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OBSTACLE AVOIDANCE MOBILE ROBOT WITH DISTANCE MONITORING USING PLX-DAQ

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Abstract
An autonomous mobile robot is supplemented with intelligence in order for the perception of its environment to detect obstacles in the path of its movement and move around in an unknown environment to reach the target by avoiding the obstacles. There are two approaches like model-based and sensor-based approaches for obstacle avoidance. In this work, an obstacle avoidance mobile robot is implemented using Arduino and ultrasonic sensor with distance monitoring using PLX-DAQ tool. The mobile Robot designed which can detect obstacles in its path using a rotating ultrasonic sensor and the robot can reach the target without making any collision with obstacles. The robot with rotating ultrasonic sensor perceives the environment in three directions and detects obstacles. The ultrasonic sensor mounted on the robot can rotate from 0 degree to 180 degrees(left to right) with the help of a servo motor and find a obstacle free route by measuring distance between obstacle and robot on its left side, right side and front side of robot. The robot turns left, right or goes forward automatically depending upon the side at which there is no obstacle or a path of obstruction which is at a greater distance from the robot. The distance measured by ultrasonic sensor in three directions will be sent by Bluetooth using PLX-DAQ tool and distance will be displayed on computer with action taken by robot.
Key words: Obstacle avoiding robot, Arduino, Ultrasonic sensor, PLX-DAQ.

I. INTRODUCTION

The Autonomous robots are intelligent machines capable of performing tasks by moving on its own in an unknown and unstructured environment. With the development of robotic technologies over the years, the mobile robots have been widely employed in many fields such as factory automation, office automation, dangerous environment detection, exploration, military, and security systems and so on. The Autonomous mobile robots are being developed for numerous applications where long term capabilities would be beneficial. The main aim of mobile robotics is to create completely autonomous robots, in the sense that they must be able to complete their tasks without human intervention. An autonomous mobile system should be able to plan its route by avoiding obstacles in the path to reach the destination with an acceptable accuracy.

II. RELATED WORK

There have been a number of approaches in designing obstacle avoiding robots using different sensors like laser scanner, infrared sensor, GPS and multiple sensors to accomplish obstacle detection and avoidance. These works differ by selection of sensors, path mapping process and the algorithms applied to set the operational

parameters. In obstacle detection, the selection of sensor is important for the required application of the robot, otherwise it might fail to operate. For example, a robot with optical sensors in a room with glass walls might create more collisions than avoidance because optical sensors fail to detect transparent objects like glass. Hence sensors should be selected in accordance with the characteristics of the obstacles

Aniket D. Adhvaryu et al has developed Obstacle-avoiding robot with IR and PIR sensors. It can therefore be used for educational, research or industrial implementation [2]. The IR sensors are far from perfect and have quite a small range, most effective at distance between 10cm to a maximum of about 1m. However, complex scenery (many different objects) will cause a problem as the sensor will see all objects within the arc created by the IR emitter. Another disadvantage of IR sensor is that the Sunlight or flames also present cause a problem as they emit a lot of IR light and thus interfere with the IR sensor providing false readings at receiver.

Aamir attar et al have demonstrated the line follower and obstacle avoidance robot using arduino which intelligently detects the obstacle in its line following path and navigates according to the actions that user set for it. The disadvantage of this method is robot takes more time and more path length as robot moves only on line created by user [3].

Chan-Hong Chao[4] have proposed image processing based obstacle avoidance for mobile robots using two cameras. The two cameras were used to calculate the relative distance between target and obstacle from the mobile robot. According to the distance the mobile robot plans a collision-free track to reach target .

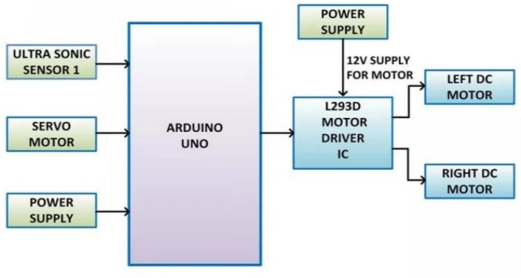
The obstacle Avoiding Robot By Faiza Tabassum[5] have developed a obstacle avoidance robot using three ultrasonic sensors in front to detect obstacles in three direction. Instead of three sensors we have developed obstacle avoidance robot using single ultrasonic sensor that can rotate in three directions and detect the obstacles.

III. PROPOSED METHOD

In Mobile robot obstacle avoidance ultrasonic sensor is preferred than IR and optical sensors due to high range of detection and unaffected by target structure and color. In this work we have implemented obstacle avoidance mobile robot using single ultrasonic sensors to detect and avoid obstacles in three directions such as left,rigt and front of robot. The ultrasonic sensor can rotate from 0 degree to 180 degrees with the help of a servo motor and find a obstacle free route by measuring distance between obstacle and robot on its left side, right side and front side of robot. The robot automatically turns left, right or goes forward depending upon the side at which there is no obstacle or a path of obstruction which is at a greater distance from the robot. The distance measured by ultrasonic sensor is monitored using PLX-DAQ tool. The distance between the robot and obstacles along with action taken by the robot is displayed on personal computer.

A. Block Diagram

The block diagram proposed method is as shown in figure(1). The Entire circuitry of the robot is built on Arduino UNO platform. It consists of Arduino Uno, a ultrasonic sensor, servo motor and motor driver IC coupled with two geared DC motors are interfaced with the Arduino Uno.



Fig(1): Block diagram

The robot move in forward direction and manages to detect any obstacle in front of

the robot and rotate ultrasonic sensor from 0 degree to 180 degree with help of servo motors. The ultrasonic sensors measures the distance on left side, right side and front of robot and turn robot either left or right depending on where ever there is no obstacle or towards the side with more distance available to move around.

B. Circuit Connections

The control circuitry has the following components and circuit connections –

Power Supply - In the circuit, Arduino UNO, servo motor and the ultrasonic sensor need a 5V regulated DC for their operation while the motor driver IC needs 12V DC. A 12V NIMH battery is used as the primary source of power. The supply from the battery is regulated to 5V and 12V using 7805 and 7812 ICs. The pin 1 of both the voltage regulator ICs is connected to the anode of the battery and pin 2 of both ICs is connected to ground. The respective voltage outputs are drawn from pin 3 of the respective voltage regulator ICs. An LED along with a 10K Ω pull-up resistor is also connected between common ground and output pin to get a visual hint of supply continuity. Despite using 12V battery, IC7812 is used to provide a regulated and stable supply to the motor driver IC.

Arduino UNO - Arduino UNO is one of the most popular prototyping boards. It is used frequently in robotic applications as it is small in size and packed with rich features. The board comes with built-in Arduino boot loader. It is an Atmega 328 based controller board which has 14 GPIO pins, 6 PWM **HC-SR04 Ultrasonic Sensor** - The HC-SR04 ultrasonic sensor uses sonar to determine the distance to an object like bats or dolphins do. It offers excellent non-contact range detection with high accuracy and stable readings in the range from 2 cm to 400 cm.

There is an ultrasonic sensor used in the circuit mounted in front of the robot. The ultrasonic sensor mounted on the front is connected to pins A0 and A1 of the Arduino board. The ultrasonic sensor has four pins - Ground (Pin 1), Echo (Pin 2), Trigger (Pin 3) and Trigger. The VCC and ground pins are connected to common VCC and Ground respectively. The Echo pin of the sensor is connected to pin A1 and Trigger pin is connected to pins A0 of the Arduino board.

C. Flow chart

The functioning of the robot is summarized in the following flowchart in figure2.

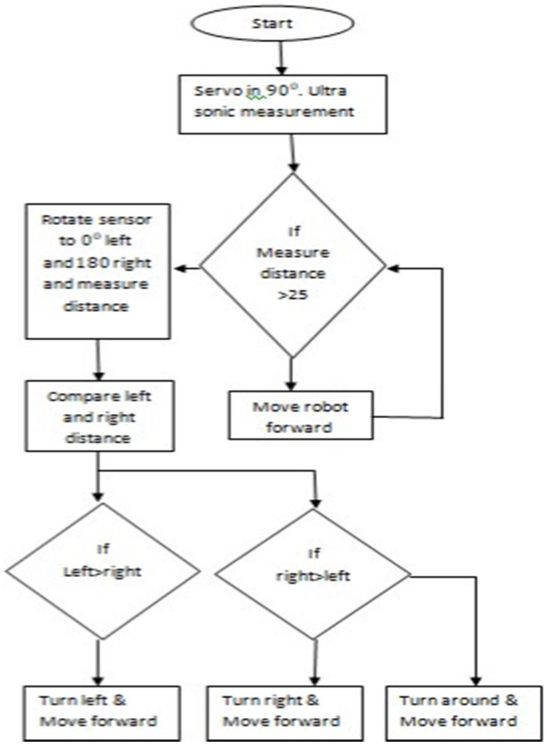


Fig1: Flow chart

Initially the robot move in forward direction and ultrasonic sensor in 90 degree position scanning obstacles in front of robot and robot moves forward. If any obstacles present then rotate ultrasonic sensor from 0 degree to 180 degree with help of servo motors. The ultrasonic sensors measures the distance on left side, right side and front of robot and the robot automatically turns left, right or goes forward depending upon the side at which there is no obstacle or a path of obstruction

which is at a greater distance. If right obstacle distance is more compared to left obstacle distance then robot turns right, similarly if left obstacle distance is more compared to right obstacle distance then robot turns left.

D. PLX-DAQ V2 tool

PLX DAQ v2 is a program used to establish communication between Microsoft Excel on a Windows Computer(PC) and any device that supports serial port protocol.

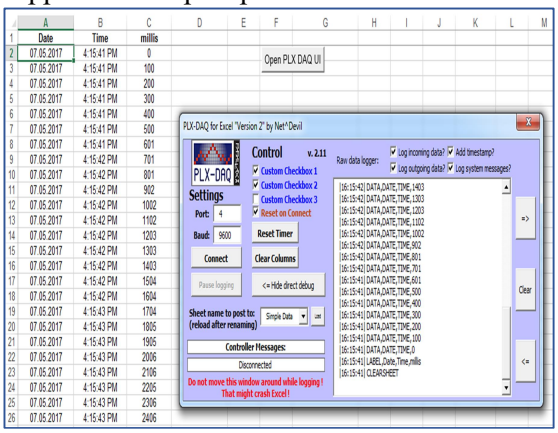


Fig3:PLX-DAQ V2 tool

The PLX-DAQ program uses two parts to work namely the special Microsoft Excel Spreadsheet with the PLX DAQ v2 UI and commands plus any Arduino device that sends special commands for communication using Bluetooth.

IV. RESULTS AND DISCUSSION

An autonomous mobile robot is designed using Arduino and a rotating ultrasonic sensor. The robot uses an ultrasonic sensor to sense its environment and detect obstacles in its path by rotating ultrasonic sensor. The robot can rotate the ultrasonic sensor from 0 degree to 180 degrees with the help of a servo motor and find an escape route by measuring distance between obstacle and robot on its left, right side and front of robot. The robot automatically turns left or right depending upon the side at which there is no obstacle or a path obstruction is at a greater distance.

The ultrasonic sensor rotate from 0 degree to 180 degree left to right and calculates the distance between robot and obstacles in three directions such as left side, right side and front of robot.

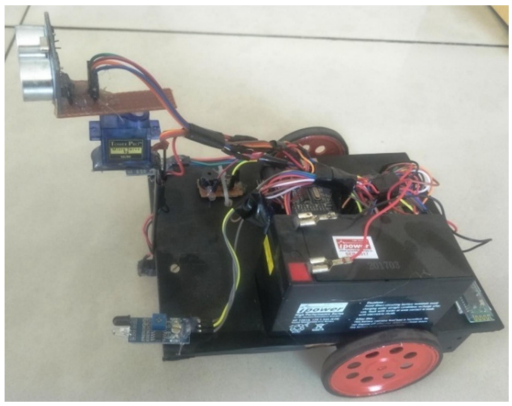


Fig4: Rotating ultrasonic sensor obstacle avoidance robot

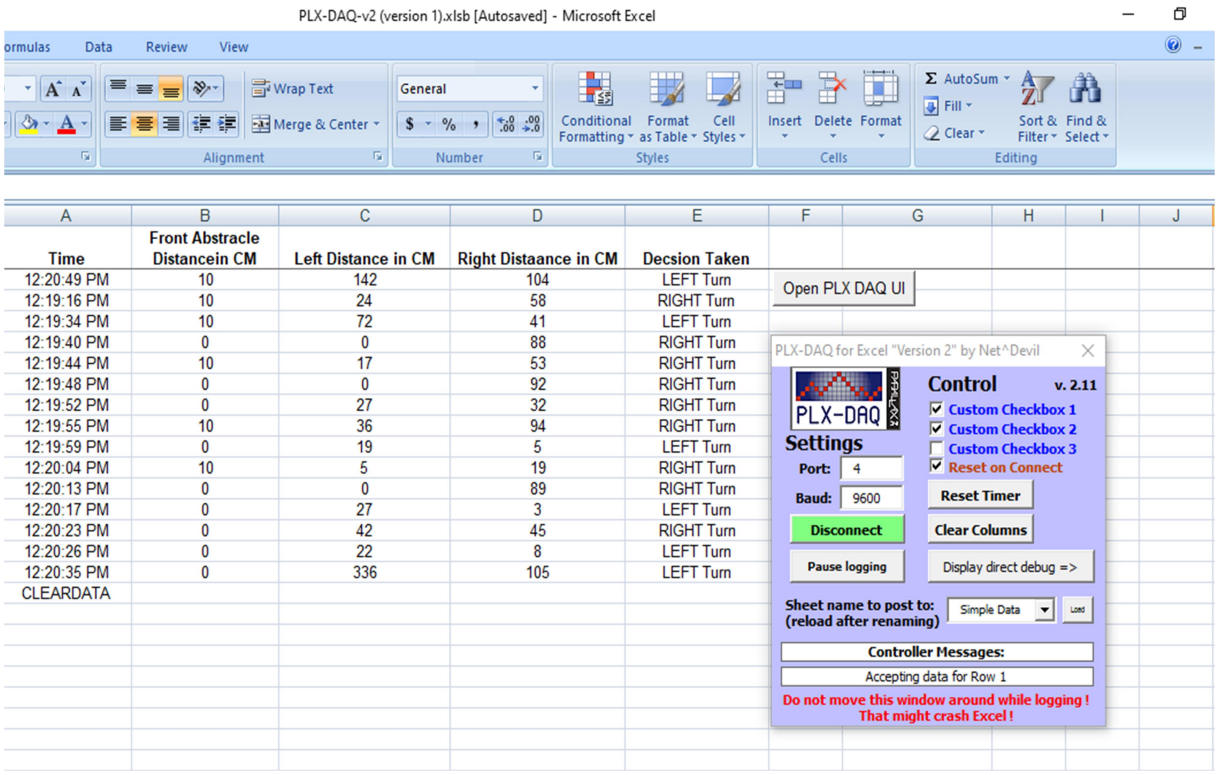
The table1 shows the distance information from ultrasonic sensor received using PLX-DAQ data acquisition tool.

Front distance in cm	Left side distance in cm	Right side distance in cm	Action taken
10	142	104	Left Turn
10	24	58	Right Turn
10	72	41	Left Turn
0	0	88	Right Turn
10	17	53	Right Turn
0	0	92	Right Turn
0	27	32	Right Turn

Table1: Obstacle distance information and action taken by the robot.

The distance will be displayed in Microsoft excel sheet of computer using

PLX-DAQ tool as shown in fig(5) below. It seen from the fig(5) that the robot measures the obstacle distance in three directions using ultrasonic sensor. The distance information will be centimeter. .



Time	Front Abstracle Distancein CM	Left Distance in CM	Right Distaance in CM	Decsion Taken
12:20:49 PM	10	142	104	LEFT Turn
12:19:16 PM	10	24	58	RIGHT Turn
12:19:34 PM	10	72	41	LEFT Turn
12:19:40 PM	0	0	88	RIGHT Turn
12:19:44 PM	10	17	53	RIGHT Turn
12:19:48 PM	0	0	92	RIGHT Turn
12:19:52 PM	0	27	32	RIGHT Turn
12:19:55 PM	10	36	94	RIGHT Turn
12:19:59 PM	0	19	5	LEFT Turn
12:20:04 PM	10	5	19	RIGHT Turn
12:20:13 PM	0	0	89	RIGHT Turn
12:20:17 PM	0	27	3	LEFT Turn
12:20:23 PM	0	42	45	RIGHT Turn
12:20:26 PM	0	22	8	LEFT Turn
12:20:35 PM	0	336	105	LEFT Turn
CLEARDATA				

Fig(5): Displaying Distance using PLX-DAQ tool

V. CONCLUSION

To avoid the obstacle around the robot multiple sensors were used in different directions each in front, left and right directions in earlier methods. But in this work the obstacle avoidance is achieved using one ultrasonic sensor which can work like a human head to sense the obstacle around it. The distance between obstacle and robot in three directions is measured by ultrasonic sensor and it will be displayed in Microsoft excel sheet using PLX-DAQ tool along with action taken by the robot

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