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## Automatic Distance Measurement and Braking System by Using Ultrasonic Waves

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**ABSTRACT:** Detecting discontinuities in metals, composites, polymers, ceramics, and water levels are among the most prevalent industrial applications for ultrasound detection. Since ultrasonic sensors employ sound instead of light for detection, the laws of physics that describe the propagation of sound waves through solid materials have been used. We hope this paper will help you better understand some of the most common ultrasonic sensors in use today. Sensor implementation and operation are also described in detail.

**KEYWORDS:** Sensor , Ultrasonic , Automatic , Automobile, Braking System, Measurements

### I. INTRODUCTION

Humans have long relied on the ability to take measurements. For example, we use it to comprehend events that may be measured numerically, such as time (seconds), mass (kg), or distance (metres). While it is possible to perform these measurements without the aid of a device, it is far more efficient to employ one that can offer reliable data. Engineering and science are two fields where mistakes can have serious consequences, and this is especially true.

In the actual world, distance measurement is the process of gathering and comparing data. Science, engineering, and astronomy all rely on it, as does commerce. In our everyday lives, we employ a wide variety of distance measurement devices, ranging from simple rulers to sophisticated interferometers. EDM systems are used in a variety of fields, including aviation, navigation, and a host of others. For linear positioning and motion control in aviation, a direct feedback system is necessary. The GPS system, which uses satellites to determine distance, is a good example. As a result, the use of distance measurement technology in our world is undeniable. To better understand how to build an ultrasonic distance metre, a literature review was conducted. [2] Journals, books, and the internet were employed to study the behaviour of ultrasound. We'll dive into the various distance measurement sensors on the market, each with its own sensing technologies. Here's the rundown of the different distance sensor types, such as Ultrasonic Sensor , Infrared Distance Sensors , Laser Distance Sensors.

Using short bursts of ultrasonic waves, ultrasonic distance measuring is a non-contact way of determining distance. When electrical signals are converted into ultrasonic waves, a transmitter produces a short, high-frequency burst of ultrasonic waves. It is common for ultrasonic waves to be reflected at the borders of different materials when they come into contact with a target object. It is the receiver, which receives the returned ultrasonic waves and converts them to electrical signals, that is placed next to the transmitter. [3]

The ultrasonic module is connected via an 8051 microcontroller. There is a transmitter and a receiver in an ultrasound module. When the object is contacted by sound, the module sends the sound waves to it, and the transducer receives them. The time it takes for sound waves to travel from where they are sent to where they are received is used to compute distance. The microcontroller is programmed to perform the calculation, which is then shown on the LCD panel. [4]

### II. PRINCIPLE OF ULTRASONIC DETECTION

Mechanic waves move across the mediums, which can be solid, liquid, or gaseous The speed at which sound waves can travel through a given medium depends on the medium itself. High-frequency sound waves bounce off of surfaces and create distinctive reflections. Regardless of the medium, sound is an electromagnetic wave that travels through it.

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Depending on the propagation medium, sound waves can travel through different mediums at different speeds. Spectacular echoes are produced when high-frequency sound waves reflect off of obstacles. [5]

## Advantages

- 'It prevents accidents'
- Different modes of operation, such as automated, are available.
- Any object can be detected.
- Can evade obstacles with ease.
- Higher range can be gained by using ultrasonic modules.
- Using only the visual line of sight to communicate.
- The device's primary benefit is that it can replace a slew of expensive pieces of equipment.
- The cost per unit is reduced because to the usage of inexpensive components.
- As a result, the project is also environmentally friendly.
- Because there is less hardware, the device is smaller.

## III. REVIEW OF LITERATURE

Both touch and non-contact methods of determining distance are described by Sharma and Abrol (2014)[6]. A non-contact method is being employed since the ultrasonic sensor does not need any physical contact to measure the thing being studied. It does it by using ultrasonic sound waves to propagate. The HC-SRO4 will be the ultrasonic sensor employed by the researchers. Short, high-frequency sound pulses are sent out by the sensor's transmitter and returned to it via a surface. The Pulse Method is an electronic method for calculating distance.

As stated in a paper by Rüeiger (2012)[7], "A short, intense signal is emitted by an instrument." It makes a round trip to and from a specific location and then returns. A pulse's "flight time" between transmission and reception can be used to calculate its distance.

According to a paper published by Ishihara, Shiina, and Suzuki (2009)[8]. Specifically, they looked into a sensor's ultrasonic properties. Because sound travels at a slower speed than light when travelling through air, signal processing is made simpler. In addition, because of the shorter ultrasonic wavelengths, "more highly accurate distance measurement" is possible. Lastly, because the transparency or colour of a surface has no effect on ultrasonic, determining the distance to such things has no bearing on the results.. Finally, ultrasonic is immune to the effects of light and airborne dusts, allowing it to do distance measurements in outdoor conditions.

A. Carullo and M. Parvis (2001)[9] Vehicle sensor that uses ultrasonics to calculate distance. 143. IEEE Sensors Journal. Vol 1 No 2. IEEE Sensors Journal. Carullo and Parvis (2001) used an ultrasonic sensor to measure the distance between the ground and the bottom of a car, as ultrasonic sensors are widely used in the field. Getting the car's height from the bottom surface to the ground was their primary goal in order to meet the automobile industry's standards. The researchers' experiment was a success, demonstrating the ultrasonic sensor's adaptability in a variety of applications.

For distance measurement, Woo and Lien (1979)[10] invented a similar electromagnetic device that functions in the same way as researchers' gadget. Even yet, the most significant distinction is that they detect distance with an optical sensor rather than an ultrasonic one.. However, they also have a display that may show the results of their measurements. Depending on the user's preference, the display can show the measures in centimetres, inches, or metres, respectively. By including two measurement units, the researchers hope to achieve a similar goal. Centimeters and inches, the two most extensively used measures for determining distance, are combined to form this unit.

## Objectives

- Accurate and stable measurement of a short distance
- Any impediment can be used to measure a distance.
- With a working range of 0.5 m to 4 m and an accuracy of 1 cm.
- This project requires a simple circuit and an appropriate piece of hardware.

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## IV. RESEARCH METHODOLOGY

In the air, ultrasonic distance measurement techniques include the continuous wave and the pulse echo. A burst of pulses is broadcast via the transmission medium and reflected by an object at a predetermined distance in the pulse echo method. The pulse propagation time is related to the object's distance from the transmitter to the receiver. Because of this, the device relies on its target for a contactless distance measurement. The target needs to have an appropriate orientation that is it needs to be perpendicular to the path of propagation of the pulses. The amplitude of the received signal gets greatly attenuated and is a function of nature of the medium and the distance between the transmitter and target. The pulse echo or time-of-flight method of range measuring is subject to high degrees of signal attenuation when utilised in an air medium, thereby restricting its distance range.

### Result and Discussion

Four potentiometer sensors positioned on the back of the car were used to measure the spring heights as the vehicle moved (see Fig. 1). The ultrasonic sensor and potentiometer outputs were recorded using a portable digital recorder. Tests have been conducted on asphalt and rough ground at various speeds. [11]

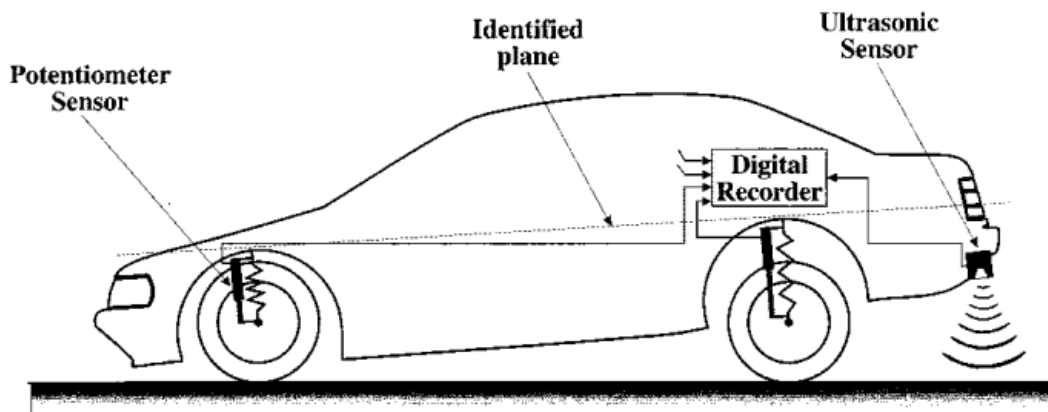


Fig. 1 shows the sensor configuration on the car utilised in the tests.

An ultrasonic rangefinder typically delivers a 'ping' and listens for an echoes before making a measurement. There is an echo in the form of a sound wave that travels from the transmitter to the receiver after being reflected by various objects (below left). The time delay between the produced and reflected sounds can be used to compute the distance to an object if the sound speed is known. [12-13]

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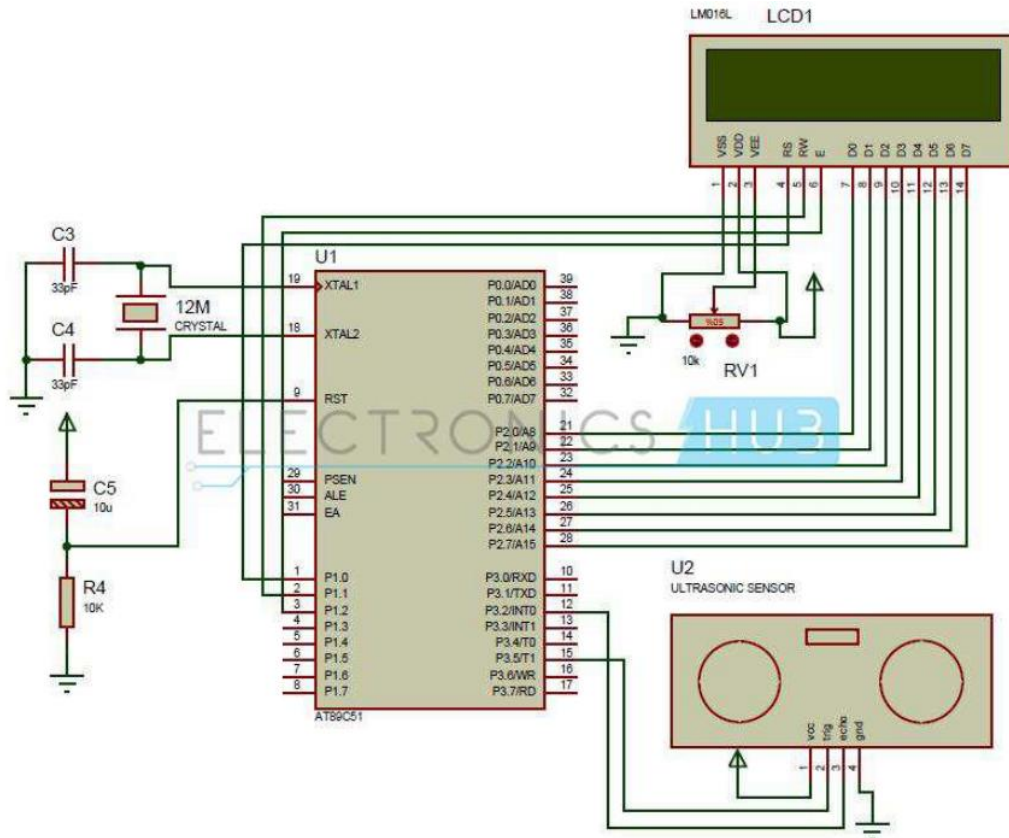


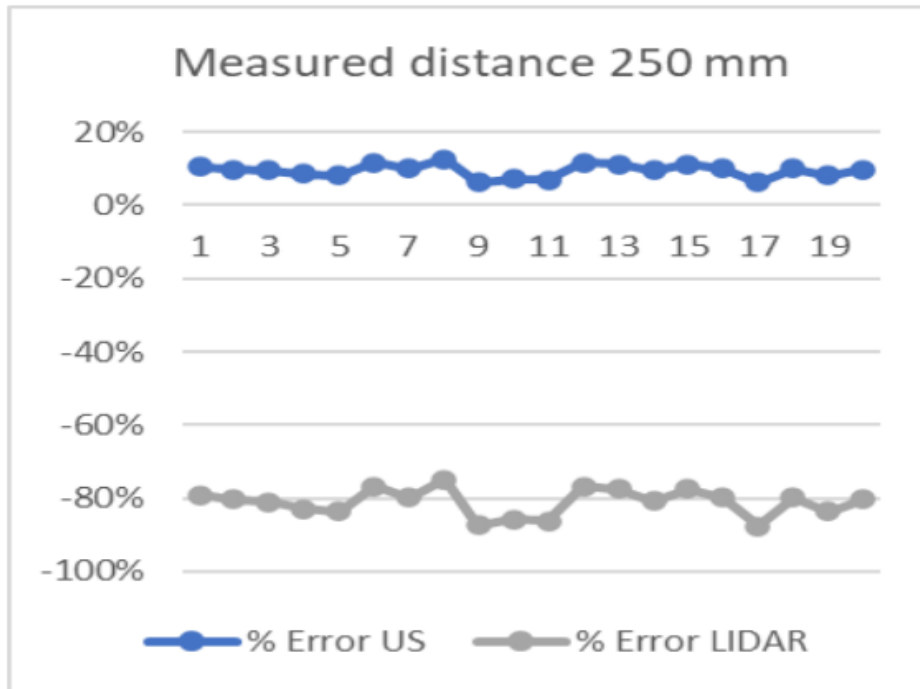
Figure 2 shows a range finder ultrasonic distance meter's circuit board layout.

The graph in Fig. 3 demonstrates that an ultrasonic sensor can measure a distance of 250 mm with a measurement error of roughly 10% for twenty measurements of the exact measurement location. The LIDAR sensor, on the other hand, has a measuring inaccuracy of around 80%. [14-15]

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Measurement of sensors at 250 mm distance, as shown in Figure 3.

The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. It will detect from 2cm to 400 cm or 1” to 13 feet.



Fig. 4 Layout of Ultrasonic sensor

Its operation is not affected by sunlight or black material like Sharp rangefinders. It comes complete with ultrasonic transmitter and receiver module. Fig 4 shows the layout of the ultrasonic sensor which consist of pins like VCC, Trig, Echo and GND

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## V. CONCLUSION

For two target items, we tested a new distance measurement system that measured the distances to both objects almost simultaneously using a pair of ultrasound sensors. As long as a single target was positioned between 0.5 and 2.75 metres, there was a less than 5% inaccuracy in the measured distance. In the vast majority of cases, the system was able to accurately measure the distance between two targets to within a 5% margin of error. The sensor, despite its simplicity and inexpensive cost, is capable of achieving resolutions of more than 1mm in quiet environments. Since the sensor data is refreshed every 20 milliseconds, smoothing techniques can be easily implemented on the fly by the vehicle's computer system.

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