Amrutvahini College of Engineering, Sangamner
Department of Electronics and Telecommunication
Project Based Learning (PBL) Project Synopsis
Academic Year: 2021-22

Project Title: **Contactless Distance Measurement System**

Project Group Members:

1. **Sarthak Devidas Varade (Roll No: 60)**
2. **Aditya Rajendra Varpe (Roll No: 61)**
3. **Tejas Bhausaheb Varpe (Roll No: 62)**
4. **Onkar Uttam Waman (Roll No: 64)**
5. **Omkar Sunil Yelmame (Roll No: 65)**

Introduction:

Distance measurement of an object in front or by the side of a moving entity is required in a large number of devices. These devices may be small or large and also quite simple or complicated. Such distance measurement systems are available. These uses various kinds of sensors and systems. Low cost and accuracy as well as speed is important in most of the applications.

Among the various techniques of noncontact measurement, ultrasonic technique is the best when we need stable and accurate distance of obstacle, no matter what colour it is. It is also usable outside in the sun. As the human ear's audible range is 20 Hz to 20 kHz, it is insensitive to ultrasonic waves, and hence the ultrasound waves can be used for applications in industries or vehicles without hindering human/other activity.

In this project, we are going implement such a measurement system which uses ultrasonic sensor unit and an Arduino Uno based system. The Arduino Uno is easily available at low cost. An error correction is applied to minimize the error in the measured distance. Ultrasound sensors are very versatile in distance measurement. They are also providing the cheapest solutions. Ultrasound waves are useful for both the air and underwater. Ultrasonic sensors are also quite fast for most of the common applications. The working of this system is to take input from ultrasonic sensor about the obstacle and send it for processing to Arduino, then display the results on the lcd screen.

Amrutvahini College of Engineering, Sangamner
Department of Electronics and Telecommunication
Project Based Learning (PBL) Project Synopsis
Academic Year: 2021-22

Related Work:

SR NO.	Research Paper	Positive Aspects	Negative Aspects
1.	Design of an Ultrasonic Distance Meter[1]	It can measure distance very accurately	But the range of measurement is 2.5 m
2.	Obstacle Detection Using the Concept of Ultrasound[4]	It can detect obstacles in its path	It can only detect obstacle not the distance
3.	Optical Sensor for Noncontact Measurement of Lignin Content in High-Speed Moving Paper Surfaces[8]	The optical sensor is faster than ultrasonic sensor	But optical sensor cannot be used in direct sunlight or high temperature
4.	Embedded System Based Radio Detection and Ranging (RADAR) System Using Arduino and Ultra-Sonic Sensor[6]	It uses high intensity ultrasonic waves which can travel distance up-to 3 m	It is not portable which makes it hard to transport

Research Motivation:

When measuring with a tape, there is a chance that it will bend and may lead to inaccurate readings. With a typical tape measure, it requires two-hand operation in many cases. Also, in market the laser-based measurement devices are available but they can't be used in direct sunlight. As IR sensors distance measurement systems cannot work good in different light conditions and also cannot work in water, hence to overcome all these drawbacks we are going to build a low-cost system to measure the distance which will work under water and is not affected by varying light conditions.

Amrutvahini College of Engineering, Sangamner
Department of Electronics and Telecommunication
Project Based Learning (PBL) Project Synopsis
Academic Year: 2021-22

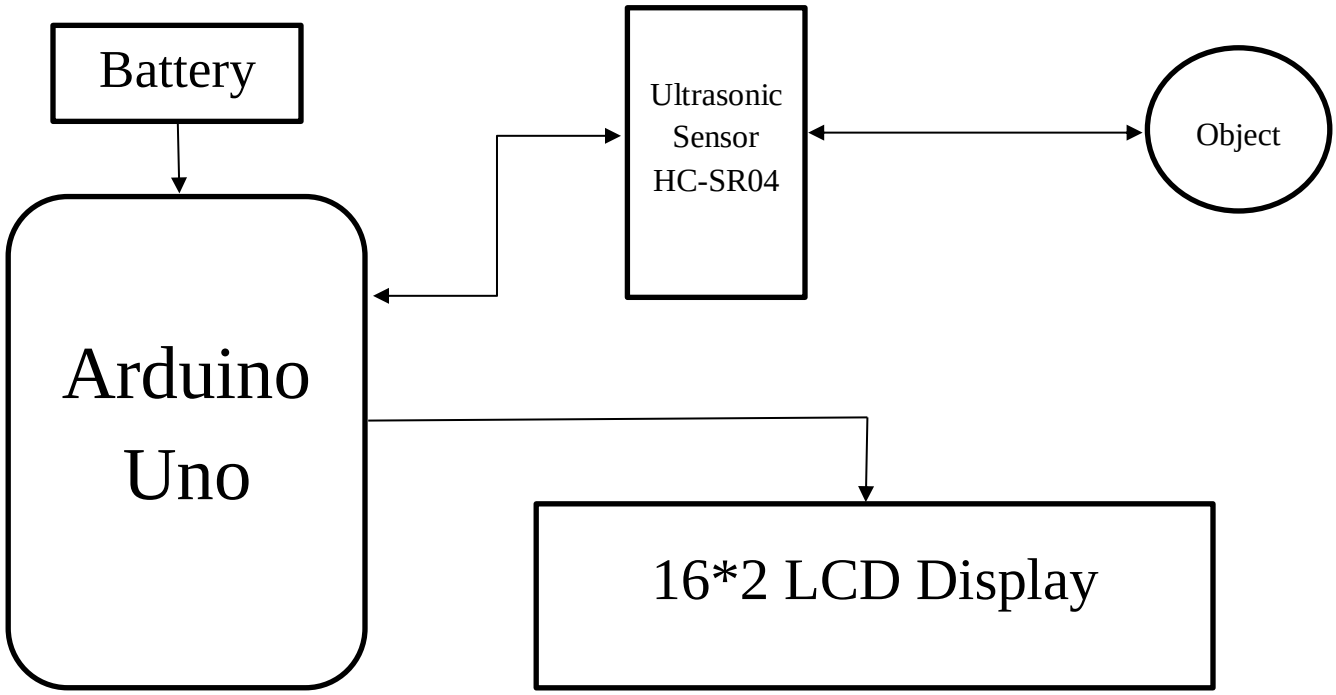
Project Aim:

The aim of this project is to design and develop contactless distance measurement system which uses ultrasonic waves to detect obstacle.

Objectives:

1) To study the working of ultrasonic sensor, Arduino uno, lcd display.
2) To study the behavior of ultrasonic waves i.e., reflection of ultrasound.
3) To measure distance without direct contact with the object.
4) To measure the distance with accuracy.
5) The main objective of this system is to measure the distance between system and the object without any physical contact with the object.

Block Diagram:



Amrutvahini College of Engineering, Sangamner
Department of Electronics and Telecommunication
Project Based Learning (PBL) Project Synopsis
Academic Year: 2021-22

Expected Outcome:

We are expecting that, when user turns on the power button of the system then immediately Arduino instructs ultrasonic sensor to transmit ultrasonic signal towards the object and the object will reflect that signal. So, by using the difference between the transmitted and reflected waves, then Arduino will calculate distance between object and ultrasonic sensor. This calculated distance will be sent to the lcd display. So that the accurate distance will be displayed on the screen.

Project Type: Inhouse

Any Other Details -
Components used:

1. **Arduino UNO Board:** Arduino UNO is an open-source, low cost, power efficient, high speed microcontroller board build using ATmega328P microcontroller. It has a type B USB port for power as well as code uploading purpose. It can be programmed using Arduino IDE.

2. **Ultrasonic Sensor(HC-SR04):** This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit.

3. **LCD Screen(16*2):** LCD (Liquid Crystal Display) screen is a low cost, power efficient electronic display module and has a wide range of applications. It is 16*2 module i.e., it can display 32 characters at a time on the screen.

4. **Battery(9V):** A typical 9V battery is used to provide power to the whole system. It can provide power to the system up to 30 hours.

5. **Jumper Wires:** They are used to connect the modules and sensors with each another.

6. **SPST switch:** It is used to power ON/OFF the whole system.

Algorithm:

Step 1: Start

Step 2: Transmit pulse and initialize the timer

Step 3: Count time until getting reflected pulse

Step 4: If get reflected pulse then stop the timer, else wait until getting reflected pulse

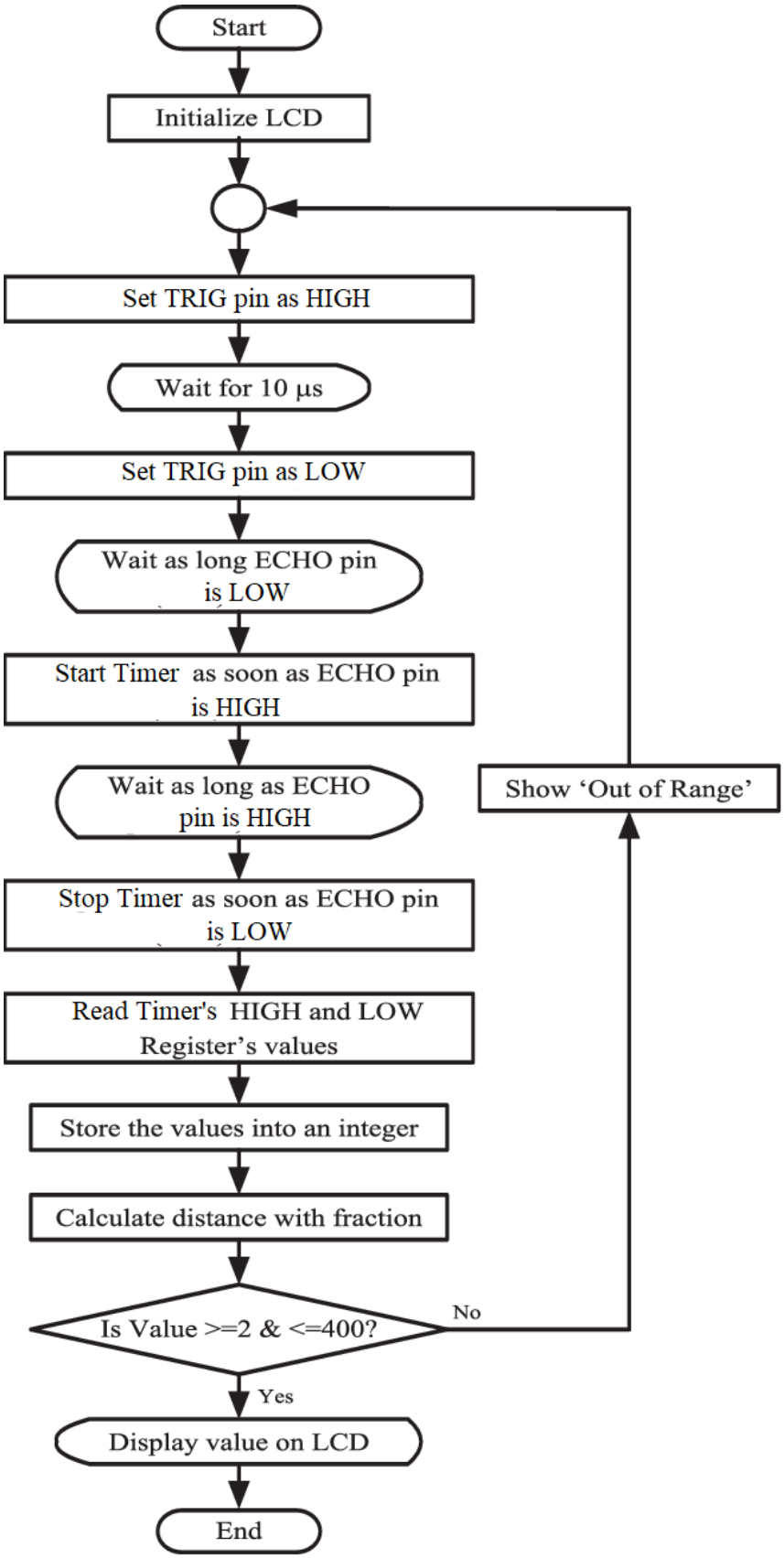
Step 5: Then send counted time to MCU for calculations

Step 6: After calculation send the results to display them on lcd screen

Step 7: End

Amrutvahini College of Engineering, Sangamner
Department of Electronics and Telecommunication
Project Based Learning (PBL) Project Synopsis
Academic Year: 2021-22

Flowchart:



References:

Research papers:

[1] Arefin Shamsul MD., & Mollick Tajrian (2013). Design of an Ultrasonic Distance Meter. International Journal of Scientific & Engineering Research Volume 4, Issue 3 M.

[2] Rüeger, J. (1980). Recent developments in electronic distance measurement. Australian Surveyor. 30. 10.1080/00050326.1980.10442489.

[3] Jetzt, J. J. (1979). Critical distance measurement of rooms from the sound energy spectral response. The Journal of the Acoustical Society of America, 65(5), 1204-1211.

[4] Suleiman Khayal, Osama. (2016). Obstacle Detection Using the Concept of Ultrasound. 10.13140/RG.2.2.15918.82246.

[5] Huang, C. F., Young, M. S., & Li, Y. C. (1999). Multiple-frequency continuous wave ultrasonic system for accurate distance measurement. Review of scientific instruments, 70(2), 1452-1458.

[6] Ahman, Emmanuel & Maryam Oluwadamilola, Abdusalaam & Lukman, Ajao. (2017). Embedded System Based Radio Detection and Ranging (RADAR) System Using Arduino and Ultra-Sonic Sensor. American Journal of Embedded Systems and Applications. 5. 7-12. 10.11648/j.ajesa.20170501.12

[7] H. Bhuyan, M. A. Rabby, M. A. Parvez and M. M. G. Tarik, "Microcontroller Based Display System Design using LED Array," Proceedings of the Conference on Engineering Research, Innovation and Education, Shahjalal University of Science and Technology, Sylhet, Bangladesh, 11-13 Jan 2010, pp. 417-420.

[8] K. Ramasubramanian, R. A. Chandini and V. Mallapragada, "Optical Sensor for Noncontact Measurement of Lignin Content in High-Speed Moving Paper Surfaces," IEEE Sensors J., vol. 5, no. 5, pp. 1132-1139, 2005

[9] Duval, "Advances in Analog Distance Sensing", Sensors Magazine, September 2004.

[10] B. Legrand, Y. Dordet, J. Y. Voyant and J. P. Yonnet, "Contactless Position Sensor using Magnetic Saturation," Sens. Actuators A, vol. 106, pp. 149- 154, 2003.

[11] L. F. Root and L. Kaufman, "Noncontacting Low-Cost Instrument for Film Thickness Measurement," IEEE Trans. Instrum. Meas., vol. 41, no. 6, pp. 1014-1019, 1992.

[12] M. A. Mazidi, R. McKinlay and D. Causey, "PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18," PrenticeHall, USA, 2007

Blogs:

[14] The ultrasonic sensor tutorial
https://lastminuteengineers.com/arduino-sr04-ultrasonic-sensor-tutorial/

[15] Arduino complete guide
https://howtomechatronics.com/tutorials/arduino/ultrasonic-sensor-hc-sr04/

YouTube:

[17] Ultrasonic Sensor HC-SR04 and Arduino Tutorial
https://youtu.be/ZejQOX69K5M

Amrutvahini College of Engineering, Sangamner
Department of Electronics and Telecommunication
Project Based Learning (PBL) Project Synopsis
Academic Year: 2021-22

Remark of Project Guide:

Remark of PBL Coordinator:

Remark of Head of Department:

	Dr. S. R. Jondhale	Dr. R. P. Labade
(Project Guide)	**(PBL Coordinator)**	**(Head, E&TC Department)**