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Analysis of Obstacle Detection with Distance Measuring using Arduino Uno and Ultrasonic Sensor

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Abstract - *Finding the distance we want to measure is really hard these days. Still, the tape is an easy option, but this type of tool will be limited of hand error. Prior to this, engineers had produced a range finder module but in the end, they found out that the module has many problems such as distance limit, different results with various colored obstacles, and we need to measure it all the time before we start using it. Regular distance measurement is done by consuming human error. It is accurate and correct measuring the distance of the minimum width, which is the main purpose of this project. This device may measure distances from a distance of 0.5m to 4m with 1cm accuracy. This project is used to measure a file of distance through ultrasonic sensors. It works by the transmission of ultrasonic waves at 40 kHz. After that, the transferors will rate the amount of time taken for the audio flow to certain areas then return as a marked echo. The microcontroller will calculate the distance depending on the speed of noise at 25 ° C at current and current temperatures taken. The distance there will be displayed in the LCD module. The project value calculates the exact distance from any obstacle we want to measure. The device can be used in many different fields and categories such as distance calculations in construction camps, robots, car sensors to avoid obstacles to many other applications. The device build process was based on as many uses as possible in the lessons taken from the file universities, such as Micro Processor, Basic Electrical Engineering, Multimedia, and Electronics programs and devices to work done in labs. Such applications are already available, but the efficiency of the available distance measurers is not achieved thoroughly. This newly developed application proposes to take a step further and measure the distance that enhances visual accuracy on a much larger scale.*

Key Words: Arduino, Sonar Sensors, Distance Measurement, Calibration, Arduino Uno, Processing

1.INTRODUCTION

[1] The ultrasonic sensor has a transducer that emits a high frequency, acoustic waves that are not audible on one side when the transducer component vibrates. When the waves hit something, the transducer receives an extended signal. [2] The sensor then determines its distance from an object depending on the length of time between the initial sound and the echo return. Ultrasonic sensors require precise time rotation, so acoustic sensors really require a specific processor to drive them. [3] Ultrasonic sensors should be the first means of obtaining clear substances, beverages, dense substances of any kind (rough, smooth, shiny), and irregularly shaped objects. This makes them one of the best options for measuring the height of containers that can vary in size, size, colors, and materials. [4] The transmitter transmits the ultrasonic waves close to the object and by the time taken by the echo from the resistance and resistance transmitter to the receiver, the distance is calculated. [5] When the obstacle is within the specified range the compiler sends a signal to the microcontroller which sends the output signal.

1.1 BACKGROUND OF THE WORK

During the 18th century, the growth of electro-optical distance radiation has evolved with the technique of determining the speed of light. Fizeau, who determined the speed of light in the 1840s, with many inventions; [6] Bergstrand was then encouraged to design the first "Geodimeter" in the 1940s. [7] This phenomenon has evolved and evolved throughout history with the longing of scientists. In addition, recent scientists began to apply for a patent on the electromagnetic distance meter, this was done by Löwy in 1923. [8] The use of this ultrasonic distance measuring device helps to measure the distance between two objects. Instead of using devices such as measuring tape, an ultrasonic device can determine a length between two points up to four meters. [9] The researchers decided to conduct this study to create a type of ultrasonic distance measuring device and to study and understand the basic concepts of using ultrasonic as a distance measurement method. [10] The concepts of how to code performance works when using Arduino UNO, ultrasonic distance measurement, Sonar, etc., This project will help to measure two points; this device uses the sonar concept to determine the object range.

Distance measurement is a function of finding and comparing in the real world. There are many types of distance measurement systems. [11] One of the ways to get scope according to infrared (IR) techniques. We effectively eliminate environmental disturbances by using circuit techniques and let the costly IR sensor accurately detect the target location. [12] The low power consumption of ultrasound is found in viscosity determination, stress, hardness, non-corrosive testing, and acoustic extraction. [13] Ultrasonic medical and surgical devices operate with high

frequency and low frequency of biological tissue separation. Ultrasonic Generator is basically a transmitter that transmits ultrasound around using air as a balance. [14] Ultrasonic is also used for quality and depth measurement. The ultrasonic range identifier using PING Parallax's >>> ultrasonic sensor provides better performance [15] The ultrasonic sensor can get a diameter of 2cm to 2.5m with an accuracy of 0.1cm.

1.2 IMPLEMENTATION

This is a hardware IoT project using SONAR SENSOR and ARDUINO which is used to measure the distance of an object from the Sensor. [16] Internet of Things are objects with software or sensors which are used for collecting and exchanging data with other different devices. These devices range from ordinary objects to developed industrial tools.

SONAR refers to Sound Navigation and Ranging. It is a technique that uses sound propagation basically underwater to navigate, measure distancing, communicate with, or detect objects on or under the surface of the water. [17] This technology can be used in many real-world practical and useful projects. Arduino boards can read inputs and turn them into an output like turning on an LED, publishing something online in the real world.

We can compel our Arduino board to do what it does by sending small commands to the microcontroller on the board to perform systematic tasks. [18] To instruct perfectly we can use the Arduino programming language, and the Arduino IDE based on Processing. IDE is Integrated Development Environment. Here in our project, we have used Arduino Uno and set some specific instructions to implement distance fetching.

[19] Arduino has been applied for thousands of projects for different practical uses. Basic to advance every type of works has been done with this Arduino. A community from the entire world like students, hobbyists, artists, programmers, electricians, engineers, developers, researchers, professionals have used the facilities of this open-source platform. [20] Gradually the contributions of everyone have been added up to a surprising amount of accessible knowledge. To neophytes as well as advanced, users implemented many projects using this technology.

Arduino Uno is based on the ATmega328P which is a microcontroller board. [21] It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. It contains all the things which are needed to support the microcontroller. We have to simply power it with an AC-to-DC adapter or battery to get started by just connecting it to a computer with a USB cable. We can use our UNO without worrying too much about doing something wrong because the worst-case scenario can be to replace the chip for some money.

[22] The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino which are now evolved to newer releases. We needed some jumper wires for connecting the sonar sensor and the Arduino Uno.

For this project first of all we connected the SONAR sensor with the Arduino UNO with jumper wires. Then we have connected the Arduino to the Laptop in the USB port using the USB cable. After that, we have opened Arduino IDE in our windows on our laptop. Then we have written some code to give preferred instructions to Arduino according to our processing.

The main purpose of our project is to measure the distance between the sensor and the object. For the measurement, we have placed a 30 cm scale on a table or floor. Then we have placed the SONAR sensor at the starting edge of the scale or at 0 cm point. Then we have connected the SONAR senor with the Arduino UNO according to the circuit diagram. We have used male-to-male jumper wires to connect those. Then we have connected the Arduino with the laptop by the USB cable through the USB port. After that, we have uploaded the instructions through code in the Arduino UNO. Then the measured distance has been shown on the screen.

We have used the LED display screen of our laptop to show the output. The output comes in cm and it has been shown clearly on the black and empty screen. We have placed the object in different places in different cm points and the output changes accordingly. [23] The distance which the laptop shows is accurate as we can cross-check it by seeing the scale with just bare eyes. The object we have used are like remote, mouse, pen, pencil box, etc. The output is not slow it comes in a time of blinking eyes as soon as we change the position of the object.

[24] Basically, this project is to determine the distance of an obstacle from the SONAR sensor. The obstacle is detected in the path of the transmitted sound waves toward a target. The distance will be measured by calculating the time it took to come back to the transmitter. The SONAR sensor acts like both transmitter and receiver. Here one round part is a transmitter and another round part is the receiver. [25] The ultrasonic waves travel faster than other sounds. These waves come from the transmitter and reflect from the object to obstacle and finally some back to SENSOR. Like this the processing of our distance fetching project takes place.

This system has many real-world applications. [26] We can use this idea in the parking areas in the individual cars so that if a car is parked within the minimum distance, then an alarm will alert people. This system can be also implemented in any lock or safety system. If a human comes to a certain close distance to the safe it will generate an alarm to security systems. [27] This idea can be implemented to solve any distance measurement-related problems. This idea is very useful and in the future, it can be implemented in many electronics, mechanics, or any other field.

This project using Ultrasonic Sonar Sensor and Arduino Uno not only gave us a successful and efficient way to measure distance but also the procedure and approach enhances our knowledge. We have understood the working process of the SONAR sensor and the concept of transmitting and receiving ultrasonic waves. We have learned about Arduino UNO. We have worked in [28] Arduino IDE and learned to set instructions in Arduino UNO. These concepts are used worldwide by many scientists, researchers, developers, etc. The procedure of this project has attracted our attention for its great real-world applications.

2. EXPERIMENTAL SETUP

The architecture of the distance measuring system is shown below in Figure 1:

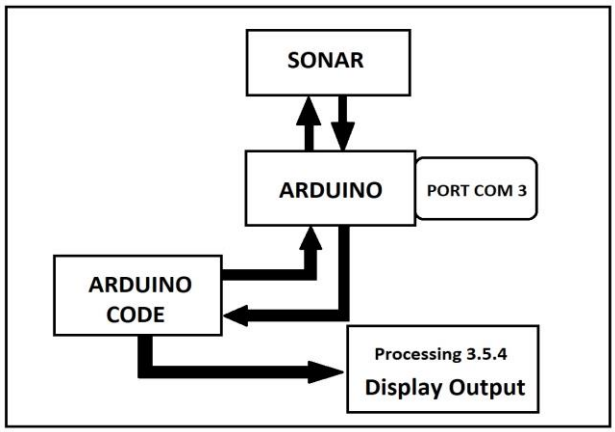

Figure 1: Architecture of the Distance Measuring System

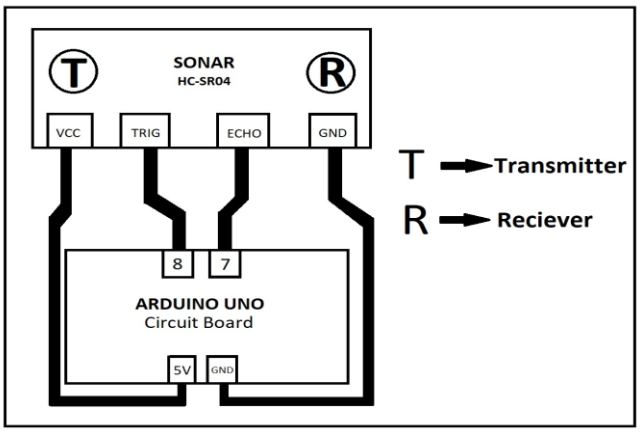

Figure 2: Hardware Circuit Diagram of the Distance Measuring System

2.1. RESULT ANALYSIS

Table 1: Experimental Results

S No.	Actual Distance (cm)	Measured Distance (cm)	% Error
1	5	6	20
2	10	11	10
3	15	17	13.33
4	20	22	10
5	25	27	8
6	30	30	0
7	35	35	0
8	40	40	0
9	45	45	0
10	50	50	0

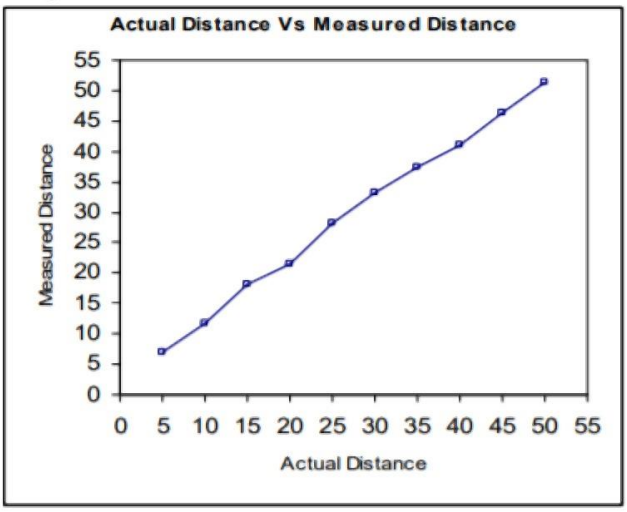

Figure 3: Graph between Actual Distance and Measured Distance

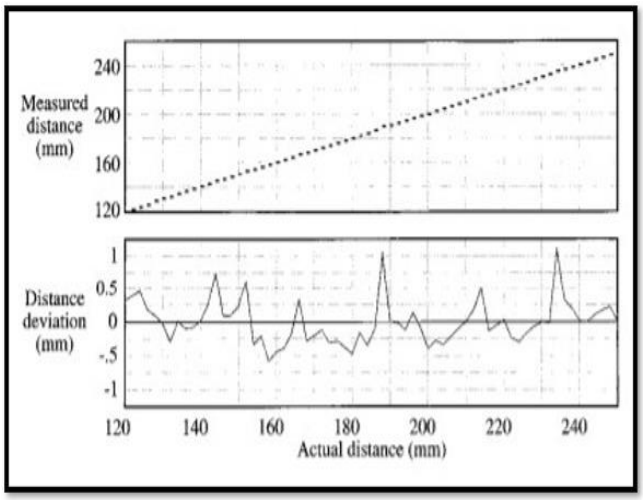

Figure 4: Sensor Linearity with respect to distance

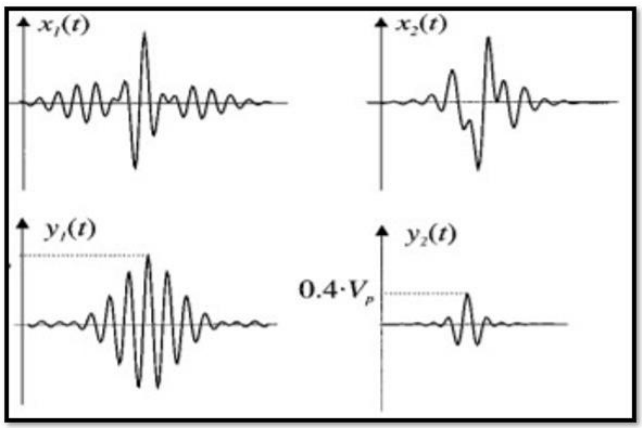

Figure 5: Examples of Simulating Signals and Expected Echoes

2.2. FUTURE SCOPE

1. We can use humidity sensors in the future to measure distance in different environments.

2. Using ultrasonic sensors with better specifications we can increase the distance measurement range.

3. This system is used in driverless cars to detect obstacles.

The range can be improved by:

1. Using temperature adjustable devices, it can be used over a wide temperature range.
2. Using High Range Ultrasonic sensors to extend the range of distance measurement.
3. Using two ultrasonic sensors for Two-Dimensional Measurements like Length and Breadth at the same time.

3. CONCLUSIONS

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The importance of a project is to calculate the exact distance from any obstacle it seeks to measure. [29] The device can be used in many different fields and categories such as distance calculations in the construction industry, robots, car sensors to avoid obstacles, and many other applications. [30] The process of designing this device was based on the use of as much as possible in university-based courses, such as Microsoft Processor, Basic Electrical Engineering, Multimedia and Systems, and Electronics Devices, as well as practical work in laboratories.

Applications of Distance Measuring System include the following:

This is a very economical technology and can be used in several other fields as well, few are listed as below:

1. Can be used as parking assistance systems in vehicles with high-power ultrasonic transmitters. 2. Can be used as a burglar alarm with suitable additional software for homes and offices.

3. Can be used in liquid level measurement.

4. Can be used to check breakdowns in wires or threads.

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