Tracking of any intruder on territory border using 360-degree radar and sensor

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Abstract. In the era of modern world, lot of human lives are engaged with this perilous procedure of observation. Reconnaissance is a perilous activity. There is consistently a danger of getting trapped in spying, so we plan to discover safety with no risk. Doppler radar used for producing true results considering all army activity involved with data during transmission. This project presents an approach in detecting an intruder in a border using Doppler radar-based Intrusion Detection Systems which can be mounted on watch towers, grill fences, top of trees etc., Experimental results show that the use of the display as classifiers are more efficient in malicious intruder accurately. The data collected from the sensor and transmit through the Lora WAN to the hub. The performance of the Intrusion Detection System (IDS) is evaluated in comparison to other classifiers, displaying the testing accuracy, sensitivity, specificity, and precision. Doppler based Intrusion Detection Systems have shown increased efficiency and low false positives. It has the advantages of working in all weather conditions such as heavy sunshine, heavy rainfall with proper data.

Keywords: - Microwave Doppler sensor, micro controller and Sonic Radar.

1. Introduction
Radar is an object detection system, which uses waves to determine the range, altitude, direction, and speed of objects. The radar antenna transmits pulses of radio waves or microwaves that bounce off any object in their path. The object returns a portion of the wave to the receiver which is in line of sight with the target [1]. The analysis of the signal, associated with a filter, makes it possible to calculate the position and the distance to which the target is. The principle consists in detecting a reflected electromagnetic wave. Such a wave can be reflected on a metal object. Some materials do not reflect radio waves, such as air, wood, plastic and most glasses. The reflected signal depends on the size, the materials of which the object is made, and the frequency used to detect it [2]. The reflected energy not only indicates the presence of a target, but can be used also to determine the location, speed and nature. Radar can perform its function at short and long distances and under conditions impervious to optical sensors [3]. The Doppler frequency shift is widely used in radar as the basis for separating desired moving targets from fixed ones. Radar can also provide information about the nature of the target being observed [4]. The Arduino core encapsulates low-level aspects of Micro controller programming (e.g. register manipulation), allowing users to concentrate on their particular task [5]. This project deals for detecting only living...
humans using pir sensor, vibration sensor by observing the movement of the body humans can be detected [6]. The system has a wireless communication between those two so that robot can easily moved and humans can be detected [7]. This project deals for security purpose in home. The security systems have proved to be ineffective so in places where manpower is employed for security, there is a great risk of human life being at stake. Hence, this robot can be used which has control among the whole house[8]. This project deals with Object Detection and Tracking-Based Camera Calibration for Normalized Human Height Estimation and Temperature measured[9]. The Doppler frequency shift is widely used in radar as the basis for separating Radar Based on Physical Characteristics of targets[10].

The main objective of the paper is locating humans in unknown locations, for example using a high-powered Doppler radar and sensor to detect an intruder at the border.

2. Radar
Radar is a location framework that utilizes radio waves to decide the range, edge, or speed of articles. It is very much utilized to distinguish airplanes, ships, rocket, guided rockets, engine vehicles, climate developments, and territory intrusions. A radar framework comprises of a transmitter delivering electromagnetic waves in the radio or microwaves area, a transmitting receiving wire, a getting reception apparatus regularly a similar reception apparatus is utilized for transmitting and accepting, and a beneficiary and processor to decide properties of the object(s). Radio waves beat or consistent from the transmitter reflect off the item and return back to the collector, giving data about the area and speed.

3. Micro doppler radar
The Doppler impact is the contrast between the watched recurrence and the transmitted recurrence of a wave for an onlooker moving comparative with the wellsprings of the waves. It is ordinarily heard when a vehicle sounding an alarm approaches, passes and retreats from a spectator. The obtained recurrence is higher contrasted with the transmitted recurrence during the methodology which is indistinguishable at the moment of cruising by, and it is lower during the downturn. This variety of recurrence relies upon the bearing wave source which is moving until the onlooker looks for the change in a movement. It is most extreme when the source is moving legitimately toward or away from the spectator and reduces with expanding point between the course of movement and the heading waves, if there is no move. Envision a baseball pitcher tossing one ball each second to a catcher a recurrence of 1 ball for each second. Assume that the balls travel at a consistent speed and the pitcher is fixed, then the catcher gets one ball each second. Now we assume that if the pitcher is running towards the catcher, the catcher gets most of the balls regularly on the grounds that the balls are less scattered the recurrence increments. The converse is valid if the pitcher is moving ceaselessly from the catcher. The catcher gets balls less every now and again in view of the pitcher's retrogressive movement the recurrence diminishes. On the off chance that the pitcher moves at an edge, however at a similar speed, the recurrence variety at which the recipient gets balls is less, as the separation between the two gradually changes. From the perspective of the pitcher, the recurrence stays steady regardless of whether he's tossing balls or transmitting microwaves. Likewise with electromagnetic radiation like microwaves or with sound, recurrence is conversely relative to frequency, and the frequency of the waves is influenced. Thus it shows the relative contrast in speed between a source and an eyewitness is the thing that offers ascend to the Doppler impact.
4. System of radar prototype

Figure 1. Block Diagram

The Radar conditions relate the scope of radar to the qualities of the transmitter, reception apparatus, and target. It is valuable for deciding the greatest range, yet it can likewise fill in as a method for understanding the variables influencing radar execution. It is additionally a significant instrument in the radar framework plan is shown in figure 1.

5. Prototyping materials

Arduino is a stage for prototyping intelligent items and utilizing gadgets. It comprises of both equipment and a programming circuit board that can be bought together from little to no effort or amassed from unreservedly accessible plans; and an open-source advancement condition and library for composing code to control the board. Arduino permits clients to make working electronic models, either independent items or gadgets fastened to a PC. It can enhance the usage within a wide scope of sensors, control a wide range of yield gadgets, and speak with programming running on a PC or talking over a system. Arduino endeavors to dispose of or ease whatever the projects as it could be experimented under the circumstances with a blend of equipment and programming. The Arduino board is a printed circuit board containing a micro controller fundamentally, a low-power PC crushed into a solitary chip, furthermore, the segments 7 expected to give it a stable power flexibly, to associate it to different segments, and to empower it to speak with the PC. All variants of the Arduino board are planned to work with standard electronic components. The board gives an 8 base platform but does not constrain clients to pre-packaged sensors. This implies that clients can utilize usual components without requiring holding up for extraordinary Arduino versions of them. The Arduino program is an endeavor to simplify the method of composing code without excessive limiting the user’s adaptability. It builds on numerous other open-source projects, adjusting them to the Arduino equipment and hiding their unneeded complexities. The Arduino computer program consists of two fundamental parts: the improvement environment and a core library, both are open-source. The Arduino development environment could be negligible but a total source code editor. It is a cross-platform application composed in Java and usable under Windows, Mac OS X, and Linux. In it, clients can manage, alter, compile and transfer their programs (called sketches). All functions can be accessed from a set of 7 toolbar buttons or a few drop-down menus. The person wants no longer fiddle with make documents or command-line arguments, which can pose full-size obstacles for the beginner. The environment consists of a serial monitor, allowing the person to send information to and receive statistics from the board, easing debugging without requiring extra software. All applications required for Arduino development are covered in a different archive downloaded from the Arduino website except for Linux users, who should set up some packages with their distribution’s package deal management tool. The GUI itself is based totally on the Processing development environment, at the same time as sketches are compiled using Avr-GCC, and uploaded with
the chip. The source code is distributed below the Gnu Public License (GPL). The Arduino center library consists of AVR C/C++ features which can be compiled in conjunction with the person’s sketch. The blended binary file can then be uploaded to the Arduino board. Using an API well-matched with wiring, the Arduino core encapsulates low-level components of Micro controller programming (Example: sign up manipulation), permitting customers to give attention to their specific task.

6. Advantages and disadvantage

**Advantages** of this project are the Doppler sensor is obvious. Firstly, As long as the person is in the sensing area, the switch can be kept on continuously. Once the person leaves, the time will be turned off, the function is quite human, and it is safe and energy-saving.

**Disadvantage** of this project is insensitive to very slow motion of the objects.

7. Result and Discussion

The results obtained in phrases of distance and directions are transferred to Processing IDE to be displayed, the target is represented through a purple dot positioned in a point of intersection between the path and the distance. Object detected, distance = 20cm and angle = 86 °. The detection of a target is recognized using two crucial parameters, that are distance and direction and shown in Lcd screen.

Radar is an object detection device that makes use of radio waves or microwaves to determine the range, altitude, direction, and speed of objects. The Radar antenna transmits pulses of radio waves or microwaves that bounce off any object in their path. The object returns a portion of the wave acquired by the receiver that is in line of sight with the transmitter. The task is achieved in two parts: The first element is CAD computer-aided layout and simulation with PROTEUS. The second element is belief and practical editing. We use object Oriented programming by way of a block software for the technology of the prototyping card code and Processing software for viewing the consequences on the computer screen shown in Figure 2. After compiling the Arduino code, the bit records are transformed to hexadecimal to be run by using the Arduino board. At the ISIS simulator level, the processed received records may be then directed as consequences to the processing. It is important to create a digital link the use of the software “Virtual Serial Port Driver” by figuring out ports next to processing and the alternative for the Arduino card on the one hand and the other hand we must add a pin-port adapter after the Arduino board to be ready to transmit records through this link.

![Figure 2. System image by Proteus](image)

The communication between Proteus ISIS and Processing is shown in the subsequent figure 3. To start the simulation, we collect the Arduino application code to get better. Hex report and we inject it into the Arduino board, here we represented the target by a voltage source, a
button and a potentiometer linked with the sensor to the take a look at the pin, wherein the push-button is used to indicate the presence or absence of the target. We click on begin to start the simulation. The Arduino board sends a sign of (+ 5V) to all of the linked pins where the trigger of the servomotor could be very important, it offers the rotational movement to the sensor so that it may hit upon moving objects and locate them in 180 degrees.

![Communication between Proteus ISIS and Arduino code](image)

**Figure 3.** Communication between Proteus ISIS and Arduino code

The board sends a HIGH pulse of width (10μs) to the TRIGGER pin of the sensor to regenerate a series of (08) 40 KHz frequency ultrasonic waves into the air from the transmitter. The ultrasound propagates via the air until it touches an impediment and returns within the other path to the sensor through the ECHO pin. The sensor detects the width of the pulse to calculate the distance. The signal on the ECHO pin of the sensor remains HIGH throughout sending and receiving, which makes it possible to measure the period of the round ride of the ultrasound and hence to decide the distance. The LCD show pals with our device to show the calculated distance consequently the Servomotor angle. The beeper is a further component, it triggers when there may be a detection, and the three LEDs decide the region of which the object is located near, mid, or far area.

The sensor sweeps from zero to 180 ° and detects fixed and transferring objects. The beeper trigger and the flashing LEDs with specific tones and colorations indicate the target distance. When there may be a presence of a hard and fast goal, there's a significant amount of strength contemplated again to the receiver. Initially for an absence of an object, the echo signal, gives a signal of weak power, whilst a goal is placed in front of the sensor, One notices the change in amplitude from in which the detection of the fixed item. For the detection of the transferring goal, an item is moved inside the course of the servomotor. The following figures represent the echo signal in real-time inside the case of a set object and shifting object in proportional displacement with the ultrasonic sensor. The sensor sweeps from zero to 180 ° and detects fixed and shifting objects. The beeper cause and the flashing LEDs with specific tones and colors imply the target distance. When there can be a presence of a difficult and fast intention, there's a massive amount of power pondered again to the receiver. Initially for a scarcity of an object, the echo signal, offers a signal of susceptible power, at the same time as an aim is positioned in the front of the sensor, One notices the alternate in amplitude from in which the detection of the fixed object. For the detection of the moving aim, an object is moved within the direction of the servomotor. The following figures constitute the echo signal in real-time within the case of a set object and shifting item in proportional displacement with the ultrasonic sensor.
8. Conclusion
The present mission entails a theoretical work observed through a realization, of a radar prototype system. The objective includes the take a look at and the realization of a radar of detection and tracking. The usage of micro Doppler for human target for the achievement, we used an Arduino board and the ultrasonic distance sensor. The radar works in rotation; it detects and calculates the distances following a sophisticated program. To carry out this work, we went through distinctive stages: We used an ultrasound detector and Doppler sensor HC-SR04 for the detection of barriers and the calculation of the space among the radar and the human object. The calculated distance is proportional to this power. For the conclusion, distance measurements have been made with a transferring detector with a scan from (0° to 180°), from which the consequences had been displayed at the Processing.

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