



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Special Issue 2, April 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

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 6381 907 438

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Object Detection Robot Using Arduino Uno and Ultrasonic Sensor

Sudhanva S Haritasa¹, Anuraag Prasanna Shendye², Dr Shalini Shravan³.

U.G Student, Dept. of ECE, R.V Institute of Technology and Management, Bengaluru, India¹.

U.G Student, Dept. of ECE, R.V Institute of Technology and Management, Bengaluru, India².

Assistant Prof, Dept. of ECE, R.V Institute of Technology and Management, Bengaluru, India³.

ABSTRACT: This project describes an obstacle avoidance robot vehicle which is controlled by an ultrasonic sensor. The robot is made using an ultrasonic sensor and it is controlled by an Arduino microcontroller. Ultrasonic sensor fixed in front portion of the robot vehicle. The sensor gets the data from the surrounding area through mounted sensors on the robot. The sensors will sense the obstacle and deviate its path to choose an obstacle free path. The sensor will be sending the data to the controller compared with the controller to decide the movement of the robot Wheel. The robot wheel movement and direction will be based on the sensing of the ultrasonic sensor and using a wheel encoder. This vehicle is used for detecting obstacles and avoiding collisions.

COMPONENTS USED: Arduino Uno Board, Ultrasonic Sensor, Gear Motor drive, Servo Motor, Motor driver Shield(L293D).

I. INTRODUCTION

The project is designed to build an obstacle avoidance robotic vehicle using ultrasonic sensors for its movement. An Arduino uno is used to achieve the desired operation. A robot is a machine that can perform tasks automatically. Robotics is generally a combination of computational intelligence and physical machines (motors). Computational intelligence involves the programmed instructions. The project proposes a robotic vehicle that has an intelligence built in it such that it guides itself whenever an obstacle comes ahead of it. This robotic vehicle is built, using an Arduino uno. An ultrasonic sensor is used to detect any obstacle ahead of it and sends a command to the Arduino.

In today's world robotics is a fast growing and travelling time of ultrasonic waves is 343m/s. This much of speed is meticulous for MCU in microcontroller to measure accurately. Practically the waves reflect back from the surface located 4 meters away in 15 ns. The ultrasonic wave does not affect humans. The ultrasonic sensor is mostly used for distance measurement application. These sensors are able to detect the barriers present in front of them. Ultrasonic sensors generate sound waves with higher frequencies that humans cannot perceive, making them ideal for quiet environments. They do not consume much electricity, are simple in design, and are relatively inexpensive. The basic block diagram is shown in fig. 1. interesting field. The robot has sufficient intelligence to cover the maximum area of provided space. Autonomous Intelligent Robots are robots that can perform desired tasks in unstructured environments without continuous human guidance. The obstacle detection is the primary requirement of this autonomous robot. The robot gets the information from the surrounding area through mounted sensors on the robot.

II. RELATED WORK

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins. (Of which 6 can be used as PWM outputs), 6 analogue inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past, or outdated boards see the Arduino index of boards.

The ultrasonic sensor is used for obstacle detection. Ultrasonic sensor transmits the ultrasonic waves from its sensor head and again receives the ultrasonic waves reflected from an object.

There are many applications that use ultrasonic sensors like instruction alarm systems, automatic door openers etc. The ultrasonic sensor is very compact and has a very high performance. It has both the transmitter and receiver. It consists of four VCC pins to offer a 5V supply to the sensor, trigger pin gives a TTL pulse (15 us), echo pin to get the output from the sensor and ground pin. Ultrasonic sensor HC-SR04.

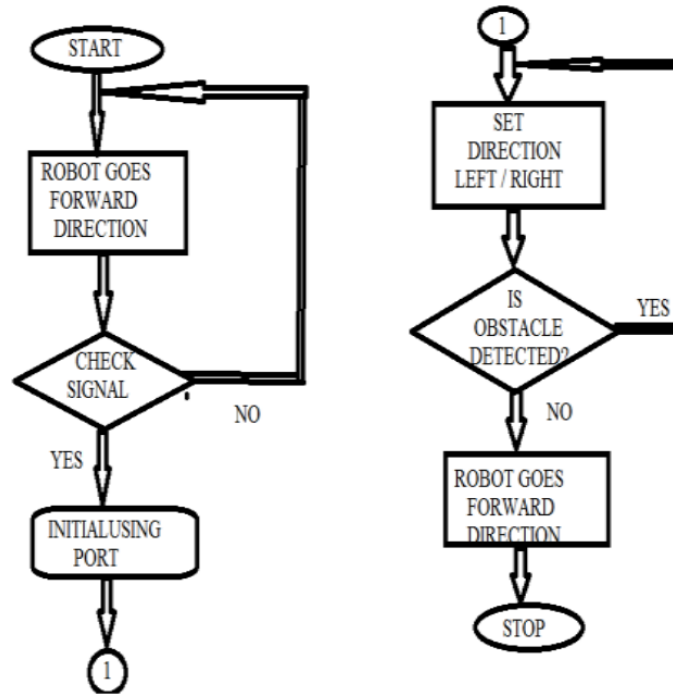


Fig 1: Flow Chart

III. GEAR MOTOR DRIVE AND SERVO MOTOR

A gear motor is a motor designed with an integrated gearbox. Gear motors function as torque multipliers and speed reducers thus requiring less power to move a given load. The design of the gearbox structure, type of gears, lubrication and type of coupling affects its performance. Depending on the number and type of gears, different combinations of output RPM and torque can be achieved. With fewer gears, the result is higher RPM and lower torque and vice versa. It can be mounted in any position.

The gear motor structure regulates whether the gear motor is suitable for light, medium or heavy loads and short or long operating periods. Depending on the internal gear structure and the reduction stages, the gear motor varies the speed on the output shaft. The reduction ratio is the ratio between the input speed and the output speed; therefore, it is one of the most important characteristic values of the gearbox. The power and load capacity of a gearbox depends on the maximum torque it can transmit, and it is measured in the physical unit Newton meter [Nm].

A servo motor (or servo motor) is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration.[1] It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analog or digital) representing the position commanded for the output shaft.

The motor is paired with some type of position encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero, and the motor stops.

IV. MOTOR DRIVER SHIELD(L293D).

The L293D is quadruple high-current half-H drivers. It is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enabled input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

The 74HC595 consists of an 8-bit shift register and a storage register with three-state parallel outputs. It converts serial input into parallel output so that you can save IO ports of an MCU. The 74HC595 is widely used to indicate multipath LEDs and drive multi-bit segment displays. "Three-state" refers to the fact that you can set the output pins as either high, low or "high impedance." With data latching, the instant output will not be affected during the shifting; with data output, you can cascade 74HC595s more easily.

Model Sample photo

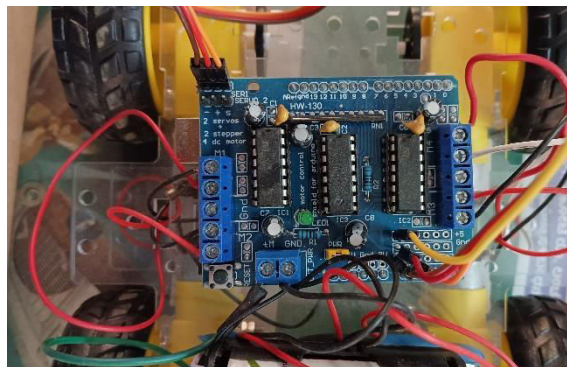


Fig 2: Motor Driver Shield

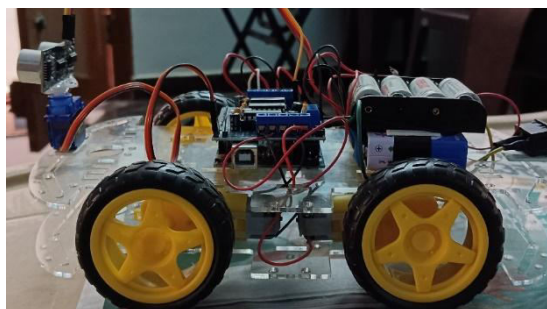


Fig 3: Robot (prototype)

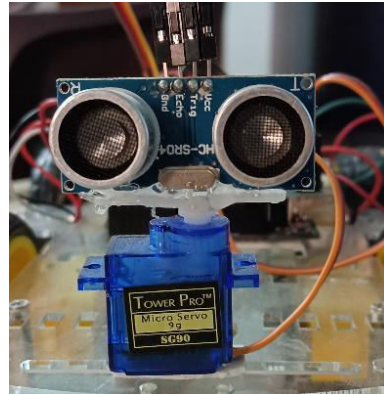


Fig 4: Ultrasonic Sensor

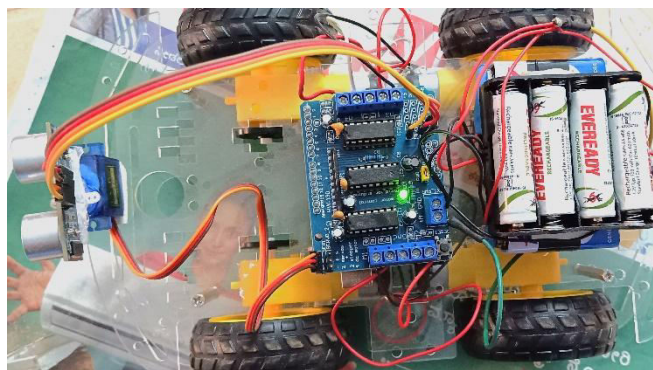


Fig 5: Working model

V. CONCLUSION

This paper was aimed to plan and execute an object detection system using ultrasonic sensors with distance estimation. This paper was successful in detecting the exact distance object and calculating the angle or direction of the object from the servo motor. The proposed system has only small errors while calculating the objects which are near to the sensor but is accurate in calculating the objects which are far from the sensor. This paper is very efficient in detecting objects and calculating the exact distance of objects. This paper will likewise have its application in mechanical and civil fields for exact and small estimations. For measuring the distance using this paper, the object whose distance is to be estimated must be horizontal to the plane of propagation of the ultrasonic waves. Overall, this paper can provide 100% efficiency unless the distance of the objects is less than 1 cm, or the size of the object is very small. However, it is important to note that the experiment was done in a constant environment.

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Department of CSE, Velammal Engineering College, Chennai, India

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