Distance Tracker Using Arduino Uno and Ultrasonic Sensor

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Abstract: The article is interfaced with an Arduino Uno and is intended to measure distance using ultrasonic waves. It is known that human hearing ranges from 20 Hz to 20 kHz. The HC-SR04 ultrasonic sensor can be used with these waves in the frequency range. One of this sensor's advantages is that it can be interfaced with the Arduino Uno, a sensing and control system, to open up new possibilities for precise distance measurement. A great way to measure distance without physically touching anything is with an ultrasonic sensor.

Keywords: Arduino Uno, Ultrasonic Sensor, Distance Measurement, LED Feedback, Microcontroller.

I. INTRODUCTION

The ultrasonic sensor releases high-frequency sound waves, and it then counts the time it takes for the waves to return after hitting an object. The Arduino determines the distance to the object in front of the sensor by measuring the speed of sound. Based on the estimated distance, the LED gives visual input; if the object is inside a certain range, it illuminates, and if not, it stays off.

The system is implemented on a breadboard where connections are made between the Arduino Uno, ultrasonic sensor, LED, and necessary resistors using jumper wires. The Arduino sketch is developed to read sensor data, calculate distances, and control the LED based on measured values. Serial communication is utilized for debugging and monitoring distance readings.

II. TOOLS & TECHNOLOGIES

1. Computer with Arduino IDE installed
2. USB Cable (typically USB A to B) to connect Arduino Uno to your computer
3. Breadboard
4. Jumper wires.
5. Arduino Uno
6. Ultrasonic Sensor (HC-SR04 or similar)
7. LCD Display (16x2 or 20x4) with I2C backpack
8. Resistors: 220Ω (for the LCD if not using an I2C module)
9. Potentiometer (for adjusting LCD contrast if not using I2C module)

Arduino IDE: Integrated Development Environment for writing and uploading Arduino code.

New Ping Library: A library for the ultrasonic sensor that provides easy-to-use functions to measure distance accurately.

III. HARDWARE OVERVIEW

A. Ultrasonic Sensor:

Ultrasonic sensors work similarly to sonar sensors. Ultrasound has been produced by sound waves which have higher frequencies than 20,000. Because this ultra sound frequency is not heard by the human ear. Similar to a microphone, the sensor's transducer both receives and transmits ultrasonic sound. Ultrasonic sensors use a single transducer for transferring and receiving data, just like other sensors. The sensor can determine the distance to measure the number of

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seconds that is processed sending and receiving the ultrasonic pulse.

Fig. 1 Ultrasonic Sensor

Fig. 2 Bread Board

B. Breadboard*:*

A breadboard is a rectangular, white board with tiny holes already drilled into it for the insertion of electronic components. In electronics projects, it is frequently employed. A breadboard can also be thought of as a prototype that forms the basis for creating circuits. The word "breadboard" comes from the phrases "bread" and "board." The word "breadboard" was used when the bread slices were initially cut. Only these boards are known as breadboards, and they provide a quick electrical connection. White plastic is the material used to build breadboards.

C. Jumper Wires:

Simply described, jumper wires are cables that have connector pins on both ends and can be used to join two locations without the need for solder. Usually, jumpers are used alongside breadboards and other prototyping equipment to facilitate the modification of circuits as needed. Male ends have a pin that can plug into things, while female ends do not have a pin plug that can plug into other things.

Fig. 3 Jumper Wires

Fig. 4 Arduino Uno

D. Arduino Uno:

Other boards, such as the Arduino Mega board, etc. use is straightforward. Input/output (I/O) pins, both digital and analog, shields, and extra circuitry comprise the board. In addition to a USB connector, six analog pin inputs, a power jack, and fourteen digital pins, the Arduino UNO is well-equipped. For programming, there is an IDE, or Integrated Development Environment. It works both online and in real-world situations. Use of the same IDE is possible for all Arduino boards.

ATmega328 Microcontroller: The ATmega328 microcontroller is a single-chip microcontroller. The processor code consists of eight bits. It consists of memory SRAM, EEPROM, and Flash, oscillator, timer, SPI serial ports, registers, I/O lines, and internal and external interrupts.

ICSP pin: The Arduino board's firmware can be programmed by the user through the In-Circuit Serial Programming pin.

Power LED Indicator: When LED is in the on condition it means power is on. and when the LED is not light up it means the power is in off condition.

Digital Input/output pins: The values of the pins can be adjusted to HIGH or LOW. D0 through D13 are the numbers assigned to digital pins.

TX and RX LEDs: When these LEDs light up, successful data has been transferred.

Analog Reference (AREF): An external power supply provides a reference voltage to the Arduino UNO board's Analog Reference connection.

Reset button: It is utilized to provide the connection with a reset button.

USB: It enables communication between the board and the computer. To program the Arduino UNO board, it is required.

Crystal Oscillator: A Crystal Oscillator is an electronic oscillator. A crystal oscillator uses the mechanical resonance of a vibrating crystal to create a precise frequency signal.

Voltage Regulator: The input voltage is increased to five volts by the voltage regulator.

GND: Ground pins have the GND designation. As a zero-voltage pin, the ground pin serves this purpose.

Vin: The voltage at the input is what it is.

Analog Pins: Analog pins are used to read the analog sensors used in the connection. It also has the ability to operate as GPIO (General Purpose Input Output) pins.

E. LED :

More and more people are starting to realize the advantages of LEDs (Light Emitting Diodes). Applying a voltage causes a PN Junction Diode to release photons or light. The PN Junction's recombination of electrons and holes is the source of this. A PN Junction Diode and an LED have comparable electrical indications.

F. Resistor (220 ohms) :

A 220-ohm resistor is used to stop the flow of electricity in the circuit. A 220-ohm resistor typically has color bands that are red, brown, black and golden. 220 ohms value means it reduces the flow of voltage and current into the circuit. A 220-ohm resistor is a passive electronic component that is used to oppose the flow of electric current.

Fig 5 Resistor

G. Arduino IDE :

The Arduino IDE where IDE is an Integrated Development Environment. The Arduino Uno is used to write the computer code and upload this code on the physical board.

The Arduino IDE will appear as:

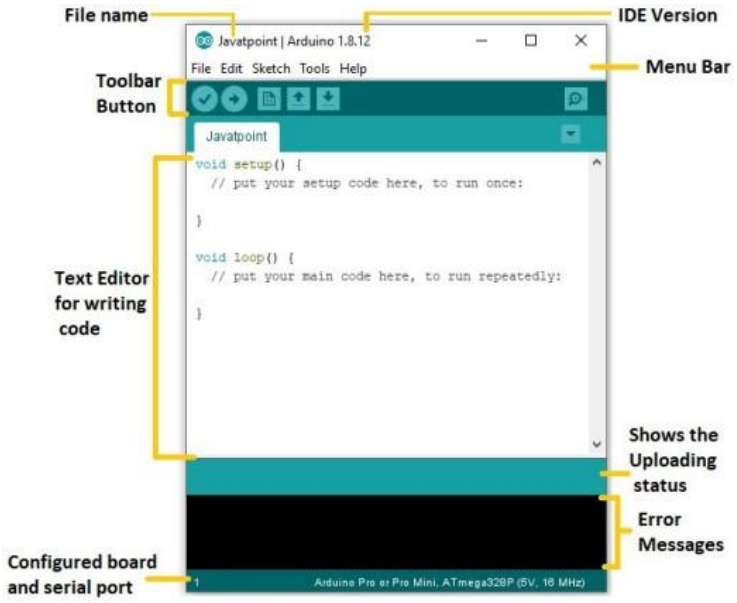

Fig. 6 Arduino IDE

H. Toolbar Button:

The New, Open, Save, Upload, and Verify icons are shown in the toolbar. It is displayed below:

Fig. 7 Toolbar

I. LED :

A growing number of individuals are beginning to recognize the benefits of LEDs (Light Emitting Diodes). A PN Junction Diode releases photons, or light when a voltage is applied to it. This is caused by electrons and holes recombining in the PN Junction. The electrical indication of an LED and a PN Junction Diode are similar.

J. Resistor (220 ohms) :

An electrical component used in circuits to obstruct the passage of electricity is a 220-ohm resistor. Resistors have been applied in Voltage division and regulation, current limiting and protection, Signal attenuation and filtering, and Impedance matching. A resistor is a fundamental electronic component used to control current flow within an electrical circuit. The adaptability and capacity to exactly manage current in a range of applications make the 220-ohm resistor recognized.

IV. DESIGN AND IMPLEMENTATION

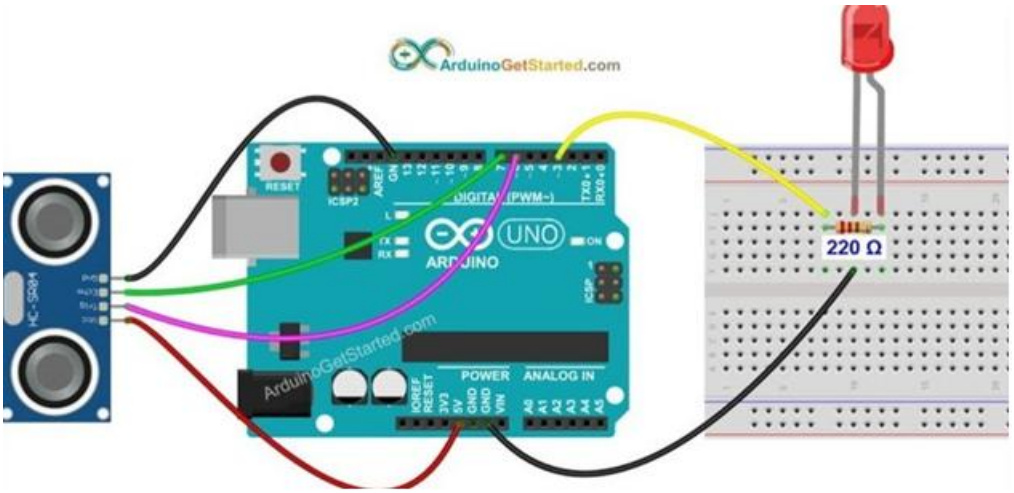

Fig. 8 System circuit design

System circuit implementation on a breadboard:

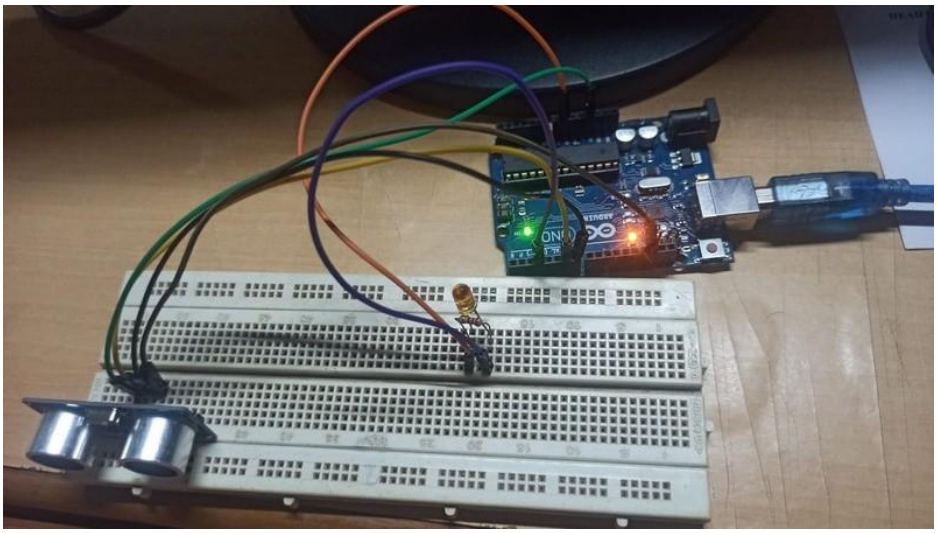

Fig. 9 Implementation on breadboard

V. FLOW CHART

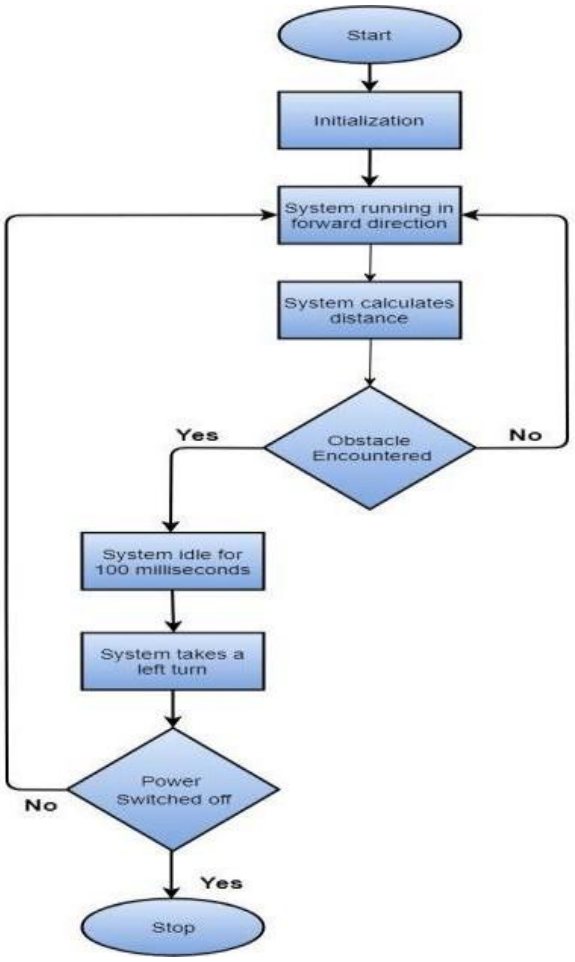

Fig.10 flowchart

VI. WORKING AND RESULTS

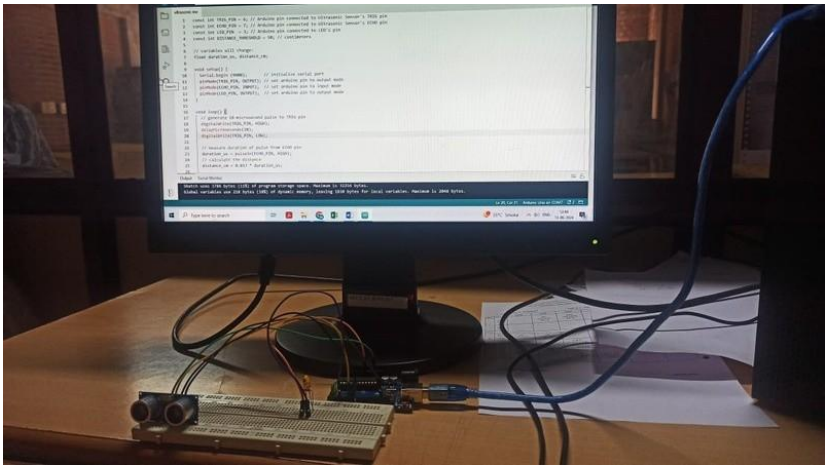

Fig. 11 Result

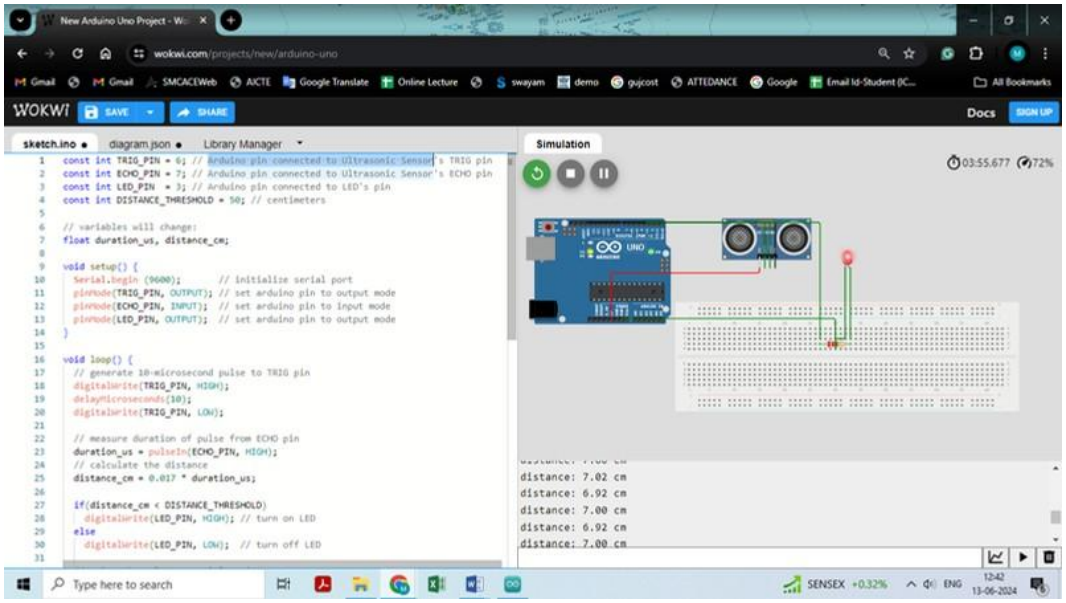

Fig. 12 Simulation Result

VII. CONCLUSION

The purpose of this article is to design and implement a wireless ultrasonic sensor distance measurement device. With this approach, we are able to locate the item in addition to determining its distance. The instrument determines the returntime of sound waves by measuring their bounce. This gives a precise measure of the distance to an object. This innovative project serves as a versatile tool, finding utility in a spectrum of applications where precise distance measurements are essential. The project's strengths lie in its simplicity, affordability, and accuracy. Its user-friendly design, coupled with the ease of implementation using Arduino and an LCD, makes it accessible for a wide audience. Whether for educational purposes, hobbyist endeavors, or real-world applications, this Ultrasonic Range Finder offers a straightforward and efficient solution to measure distances without the need for physical contact. Overall, it exemplifies the fusion of technology and practicality, showcasing the potential of such projects in making complex measurements more accessible and enjoyable. This has a wide range of applications, including robots, car sensors that avoid obstructions, building sites that need to calculate distance, and many more.

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