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Radar Using Arduino UNO

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ABSTRACT:

A detection system called RADAR (Radio detection and Ranging) utilises radio waves to identify the properties of the objects it has detected, including their height, direction, and speed. In addition to being expensive and non-target specific for wide-range detection, radar is only useful for short-range applications. The primary objective of the project is to build a simple, low-cost RADAR model using an Arduino uno and ultrasonic sensors. Sound waves are used by the ultrasonic sensor for both range and detection. Since this is a limited range detection radar system project, the ultrasonic sensor functions as a RADAR in this instance with a range of 3 to 4 metres. Thus, an Arduino will be used to examine the distance, angle, and speed of the identified item in terms of a graphical representation.

Keywords: Radar, Ultrasonic Sensor, Arduino Uno, object detection, ranging.

1.Introduction:

Radar is an electromagnetic technique employed to track and identify things. It operates as follows:

- Radiates electromagnetic energy that is able to travel over space via an antenna.
- The illustrating item, also referred to as the target, subsequently absorbs the emitted energy.
- The reradiated energy is captured by the target to the radar antenna.

Though some radar equipments are utilized as initial alerting and broad monitoring systems, some are utilised in airport air traffic control. A system for radar detection is the intellectual apparatus of a missile directing system.The radar (Radio detection and Ranging) system was developed surreptitiously by many countries before and at the time of World War II. Along with a number of other breakthroughs, the U.S. Navy came up with the term 'RADAR', in 1940. There are many new applications for radar technology, including air traffic monitoring systems, radar, air defence, naval maritime radars for site and vessel recognition and repositioning, aircraft collision prevention systems, sea surveillance, space monitoring, and contact systems. The earliest radars were built in the 1930s [1]. Radar systems have been extensively deployed by the military ever since. Because of their large bulk and initial exorbitant cost, radar systems were limited to usage in military environments. Antenna-on-chip or antenna-in-package techniques allow for the integration of a radar system into a single chip thanks to advancements in IC and packaging technology [5]. Radar systems are operating at higher frequencies in higher frequency bands. In automobile radar systems, K-band (24 GHz) and W-band (77 GHz) have previously been implemented [7]. Radars serve a purpose in commercial as well as military contexts. It has no impact by the colour or transparency of objects, suitable for usage in dimly lit areas, and not much impacted by dust, filth, or conditions with high moisture content, among other factors.

2. Literature Survey:

Radar research and development have been incredibly successful, and they have significantly altered computers. Ultimately, radar researchers will be able to achieve the necessary performance criteria in a range of circumstances and also create, develop, and refine security and user interfaces. An ultrasonic radar is a detection system that finds, tracks, and measures the height of both mobile and immobile objects like vehicles, ships, aeroplanes, weather patterns, terrain, etc, by using ultrasonic waves rather than electromagnetic radiation. Ultrasonic sensors evaluate a target's features by analysing radio or sound wave echoes, much like radar or sonar. To determine if obstacles are ahead of the sensor, their amount, and the azimuth and distance which the obstruction is picked up by the sensor, this project utilizes an ultrasonic sensor that is linked to an Arduino Uno controller. The signal from the sensor is then provided to the PC [6].

The Christian Doppler shift was initially defined in 1842 as a noticeable shift in frequency or speed that happens as an audible object moves closer or farther from the receiver, or as the listener travels closer or far from the sound producer.

German physicist Heinrich Hertz proved that solid materials may reflect radio waves in 1886. Alexander Popov, an instructor of physics at the Imperial Russian Navy Academy in Kronstadt, who devised a system in 1895 that identified distant lightning strikes. It employed a coherer tube.

Robert Watson-Watt led the U.K. research establishment in making several radio-related advancements during the 1920s after employing the technology to alert fliers ahead of impending thunderstorms in 1915.

The findings for categorization problems with car radar were released in a publication by Andrew Robertson, Roderick Murray-Smith, Francesco Fio, and Alexander Angelov in 2012.

3. Flow Chart:

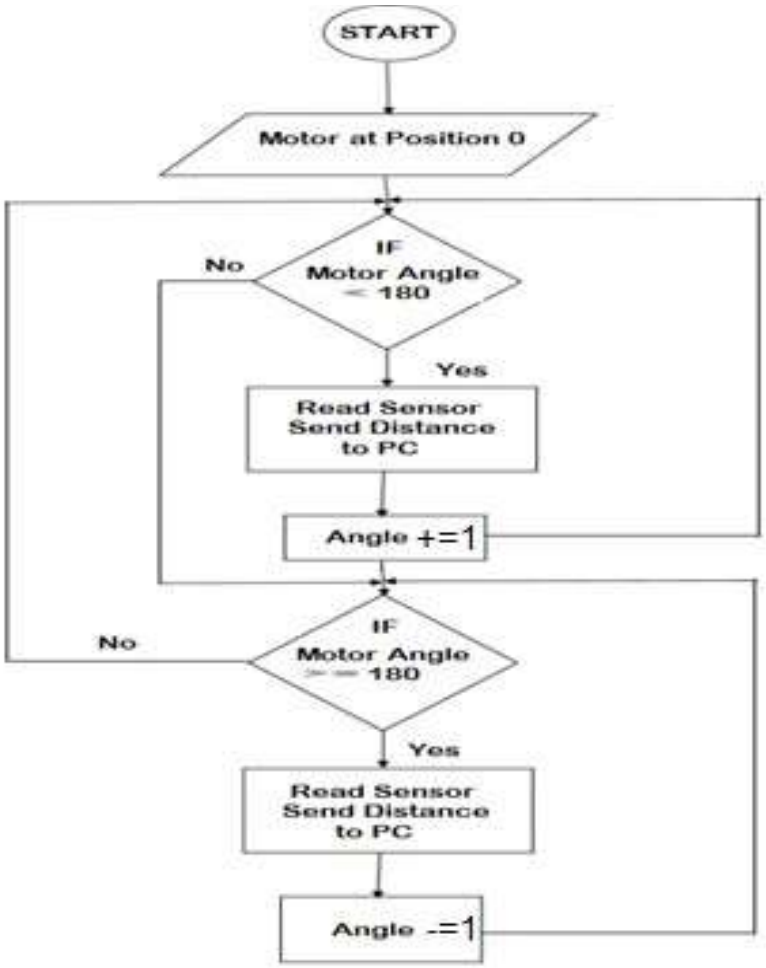

Fig3.1: flow chart

4.Methodology:

In this section, the working of the model i.e. the hardware and software simulation and connection setup is discussed.

***A.* Experimental Setup:**

Since it is more reasonably priced and manageable than radar, the ultrasonic sensor (HC-SR04) is employed for limited range recognition of objects. It generates sound waves, which are reflected back and detect objects when they strike them. Utilising a SG90 Servo motor, the ultrasonic sensor is rotated 180 degree. The Arduino Uno is now used to process this information, i.e., to convert analogue data to digital data. Jumper wires are used to link each component, including the servo motor, ultrasonic sensor, LCD, buzzer, led, etc.

***B*. Hardware implementation:**

We utilized an Arduino Uno board, a servo motor, a bread board, a liquid crystal display (LCD), an LED, ultrasonic sensor(HC-SR04) and jumper wires to build this short-range detecting radar system. Pin 9 of the Arduino Uno R3 is where the ultrasonic sensor's trigger pin is linked, and pin 10 is where the echo pin is connected. The Arduino board is attached to the LED pins RS, EN, D4, D5, D6, and D7, which display a message indicating whether or

not the item is detected. The servo motor can sweep in a 360-degree circle. The LED illuminates, a buzzer sounds, and the detected object's or target's angle and distance are shown on the LCD upon impact.

***C.* Software implementation:**

The Arduino Uno Ide(Integrated Development Environment) software is what's used to run the project's code. The ultrasonic sensor's analogue value is the input, and the digitally displayed distance, angle, and speed on an LCD along with a message indicating object detection is the output. Furthermore, we have added effects using the Tkinter application and other tools.

The output of the Proteus software's circuit simulation is displayed in the image below.

5. Results:

Some images are shown below which are the results of the hardware connection and Arduino software simulation of the project.

A. Hardware results:

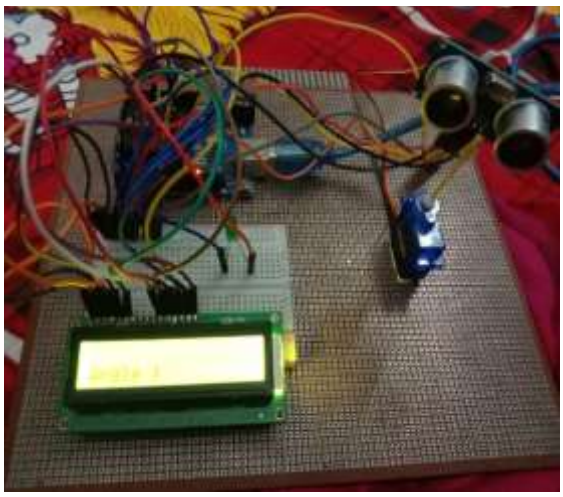

Fig 5.1: Object is not detected

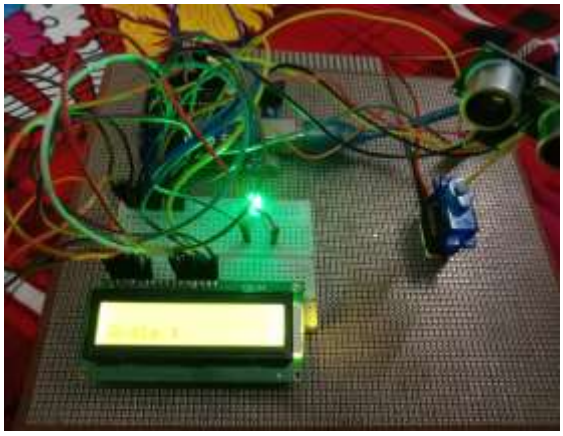

Fig 5.2:object is detected

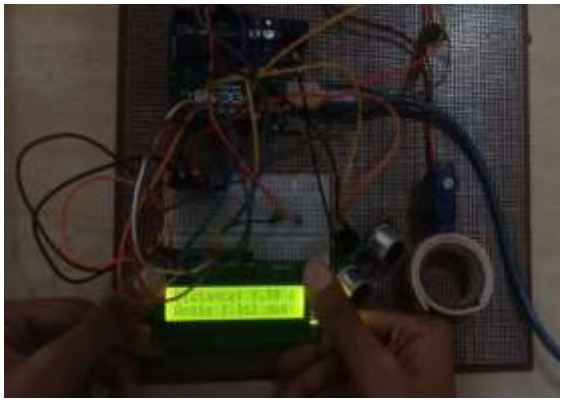

Fig 5.3: Final result

***B.* Software Simulation results:**

Output when no object is detected:

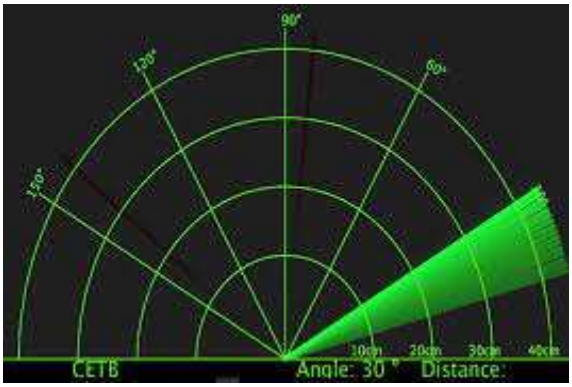

Fig 5.4: Output when an object strikes the radar:

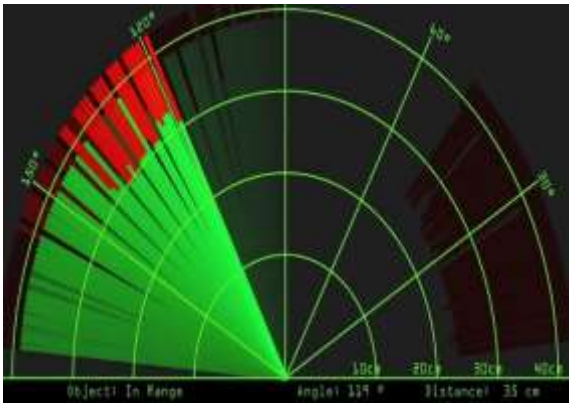

Fig 5.5: Output when object is detected

6. Advantages and disadvantages:

6.1 Advantages:

A. It is not affected by color or transparency. Basically, the Ultrasonic Sensors transmit the sound off of the object, hence the color and transparency have no effect on the radar.

B. Any dark environments have no effect on this Arduino radar sensor's detection procedure.

C. Easy to design and low price. The ultrasonic sensors are available at the market with very cheap price.

D. It has high frequency, high sensitivity, therefore, it can easily detect the external or deep objects.

6.2 Disadvantages:

A. The Arduino Radar Sensor conduct sound to continue the work. So, it is not working in a vacuum as there is no air for the sound to travel through.

B. Another limitation is the detection range. This depends on which Ultrasonic sensor have used to make the Arduino Radar Sensor.

7. Applications:

- This system may be applied for intrusion detection for various site sizes or for object identification and avoidance in robots.
- A radiolocation system that counts the distance (ranging), angle (azimuth), and radial velocity of an item with respect to the site using radio waves.
- This technology may be employed to gauge both air or water speed, tank or channel depth, and wind direction and speed (annemometer).
- A wide range of sectors, including meteorology, aviation, the military, navigation, law enforcement, agriculture, and space exploration, employ radar.

8. Conclusion:

In this project, we have implemented a cost-effective RADAR Ultrasonic system that uses an Arduino Uno to find targets that are in the range of 3 to 4 metres. Radar functions on the electromagnetic radiation concept, which detects and sometimes even identifies targets. It works by sending out electromagnetic signals, picking up echoes from targets inside its coverage area, and deriving other necessary data from the echo signals, like the target's position. This purpose of the project is to build a functional ultrasonic radar detection system that can keep an eye on a specific area. Industries can make advantage of this system.

9. Future Scope:

- Autonomous vehicles can make use of this technology.
- In terms of swift object detection.
- In aeroplanes or aircrafts to alert them of any impediment.
- The field of medical radar applications research is making good progress towards tumour localization and breast cancer detection.
- They are present in anti-collision safety systems and parking technologies.

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