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ARUDINO BASED OBSTACLE AVOIDING ROBOT CAR

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Abstract

This project involves the design and implementation of an intelligent obstacle-avoiding robot car. The objective of this project is to implement a robot car, which while moving should have the ability to detect obstacles in its path and change direction where obstacles are present without any form of external influence. The new direction to be taken to avoid collision is the direction that has the most distance between the obstacle and the sensor and this is determined by the robot based on sensor inputs. This implementation was done using an ultrasonic wave sensor, which measures distance by sending pulses. Also, the movement of the servo motor (for sensor movement) and the DC motors (for wheel movement) are controlled by the motor driver shield in order to enable the obstacle avoidance function. The commands are sent to the Arduino microcontroller chip which serves as the main control of the robot car, as it controls the sensor and car movement. The implemented robot car was able to successfully detect and avoid obstacles within the line of sight of the Ultrasonic sensor used.

Keywords: Arduino UNO, ultrasonic sensor, DC motor, Servo Motor

1. INTRODUCTION

In our world today, ROBOTICS is a very interesting research area, which is fast growing as it is the simplest way for modifying modern day technology. Since it is the most straightforward method of altering contemporary technology, robotics is an extremely fascinating field of study that is expanding quickly in our planet. I chose to work in the field of robotics and design an intelligent device to make life easier for people because robotics plays a significant part in the advancement of technology. A robot that is autonomous is one that can maneuver in an unstructured, foreign environment without assistance from outside sources. The robot's software intelligence, which allows it to assess its surroundings, identify obstacles in its route, and navigate the environment by avoiding them, is what allows it to accomplish this [1].

A necessary requirement of every autonomous mobile robot is obstacle avoidance. Obstacle avoidance is a fundamental prerequisite for any autonomous mobile robot. In order to avoid collisions while operating, a robot's navigation system in an unfamiliar region must include this obstacle avoidance feature. An autonomous robot needs to avoid collisions in order to shield the item and the robot from harm. Obstacle avoidance is required in certain application fields, such as automatic vacuum cleaners and aircraft. Robots operating in familiar environments with well-defined paths may encounter obstacles in their course due to unforeseen environmental changes. Therefore, it is imperative that the robot possess the ability to adapt by avoiding these changes.

The idea of an autonomous robot is not a new one. The concept of an independent robot is not a novel one. Every business that deploys mobile robots for jobs wants the robot to be capable of operating efficiently without outside supervision.

Achieving autonomous robot locomotion is getting closer thanks to advancements in GPS technology. Before using the robot, though, it is necessary to address the issue of how it perceives and interacts with its surroundings. In order to allay this worry, sensors are employed to gather sufficient environmental data, which the robot then processes to enable seamless navigation. Three questions remain after this approach to the problem is taken into consideration: can a sensor gather enough information to allow for movement without collisions? Furthermore, is there a quick and efficient?

FUTURE SCOPE

In the future, the sensing can be increased. A Bluetooth module and a camera can be attached, so that the user can see the obstacle and take pictures and also can take videos of it. As the sensor can detect only the obstacles with reflective surface, so in future work can be carried out to detect and avoid obstacles of absorbing surface.

1. OBJECTIVES OF STUDY

The Aim of this project is to design and implement a robot car that is able to move round an unknown environment without running into obstacles in its path. The Objectives of the project are as follows:

The robot car should have the capacity to detect obstacles in its path based on a predetermined threshold distance. After detection of an obstacle, the robot should be able to change its direction to a relatively open path by making an autonomous decision. The robot car should not require any external control during its operation. The robot car should be able to measure distance between itself and an obstacle in real time. The robot car should be able to operate effectively in an environment which is unknown to it.

2. LITERATURE REVIEW

Artificial Intelligence (AI) is the ability of a computer or a computer controlled-robot to think and perform tasks like humans. An artificially intelligent machine is one which is capable of learning, reasoning, planning, perception, problem solving [3]. This field was discovered on the claim that human intelligence can be sufficiently described to the point that a machine can simulate it.

2.1 ROBOTIC AND ROBOTS

Robotics is an interdisciplinary research area at the interface of computer science and engineering. Robotics involves the design, construction, operation, and use of robots [4]. The goal of robotics is to design intelligent machines in order to help human beings in their daily activities. This technology has resulted in automated machines that can replace humans in manufacturing processes or dangerous environments. These robots have numerous structures depending on their functions. Generally, robots are grouped into:

- Manipulator robots (industrial robots)
- Mobile robots (autonomous vehicles)
- Self-reconfigurable robots, which are robots that can adjust themselves based on the task to be performed. Robots may be designed to act on their decision-making ability or to be controlled by humans [5]. Robots work by trying to mimic/replicate the

human behavior as they are made to possess the same components of human beings. These components include:

- A muscle system in order to move the body structure
- A body structure.
- A power source used to activate sensors and muscles.
- A sense system used to obtain environmental information
- A brain system which processes the sensed information and gives the muscles information on how to respond

3. COMPONENTS

A. Arduino UNO

Arduino is an open source electronics platform that is based on the easy-to-use software and hardware. Arduino board are able to read inputs (like light glowing on a sensor, a finger touched on a button, or a message of Twitter) and turn it into an output (like activating motors, turning on an LED, publishing some content online). We can tell our board what to do by sending a group of in structions to the microcontroller on the board. Over many years, Arduino has been the brain of hundreds and thousands of projects , from day-to-day objects to complex scientific instruments. It was developed at the Ivrea Interaction Design Institute, which aims to help students without a background in electronics and programming for fast prototyping. Thanks to its simple user experience, Arduino has been used in hundreds and thousands of different projects and applications. The software of Arduino is easy-to-use fo r beginners and flexible enough for advanced users. It runs on Mac, Windows, and Linux. There are many other microcontrollers a nd microcontroller platforms other than Arduino available for physical computing. Arduino has simplified the process of working with microcontrollers. It also offers some advantages for teachers, students, and interested amateurs over other systems. Arduino UNO as shown in fig -1

Fig -1 Arudino

B. Ultrasonic Sensors

The word ‘ultra’ means ‘beyond’ and sonic means ‘sound’. Combining the two of them together ultrasonic is a sound which is above the human hearing range (20 kHz). An Ultrasonic sensor is a sensor that can detect ultrasound waves by converting the waves into electric signals or vice versa.

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic waves, and then converting the reflected waves into an electrical signal. Ultrasonic waves travel way faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the receiver and the transmitter. The transmitter emits the sound using piezoelectric crystals and the receiver encounters the sound after it has travelled to and from the target.

To calculate the distance between the sensor and the object, the sensor measures the time taken between the emissions of the sound by the transmitter to its contact with the receiver. Ultrasonic sensors are used firstly and commonly as proximity sensors. They can be found in an anti-collision safety systems and automobile self-parking technology. In comparison to Infrared sensors in proximity sensing applications, ultrasonic sensors are not as susceptible to interference of smoke, gas, and other airborne particles. Ultrasonic sensor is shown in Fig. 2.

Fig -2 Ultrasonic Sensor

C. L293D Motor Driver Shield

The L293D is a high voltage; high current Integrated circuit which is used to drive DC motors with a power supply of up to 36V. This chip is able to supple a maximum of 600mA per channel. This chip is also known as a type of H-Bridge as it enables a voltage to be applied across a load in either direction to an output, e.g. a motor.

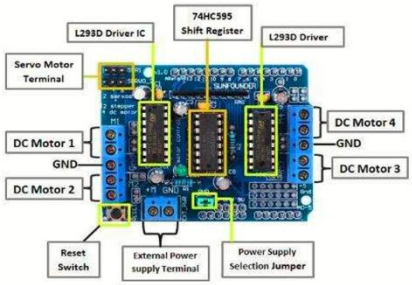


Fig -3 L293D Motor Driver

D. Servo Motor

A servomotor is a linear actuator or a rotary actuator that allows for accurate control of linear or angular position, acceleration and velocity. It consists of a sensor coupled with motor for position feedback. It also requires a relatively sophisticated controller, designed specifically for use with servomotors. The servo motor is a simple DC motor. With the help of servomechanism, it is controlled for specific angular rotation. Now-a-days, servo motors are widely used in many industrial applications. In the obstacle avoiding robot, it is used for rotating the ultrasonic sensors. Whenever any obstacle comes in front of it, the robot detects it and stops and then after that servo motor rotates in both left and right directions. Along with the servo motor, the ultrasonic sensor which is mounted on it also rotates. Servo Motor is shown in Fig. 4.

Fig – 4 Servo Motor

4. WORKING

When the robot is powered on, both the motors of the obstacle avoiding robot will run normally and the robot will move forward. During this whole time, the ultrasonic sensor will be continuously calculating the distance between the reflecting surface and the robot. This information is processed by the Arduino from the sensor. If the distance between the robot and the obstacle are less than limit set in the Arduino, the Robot will stop and scans in right and left directions for new distance by using Ultrasonic sensor. If the left distance is more than the right distance, the robot will turn in left direction by commanding the left wheel to move in forward motion and the right wheel to move in backward direction.

Similarly, if the right distance is more than left distance, the robot will turn in right direction. The robot will not collapse with any obstacle.

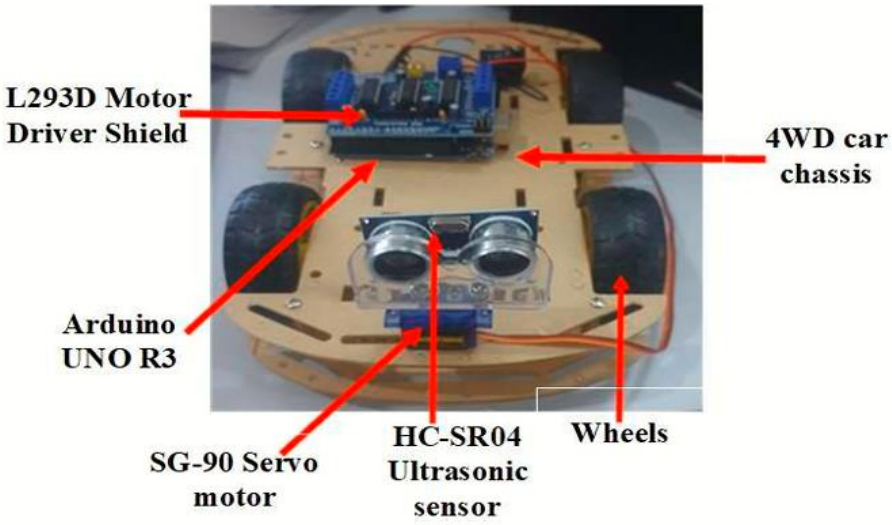
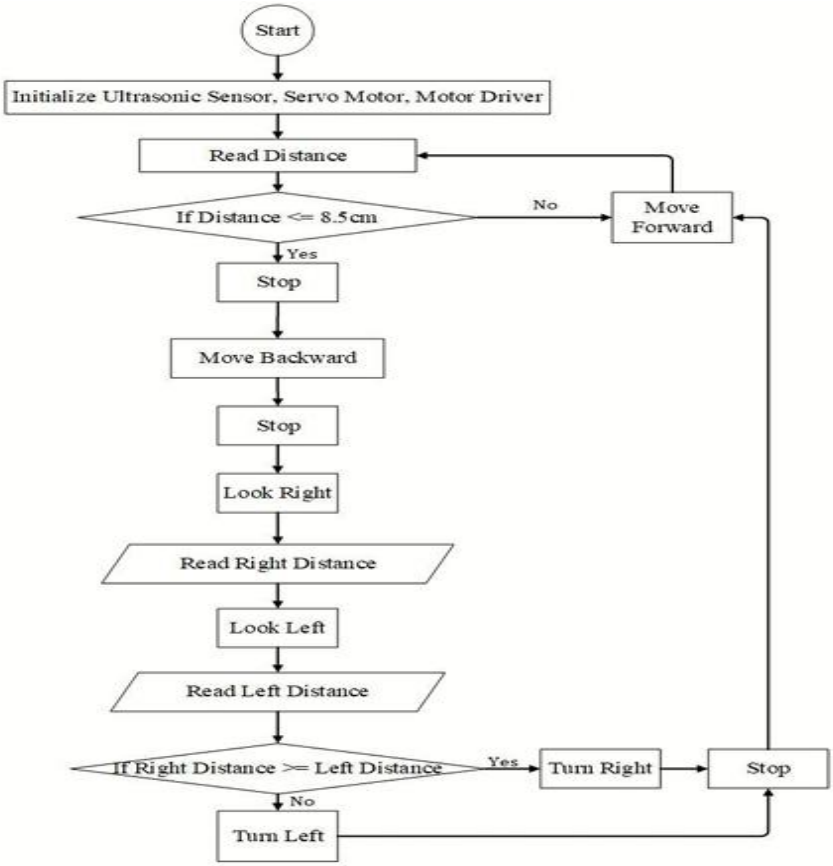


Figure 5 Components attached to the chassis



FLOW CHART OF THE PROGRAM

5. RESULTS

The outcome of this thesis is a simple, Arduino-controlled robot car which moves around detecting obstacles in its way and avoiding them. During operation of the robot, the ultrasonic sensor sends out an ultrasound wave to the front position (90 degrees), right position (36 degrees), and left position (144 degrees). When the wave strikes an obstacle, it bounces back and the distance is stored for the front, right, and left position. After this, the microcontroller compares the values based on its algorithm and determines whether to move forward or change path.

Tests carried out on the final hardware revealed the limitations of the detection algorithm. The limitations were related to cases of some obstacles not being detected and this was as a result of the sensor not being able to measure obstacles outside the measuring range of the sensor. When an object is in the way of the car and this object is not within the line of sight of the sensor, it will not be detected thereby leading to collision. To avoid this, the testing was further carried out in an enclosed area where the wall is the only obstacle and the car was able to move freely without collision. To implement a car which will detect multiple obstacles and avoid them, more sensors have to be used in order to cover a wider range for obstacle detection.

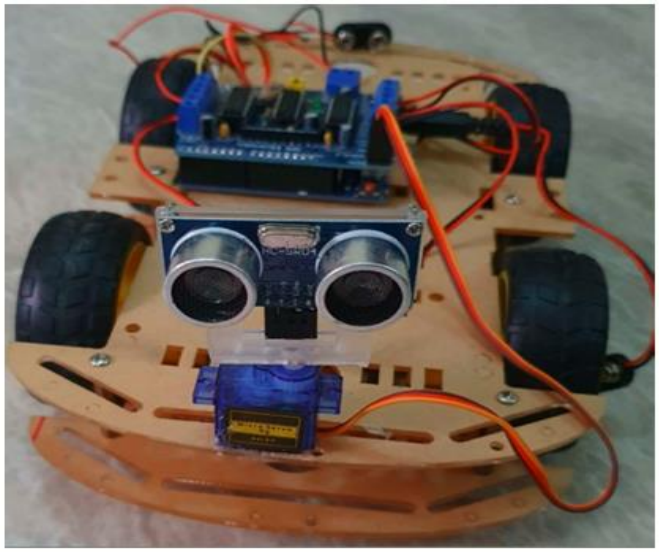


Fig – 6 The Hardware Model Of the Obstacle Avoiding robot

6. CONCLUSION

This project provides an obstacle avoiding robot that detects obstacles coming in its path and avoids it by moving in another direction. The robot is built with Arduino that processes the information to various parts. For object detection, ultrasonic sensors have been used that provides a wider field of view. Servo motor has been used for rotating the sensor. The robot is able to move by using two geared motors. It is perfectly avoiding the obstacles coming in its path

Today we are in a world of robotics and we use different types of robots daily in our life. This "Obstacle Avoidance Robot Car" project is proved using the Ultrasonic sensor for detecting objects. Motor Driver Shield for driving the DC motors, DC motors for movement of the wheels of the robot with the help of the Arduino Microcontroller. The speed of sound in Ultra Sonic Sensor is 340m/s, the sound wave will need to travel about 294µs.The factors which affect the accuracy of the designed robot include the environment the robot was tested and the number of present obstacles in the test space. These factors mainly affected the sensor which means that the accuracy of the robot is dependent on the sensor.

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