We use LSRB and RSLB algorithm to solve maze. According to the LSRB algorithm, priority is given to the left, that is, if there is an intersection, if there is no left turn first turn to the left Regardless of whether it is straight or appropriately right or behind Therefore, we always prioritize the movement of the robot according to the given conditions [5].

HARDWARE DESIGN

the system’s hardware structure mainly consists of control centre, power supply, movement control unit (MCU), and Sensor unit (SU).

A. Control Board : The control centre is designed with ATMEL AVR controller. The AVR microcontroller here is AtMega16, with 32 digital input / output pins, 8 analog pins, 16 MHz crystal oscillator and so on. It is controlled by this microcontroller.

Figure 1 : AVR ATmega16 Development Board

B. Power Supply : In this power supply consists of a lithium ion battery as a DC power source for the ear robot.

C. MCU : The maze robot is driven by two DC motors driven by the H bridge control chip L293D and provides control and direction logic. The L293D can drive two motors that can be controlled clockwise and counter clockwise with an output current of 0.6 A, a peak current of 1.2 A per channel. This circuit is protected from back EMC with output by internal diode. The range of the power supply voltage is 4.5V to 36V, and the L293D flexibly supports the motor.

D. Sensor Unit : Detection of the route is performed by the IR network. Infrared sensors are located on the left and right sides of the robot. The colour and distance of the reflecting surface are two parameters whose reflectance of infrared light changes. The infrared sensor uses the reflected photoelectric sensor module to detect the distance and color. The strength of the signal received by the red sensor is incremented each time closer to the light color object, to turn on the synthesized edge indicator. When approaching a dark object, the signal intensity decreases and the built-in LED turns off. The infrared light is emitted by the infrared LED detected by the photodiode. Use the LM 358 IC as a voltage comparator and use a potentiometer to calibrate the sensor output. When the light emitted by the infrared LED falls on the photodiode after hitting the object, the resistance of the photodiode is greatly reduced. One input of the operational amplifier is the threshold set by the potentiometer, the other input is connected to the series resistance of the photodiode. The voltage drop of the series resistance is higher when more incident radiation is present on the photodiode. The two voltages are compared by the operational amplifier, when the voltage between the voltage of the series resistor and the photodiode is higher than the voltage of the threshold voltage, the output becomes high, LED lights.

Figure 2: IR Array Sensor

DESCRIPTION OF ALGORITHM

For the robot, an algorithm that can navigate the entire labyrinth to the end is programmed. Our robot is designed using techniques of the left hand of the wall and techniques of the right hand of the wall. Both algorithms help the robot navigate the maze. Left hand technique on the wall turns as far as possible when there is an intersection, as far as possible go straight, otherwise turns to the right, otherwise turning because you are deadlocked.

The instructions used in the algorithm for both left and right wall is given in a table below:

Table 1: The instructions used in the Algorithm

Right wall following routine	Left wall following routine
if there is no wall at right,	if there is no wall at left
turn right	turn left
else	else
if there is no wall at straight	if there is no wall at straight
keep straight	keep straight
else	else
if there is no wall at left	if there is no wall at right
turn left	turn right
else	else
turn around	turn around

This algorithm is used to find the road at the end of the labyrinth. Next, we cut off the road to find the shortest route available from a given point in the labyrinth. First, I send the map of the maze to the bot as a graph. From this graph, the bot uses the algorithm to calculate the shortest path. During the calculation process, the robot calculates according to the algorithm and stores the route in the memory. The robot memorizes that way by storing each round as a character of one character in a matrix. The second step of the labyrinth solution follows the path the robot has followed, shortens it and packs it to the end of the maze. Movement is recorded as left turn = "L", turn right = "R", turn = "B", straight travel = "S".

The route that robot stored in the memory in form of array is then shortened by replacing three letters by one as shown as follows:

Table 2: Equivalent path for the sequence

Sequence	Equivalent Letter
LBR	B
RBL	B
SBL	R
LBL	S
RBR	S
SBR	L
LBS	R
RBS	L
SBS	B

Now, during the shortening procedure, each time the above three-letter sequence comes, we need to replace it with the equivalent letter above. Finally, we get the shortest path the robot moves to complete the maze.

PROPOSED DESIGN

A maze solving robot using LSRB and RSLB algorithm has been designed and tested in real time. The designed robot has proved its capability of solving any arbitrary maze by finding the shortest path due to effectiveness of algorithm. The hardware design of the proposed maze solving robot is shown below.

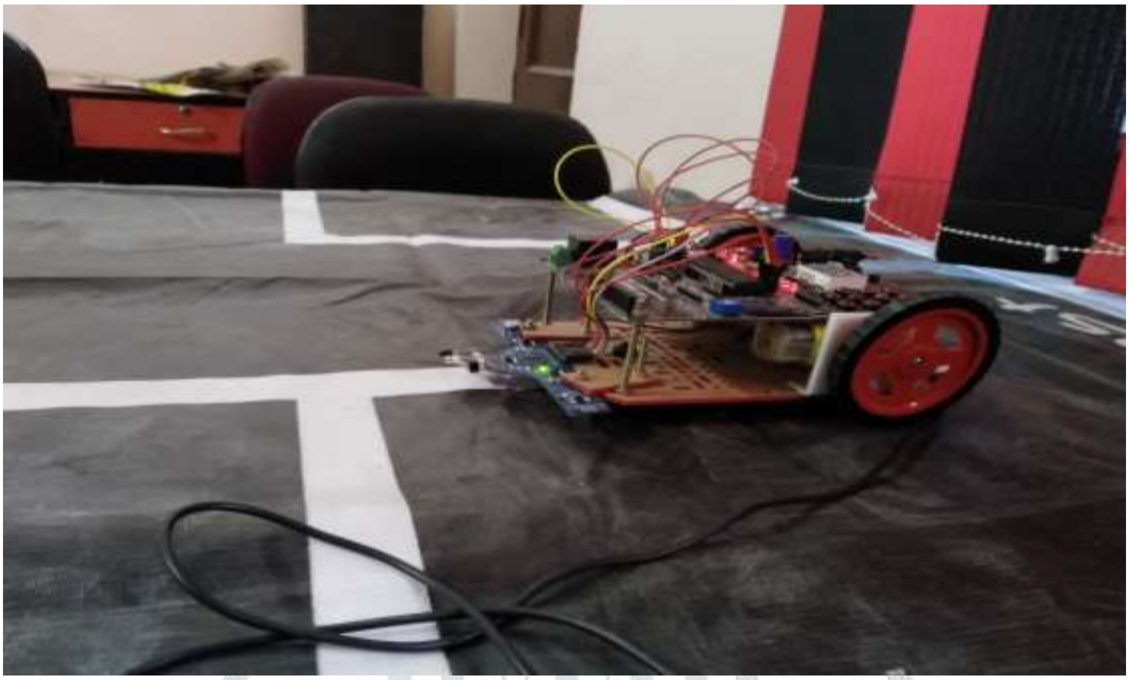

Figure 3: Proposed Hardware Design of maze Robot

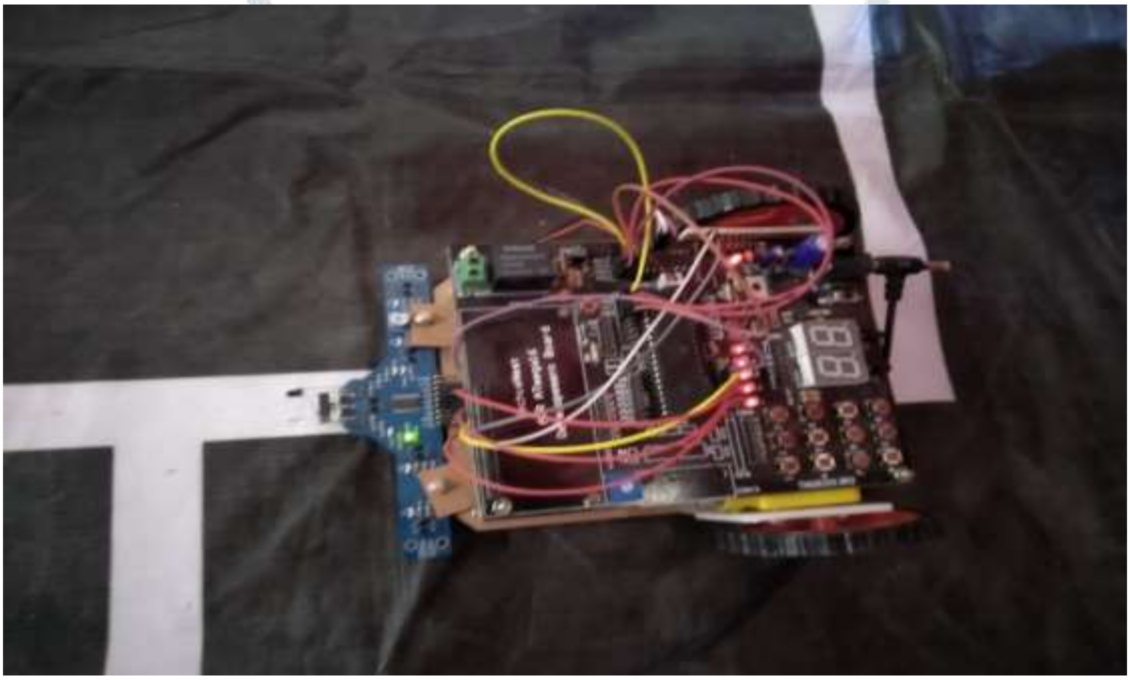

Figure 4 : Working Condition of Proposed Hardware Design

CONCLUSION

A maze solving robot using LSRB and RSLB algorithm has been designed and tested in real time. The designed robot has proved its capability of solving any arbitrary maze by finding the shortest path due to effectiveness of algorithm. The proposed algorithm has low space complexity, high performance and provides optimal solution to the maze. The proposed robot in this paper has good rpm BO motors that give it high and smooth mobility around the arena. The IR array of 5 irTx and Rx combination used , give us the advantage of precise decision making capability. And the algorithm developed in this paper eliminates the possibility of dry run and helps in solving the maze in one go.

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