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RESEARCH ARTICLE

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AUTOMATIC PATH FINDING ROBOT IN CHALLENGING ENVIRONMENTS

ABSTRACT:
In this paper, the robot analyses a path from its current position to a fixed target position and reach the target position. The obstacles which are present in the path are detected by the ultrasonic sensors, the distance between the obstacles and the robot is frequently calculated from every direction and the next movement of the robot will be based on the values obtained from the sensors. This robot moves to the target position without any human guidance or assistance.
KEYWORDS - Algorithm, obstacle avoidance, ultrasonic sensor, nuvoton board.

I. INTRODUCTION

Now a day's automated robots are used everywhere in different fields such as environment monitoring, patrol leakage of gases in chemical industries, in military etc. In this paper an algorithm is developed for the robot so that it can avoid the obstacles and move to a specified position. The robot moves according to the algorithm by avoiding the obstacles present in its path. The robot uses three ultrasonic sensors to detect the obstacles in its path, and a nuvoton board as a controller board. Whenever ultrasonic sensors detect obstacle in the path a signal is passed to the controller board. Where the controller board specifies the next movement of the robot in which direction it have to move. This algorithm helps the robot to move on its own without any human guidance or assistance and reaches the target position.

II. HARDWARE CONFIGURATION OF THE ROBOT

The hardware configuration of proposed robot is shown in Figure.1, consisting of following parts: Three ultrasonic sensors, two DC motors, Nuvoton kit.

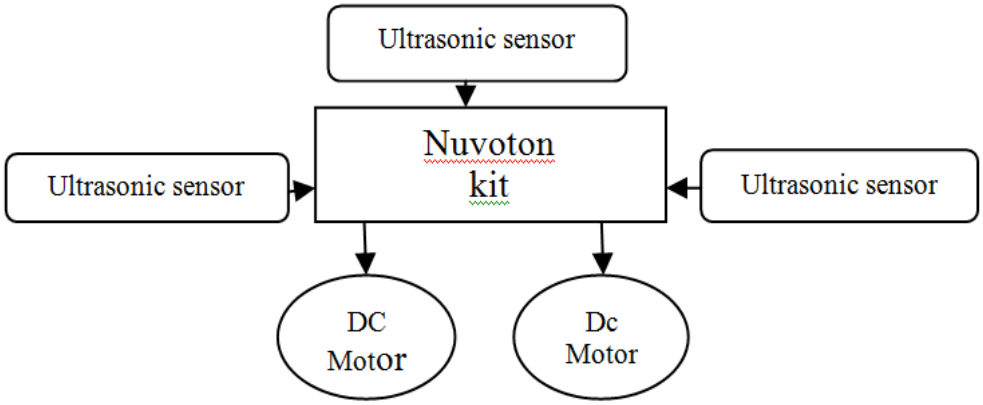

Figure.1 Block Diagram of Hardware

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2.1.Ultrasonic Sensor:

Three HC-SRO4 ultrasonic sensors are used in the robot, these sensors are placed in three different directions of the robot and the presence of the obstacles is detected by the sensors. The distance between the obstacle and the robot is calculated frequently. When the trigger pin in the ultrasonic senor is high a wave is generated by the transmitter and when the receiver detects the wave the echo pin is set to high. By using the time interval between the generated wave and the reflected wave the distance between the obstacles is calculated.

2.2. DC Motors and L298:

Two Dc motors are used in this robot. L298 driver board is used to connect these motors in a H-bridge. The driver board consists of following features, supply Voltage of 36V and 4A DC Current, drive 2 DC Motor, jumper for selecting source of Logic supply, on-board fast switching protection diodes, These two Dc motor are controlled by the nuvoton board which are connected through the L298 driver board.

2.3. Nuvoton Board :

Figure.2 Nuvoton Board

Here we have used Nuvoton board (NU-LB-NUC140) which uses ARM-Cortex M0 processor. The ARM processor serves as the brain of the project. It processes all the input signals applied to the GPIO pins and responds accordingly by giving control signals to the GPIO pins. The peripherals of this board used are the GPIO pins and timers. When the ultrasonic sensors detect the obstacles the signals are passed to the nuvoton board where it specifies the movement of the robot according to the obstacles detected in the path.

III. ALGORITHM

In this algorithm the path is considered as 'X' and 'Y' plane. The starting point of the robot is always considered as (0,0) in 'X' and 'Y' plane. The target location where the robot has to be moved is predefined as (0, A), example: (0,50m). As the robot move along the 'Y'-axis the y coordinate is incremented and decremented considering the movement of the robot as it moves in the forward direction or in the backward direction. Example: (0, A+B) here

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'B' is the distance travelled by the robot in the forward direction along the 'Y'-axis, and (0, A-B) is the distance travelled by the robot in the backward direction along the 'Y'-axis. As the robot moves in the left and right direction along the 'X'-axis as it detects the obstacles the value of the 'X'-coordinate is incremented and decremented accordingly. If the robot moves away from the origin line then the 'X'-coordinate is incremented and if the robot moves towards the origin the 'X'-coordinate decrements. The robot keeps track of the 'Y'-coordinate value and when the 'Y'-coordinate value of the robot is equal to the predefined value, the robot checks the 'X'-coordinate value and starts moving in the direction to make the predefined 'X'-coordinate value equal to the 'X'- coordinate value. Once the 'X' and 'Y' coordinate values obtained by the robot are equal to the predefined values, the destination point is reached.

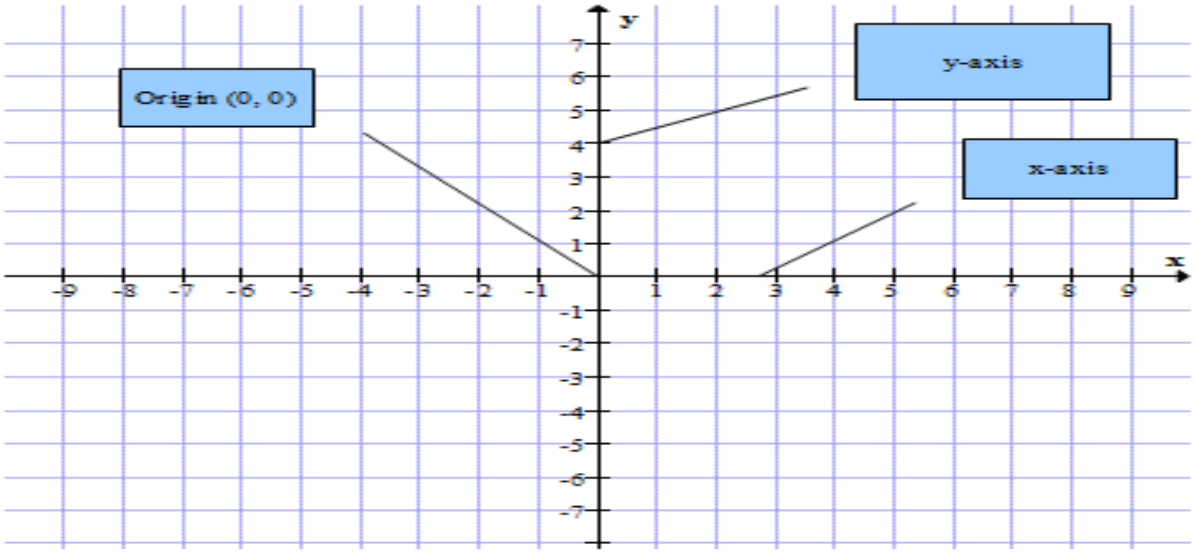

Figure.3 'X', 'Y' axis

IV. WORKING

The robot is mounted with three ultrasonic sensors at three different directions which are used to calculate the distance between the obstacles and the robot. The ultrasonic sensor is programmed in such a way that it produces a ultrasonic wave at regular interval of time continuously. The trigger pin is connected to the GPIO pin of the nuvoton board and when the obstacle is detected that is when the wave produced by the trigger is reflected back and sensed by the echo pin as this echo pin is connected to the interrupt timer pin of the nuvoton board. Whenever the trigger pulse is generated the timer starts running and when the echo pin senses the reflected wave the interrupt pin is raised and the time is captured. The time interval between the trigger wave and the echo wave is measured and the distance between the obstacle and the robot is calculated by using the following formula.

Distance_mm = (Echo Width * (340/2) / 1000)

Here echo width is the time difference between the trigger wave and the echo wave. In the similar way the remaining two ultrasonic sensors are connected to the robot using the timers and the interrupt pins.
The DC motors are fixed to the body of the robot and are connected to nuvoton board using L298. The power supply

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to the motors is given by the external DC power source. These motors are connected to the GPIO pins of the nuvoton board. The motors can be driven in forward, backward, right and left directions. This can be done by making the GPIO pins high and low.

Now each direction is given a certain value by taking a variable and assigning a value to it as follows '0' for North, '1' for South, '2' for East and '3' for West. Now the code is made in such a way that according to the variable the direction of the robot is known and the movement of the robot is decided according to the direction of the robot as shown in the flow chart below.

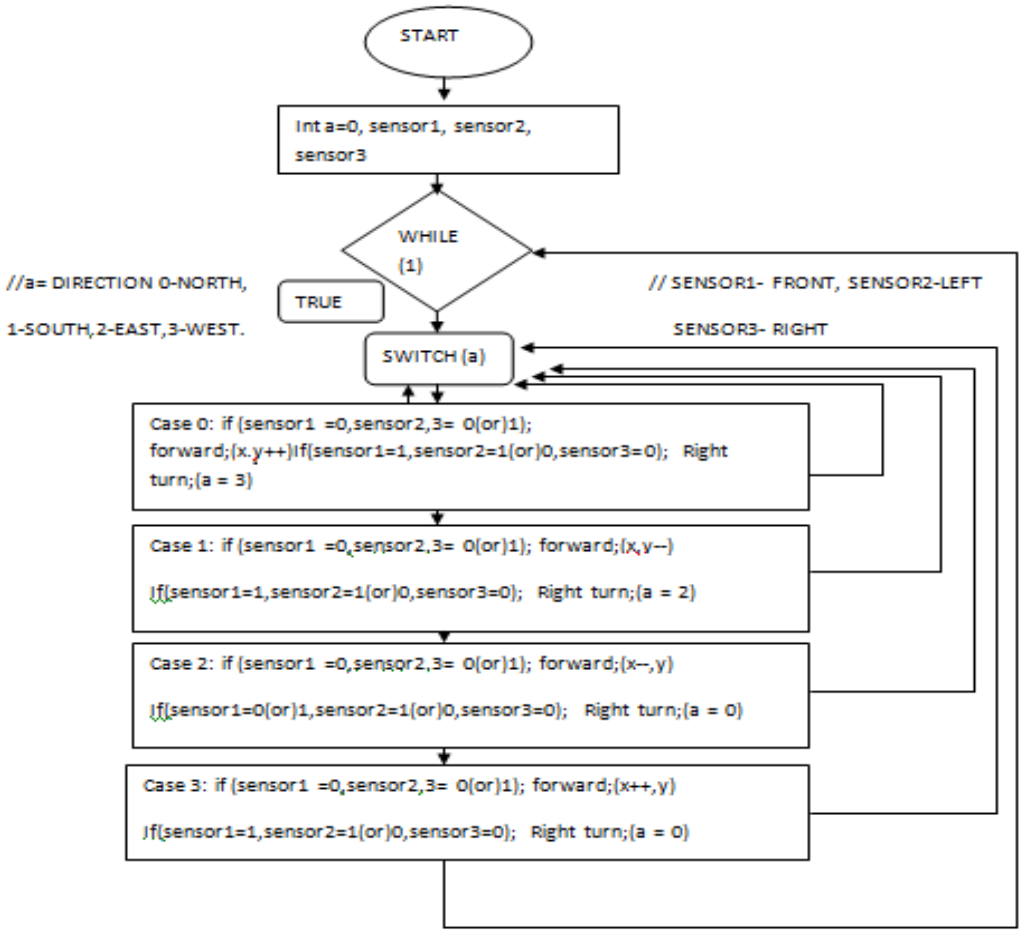

Figure.4 Flow chart for obstacle avoidance

Here in the above flow chart the x, y are the x and y co ordinates of the robot and '1' is used to indicate the obstacle in the path and '0' is used to indicate no obstacle in the path.

The distance traveled by the robot is calculated by calculating the total distance travelled by the robot for one complete rotation and the time taken to travel the distance. These values of the distance travelled are stored in a

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separate variable and is compared with the predefined value. Once both the values are equal then the robot has reached the target position.

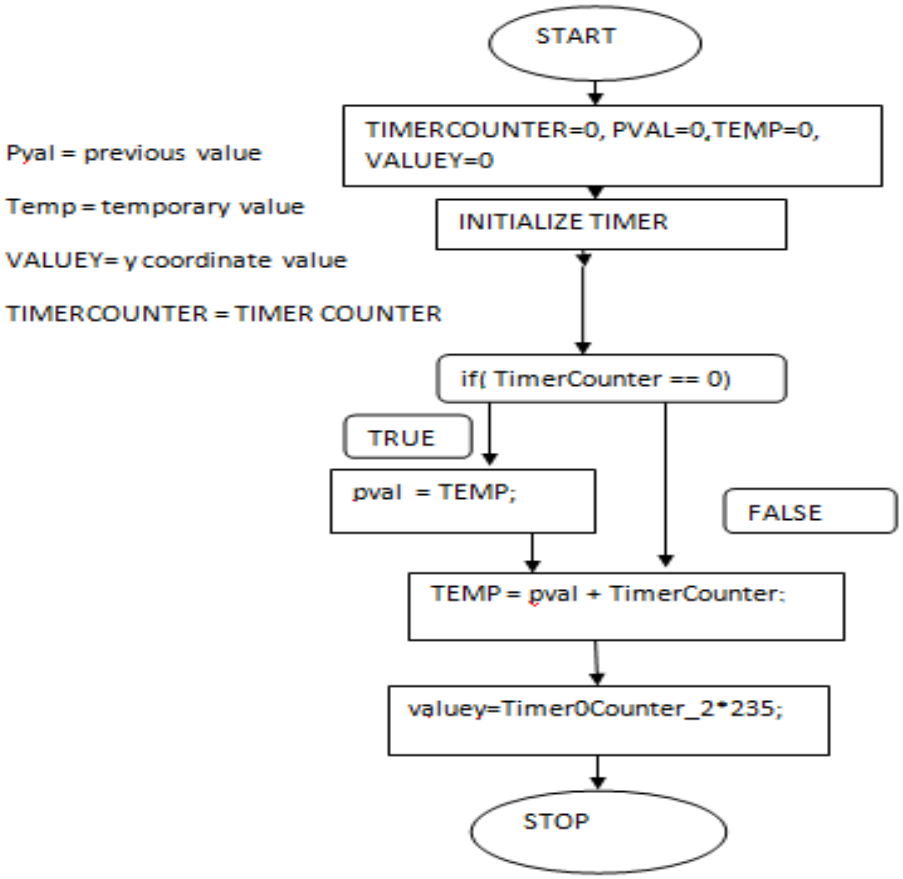

Figure.5 Flow chart for calculating distance travelled

Here in the above flow chart the distance travelled by the robot is calculated by using the time travelled by the robot in the specific direction. The time taken by the robot is calculated by using a timer. The distance travelled by the robot is obtained by multiplying travelled time with distance travelled by the robot in one second. Here the 'Y' coordinate is incremented and decremented according to the time travelled by the robot in the north and south direction, and the value of 'X' coordinate is incremented and decremented according to the time travelled by the robot in east and west direction.

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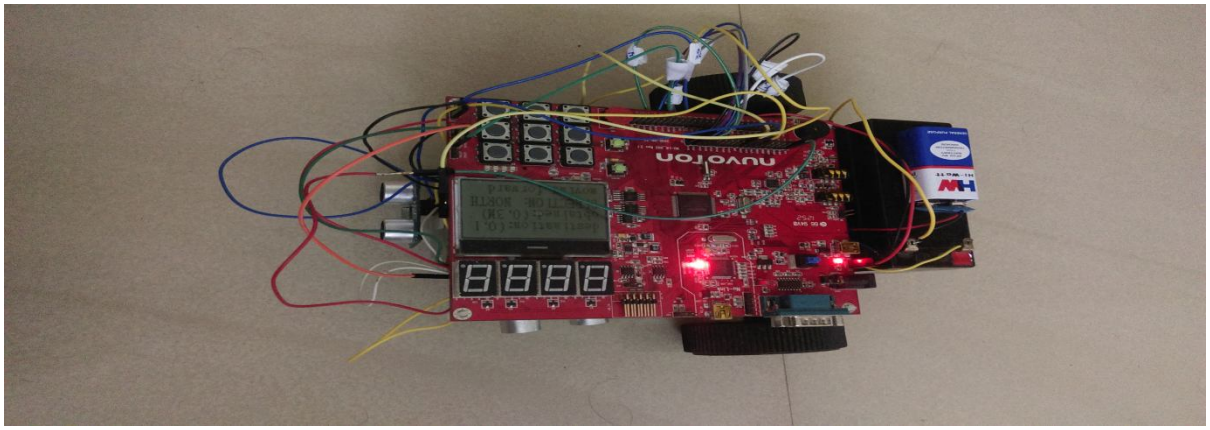

Figure.6 Obstacle detection, along with distance travelled in the specific direction.

In the above figure the robot shows the distance travelled by the robot in specific direction. And which direction it is compared with the starting position and the destination position is shown in the display.

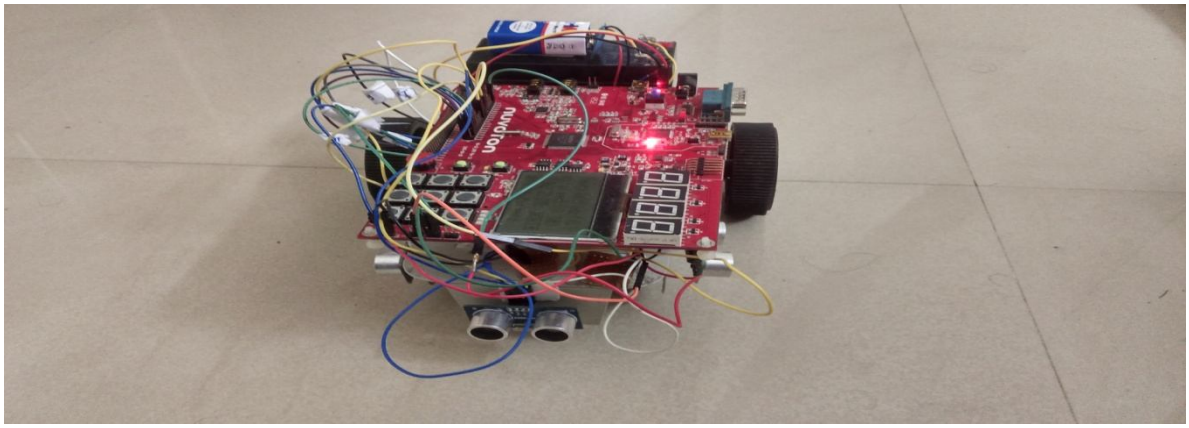

Figure.7 A complete working model of the robot.

V. RESULT

This robot can move from initial position to the target position avoiding the obstacles in its path, and move according to the algorithm to reach the destination position without any human assistance. Different paths have been tested to check the obstacle avoidance and to move the robot to the target position.

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VI. Conclusion

The robot can move from the initial position to the target position by avoiding the obstacles in its path and move according to the algorithm, but there is a slight error in the movement of the robot and turning the robot in the specific direction to obtain a certain angle.

VII. Future Enhancement

The errors in the robot have to be reduced by synchronizing the movement of the DC motors and the perfect turn must be analyzed to avoid the error in the change of the position. By this the robot can reach the target position more accurately.

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