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Distance Measurement and Obstacle Avoidance using Ultrasonic Sensor and Arduino

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Abstract

In recent days, accidents are happen often it is difficult to drive the vehicles in visibility zero condition. Some safety measures has to be taken such an accidents. This can be done by monitoring the distance between the two objects. When the objects are come closer with in certain range, The ultrasonic sensor will detect the distance and displayed in LCD screen and correspondingly speed will be reduced.

Keywords: Ultrasonic Sensor; Arduino; Motor Driver kit

1.Introduction

The combined ultrasonic transit time and optical pulse method described here is an improvement over the standard ultrasonic echo by providing a lower signal loss and more precise location of sensor reference points, specifically the transmitting and receiving transducers. The ultrasonic transit time sensor described here uses only a one-way ultrasonic pulse. The transit time, typically 0.5 to 50 ms, is proportional to the distance between the ultrasonic transmitter and receiver transducers. There are three advantages: (1) the ultrasonic signal loss is much less, (2) the location of the transducers is well defined, and (3) the phase and pulse shapes are controlled and reproducible. An optical pulse is used to synchronize the transmitter and receiver. In this version the optical pulse is sent from the ultrasonic receiver unit, initiated by its microcontroller, to the ultrasonic transmitter unit.

2. Literature Review

Some literature review related to Distance Measurement by using various technology are briefly presented here.

Darold Wabschall[1]has determined the three dimensional position of the object within the room or other area using conventional magnetic,optical or vision sensors.. Ultrasonic echo methods can be accurate under controlled conditions, but the signal loss with varying atmospheric conditions, the shape of the object, surface profile, distance between the objects, propagation angles reduce sensor accuracy significantly. For example, with collision avoidance sensors, an ultrasonic pulse train, typically 5-20 cycles at 40 kHz, is transmitted through the air to the mobile object where it is reflected. A receiver located near the transmitter detects the weak echo and records the echo (sound round trip) time.

The time of flight for the optical signal is negligible so the microcontroller (at the receiver unit) starts its timer as the optical signal is sent. Hence the timer value when the ultrasonic pulse is detected at the receiver unit is the transit time for the ultrasonic signal between the transducers. From this time of flight and the sound velocity, the distance between the transducers can be calculated.They measured the distance using the Ultrasonic Sensor.The applications of this approach are limited to situations where the transducers and associated electronics can be mounted on both ends of the distance to be determined. Thus proximity detection, which uses an echo, will not work.

Nicola Ivan[2] had done the project titled ADVANCED ACOUISTIC SENSING SYSTEM ON A MOBILE ROBOT. we describe the construction and charcaterization of a low-cost ultrasonic sensing system for obstacle avoidance on a mobile robot. In some locations and in cer-tain conditions where electronic components are not readily available and not affordable, it is more advantageous to design an obstacle sensing system with a single sensor (e.g., HC-SR04) to reduce the construction cost. They decided to use only one sensor, mounted on a servo on the front of a mobile robot that scans and detects obstacles within the interval from 15° to 165° according to our design, to allow the estimation of the distance of currently detected obstacles with the help of a fuzzy rules set. The embedded fuzzy algorithm will select what obstacles should be avoided to perform collision-free navigation. A microcontroller with an Arduino bootloader was used to perform calculations and control the sensor (HC-SR04) and actuator (SG90 mini gear). The robot has two independent wheels, driven by geared PM dc motors, via the H driver L928N. The ultrasonic sensing system accuracy can be improved by considering ambient temperature in sound speed compution.The main measurement issue in these systems involves sensor array processing. Arrays play a basic role in radar, radio astronomy, sonar, communications, directions-searching,seismology, medical diagnosis and care, and measurements. The implementation of arrays of sensors to achieve certain performance criteria involves trade-offs among the array geometry, the number of sensors, signal-to-noise and signalto-interference ratios, as well as a number of factors. From a signal processing perspective, the main objective is to detect the signal arriving from a particular look direction and cancel out any interfering signals and noise. A beamforming processor can achieve this by electrically steering the Smart Antenna, rather than mechanically guiding it as done in years gone by. The advantages of beamforming are improvements in communication quality, throughput and efficiency, especially in fields such as radar, sonar, seismology and wireless communications. A sensor array receives incoming signal information. A beamformer processes the spatial samples collected to provide the required spatial filtering [6], [7]. The sensor array may be arranged in a number of different configurations, two of which are the Uniform Linear Array (ULA) and Uniform Circular Array (UCA) in 2D space. The beamformer linearly combines the spatially-sampled time series from each sensor to obtain a scalar output time series. Beamformers are grouped into three different classes: fixed, optimum and adaptive. Fixed beamformers are analogous to bandpass filters, and they strive

to pass signals spatially from a desired look direction and suppress all other signals arriving from all other angles.
From the literature review, it is observed that we can use the ultrasonic sensor for the distance measurement.

3. Experimental Details

The following section deals with components used in measuring the distance using the Ultrasonic Sensor.

3.1. Significance of ultrasonic sensor:

Fig.1.Ultrasonic sensor

- High Sensitivity
- High Penetrating Power
- High Frequency
- High Accuracy
- Non-Contact in Nature.
- It sends out a high frequency sound pulse and then times how long it takes for the echo of the sound to reflect back.
- Sensor has 2 openings
- One Opening Transmits Ultrasonic waves
- Another Opening Receives Them

3.2 Arduino

Fig.2.Arduino

Open source electronic Platform Based on Easy-to-Use Hardware and Software. Arduino Boards - To Read Inputs such as Lights on a Sensor , Finger on Button and turn it into Output.
EX : Turning On the LED
Activating The Motor
The Process Is done Using Microcontroller On The Board.

Arduino Compiler accepts C,C++
Reason for choosing Arduino :
* Inexpensive
* Cross Platform
*Simple, Clear Programming Environment - Easy To Use For Beginners
*Open Source Extensible Software - C,C++
*Open source Extensible Hardware – Circuit Designers : Own Version Module

Inexperienced Users : Breadboard version

DISTANCE MEASUREMENT RANGE : 2 CM – 400 CM
FREQUENCY : 40HZ

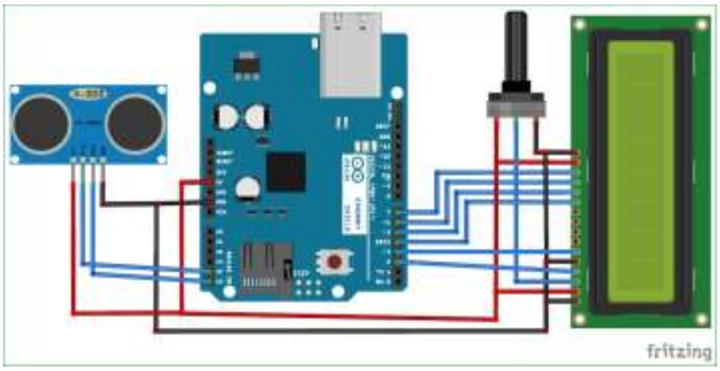

Fig.3. Schematic diagram for distance measurement

3.3 10k Potentiometer

Potentiometers also known as POT, are nothing but variable resistors. They can provide a variable resistance by simply varying the knob on top of its head. It can be classified based on two main parameters. One is their **Resistance (R-ohms)** itself and the other is its **Power (P-Watts)** rating.

The value or resistance decides how much opposition it provides to the flow of current. The greater the resistor value the smaller the current will flow. Some standard values for a potentiometer are 500Ω, 1K, 2K, 5K, 10K, 22K, 47K, 50K, 100K, 220K, 470K, 500K, 1 M.

Resistors are also classified based on how much current it can allow; this is called Power (wattage) rating. The higher the power rating the bigger the resistor gets and it can also more current. For potentiometers the power rating is 0.3W and hence can be used only for low current circuits.

3.3.1. Applications

- Voltage and Current Control Circuits
- Used as volume control knobs in radios
- Tuning or controlling circuits
- Analog input control knobs.

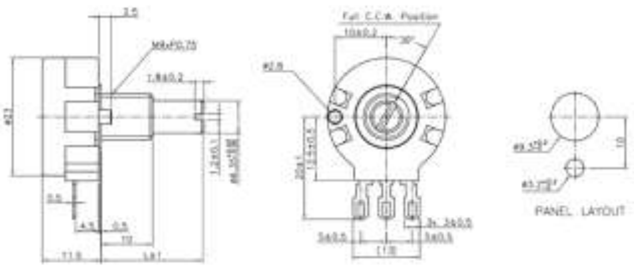

Fig.4.10k Potentiometer pins

3.4 Motor Driver IC L293D

L293D is a typical **Motor driver** or **Motor Driver** IC which allows DC **motor** to drive on either direction. **L293D** is a 16-pin IC which can control a set of two DC **motors** simultaneously in any direction. It means that you can control two DC **motor** with a single **L293D** IC. **L293D** IC is a typical **Motor Driver** IC which allows the DC **motor** to drive on any direction. ... This **L293D** IC **works** on the basic principle of H-bridge

Fig.5.Motor Shield (AdaFruit)

3.5. Working of L293D

The **L293D** IC receives signals from the microprocessor and transmits the relative signal to the motors. It has two voltage pins, one of which **is** used to draw current for the working of the **L293D** and the other **is** used to apply voltage to the motors.

3.6. L293D Motor Drive with Arduino

Place the **L293D** in the center of the breadboard, with half of the pins on either side of the breadboard. Connect 5V to Enable 1 , Vss , and Vs on the **L293D**. Connect digital output pins (we're **using** 6 and 7) to input 1 and input 2 on the **L293D**. Connect your **Arduino's** GND to both GND pins on the same side of the **L293D**

3.7. Need of L293D

L293D IC receives signals from the microprocessor and transmits the relative signal to the motors. It has two voltage pins, one of which **is** used to draw current for the working of the **L293D** and the other **is** used to apply voltage to the motors.

3.8. Circuit Connection

Using the schematic diagram we have made the connections to measure the distance using LCD display.

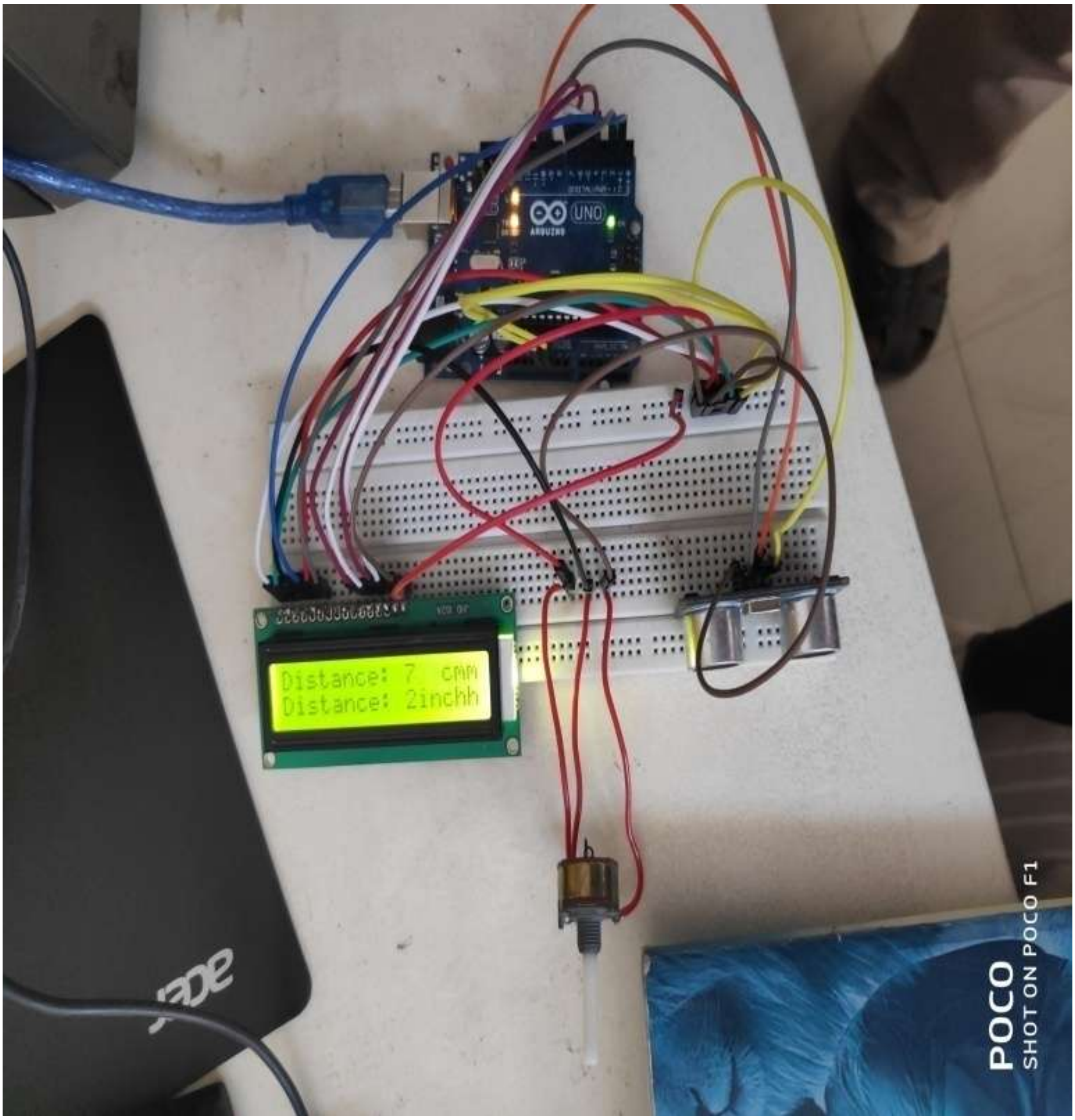

Fig.6.Diagram for distance measurement

4. Methadology

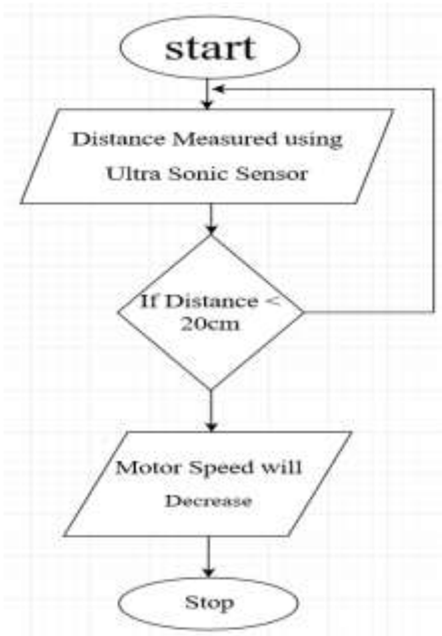

Fig.7. Flow chart

After the execution of the program to the arduino,the vehicle will start running.and then car will avoid the obstacle by using l293d circuit board. If the obstacle is less than 20 cm, the led will glow and a buzzer will alarm,so the vehicle will diverted to the free spaces .The working done is by using ultrasonic sensor and arduino with motor driver shield **L293D** IC receives signals from the microprocessor and transmits the relative signal to the motors. It has two voltage pins, one of which **is** used to draw current for the working of the **L293D** and the other **is** used to apply voltage to the motors.

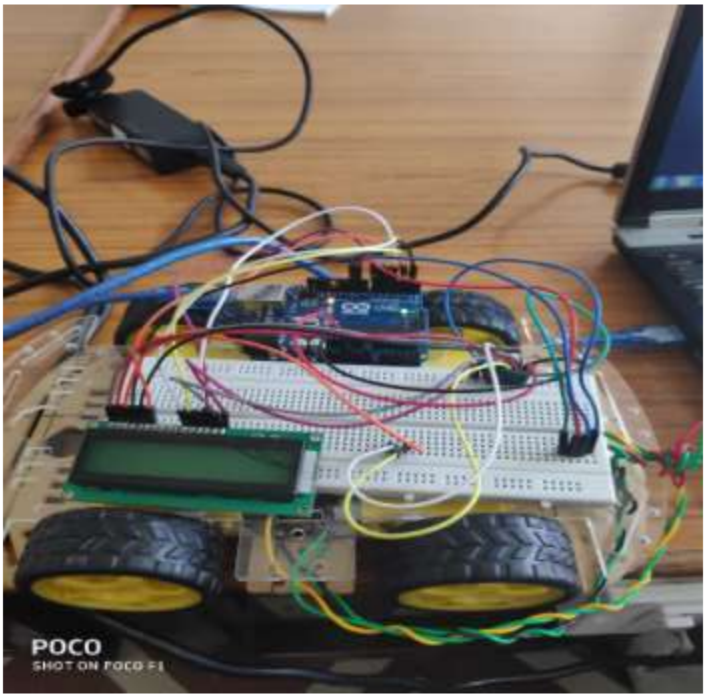

Fig.8. Vehicle setup

The above diagram shows the vehicle setup with four motors, Arduino, LCD display.

5. Conclusion

The purpose of this work is to avoid obstacle to prevent from accidents in Fog condition. The conclusion of our project is to avoid the collision between the vehicles and to improve the safety measurements in automobiles.Almost all sort of robot demands the same sort of obstacle detection.hence the obstacle avoidance is most importatnt.

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