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Review Article

The benefits and drawbacks of GPS-guided versus laser-guided missiles

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Abstract

Radio detection and ranging is applied in a variety of situations, including commercial and military sites, by means of electromagnetic waves, which are utilized to detect different physical elements such as distance, speed, position, range, and field of navigation. Radar-based security systems use this technology. A number of factors, including the kind or range of the missile intercepted, the stage of the missile's trajectory at which the intercept takes place, and whether the missile is intercepted inside or outside the Earth's atmosphere, can be used to categorize missile defense systems. Theater, tactical, and strategic are some of these kinds and ranges.

Keywords: Ultrasonic Sensor, Military Security, Defence, Internet of Things.

I. INTRODUCTION

Radar is a technique that detects things by using waves to determine their position, height, direction, or speed. The use of ultrasonic waves instead of electromagnetic waves is known as ultrasonic radar [10], [11]. Ultrasonic sensors work by listening for wave echoes, just like radar does. Radar data can be displayed using audible alarms, LCD screens, or LEDs.

II. RELATED WORKS

The design and construction of an automated missile detection and destruction system is the aim of this research. The purpose of this system is to identify the target, which is a missile, moving in various directions. When the missile reaches its destination, the target-destroying system launches it automatically in that direction. An intelligent sonar-based object tracking system that tracks the target continually makes up this system. It notifies a central control system of the target's location as soon as it detects it. The firing mechanism is moved in the direction of the target (missile) by the Central Control System. After adjusting the direction, it instructs the firing system to attack the target by sending a control order. An ultrasonic radar system and a DC-geared motor-driven firing unit interfaced with a microcontroller-based control unit are used in this project. The servo motor that is mounted inside the ultrasonic sensor keeps it moving. The launcher fixed servo motor receives the angle position as input if an item is identified. The servo motor is designed to rotate at fixed angles. Because the ultrasonic sensors can detect the target in any lighting situation and cover a longer detecting distance, the launcher will release the missile that is fixed within it. Embedded C is used for microcontroller programming [7]. Ultrasonic and Auto-Destroy Systems for Missile Detection (May 2014). In order to find, target, and destroy a moving object autonomously, Samir Chopra, Suman Bharti, Tarun Singh Negi, and Prof. P.D. Kulkarni are working on building a robotic platform that includes a stepper motor equipped with an ultrasonic sensor. The ATmega32, an 8-bit, low-power, high-performance microcontroller from Atmel's Mega AVR family, serves as the control system [1]. The choice to find and eliminate the missile in motion is made by this system. To destroy the missile, it transmits a control signal to the firing unit. By using a microcontroller, the ultrasonic transceiver (transmitter and receiver) can identify missile targets and show the direction of the missile on an LCD. The program will activate the laser gun for the closest detected target and fire it if there is a target within the detection range. When any of the ultrasonic sensors detects a missile, a buzzer sounds to notify those in close proximity. A wireless camera has been introduced to capture images on the battlefield. A robotic platform is controlled by an RF transmitter and receiver [2]. Missile detection and destruction system using microcontroller-based architecture. July of 2014 Nagarjuna, Acharya S. Nagakishore Bhavanam. According to the proposed paper, this project comprises of a firing unit operated by a DC-geared motor that is interfaced with a microcontroller-based control unit, and an intelligent sonar-based object tracking system. Since ultrasonic sensors can detect targets at great distances and in all lighting conditions, they are chosen over infrared sensors. The control unit is an Atmel 89c52 microcontroller. The firing unit receives directions from the control unit to destroy the missile target as soon as it is detected. The embedded C programming language is used to program microcontrollers [3]. Robot Platform Missile Detection and Auto-Destroy System. (2015) Prof. S. M. Bhilegaonkar, Ms. Palwe Pooja Balasaheb, Ms. Shinde Tejashree Anil, and Ms. Sonawane Chaitali Shivajirao. The auto-destructive system for missile detection on a robot platform is proposed in this research. The ATmega16 microcontroller is utilized for loading embedded C programs. There are four ports on the 40-pin ATmega16 integrated circuit: ports A, B, C, and D. An 8-bit microprocessor using RISC architecture is the AT Mega16. It operates at a frequency of 16 MHz. It features an integrated analog-to-digital converter and uses little power. Powerful instructions are carried out by this microcontroller in a single clock cycle. Because the ultrasonic sensor and stepper motor are mounted, the sensor continually rotates in a 360-degree circle. The laser cannon will activate and the stepper motor will stop if an impediment gets in the way of the ultrasonic beams. The distance is also measured by the sensor and shown on an LCD display. Here, obstructions are detected and destroyed using a laser. For that RF transmitter for transmitting wireless data, RF receiver for receiving data, and motor driver IC for robot movement based on our input data, robotic platform movement in all necessary directions entails forward, backward, left, right, etc. [4]. An ultrasonic proximity detector is used in an automatic missile detector. (April of 2016) Roshan Kumar, Narayan Thakkar, Shrushti Sindhemeshram, and Shubham Sahu. The targeting system in this suggested system receives control commands from an 8051 microcontroller, which serves as the central control system, in order to launch a laser attack against the missile target. Developed by Intel in 1980 for use in embedded systems, the Intel MCS-51 (also known as the 8051) is an internally designed Harvard architecture single chip microcontroller series with a complex instruction set computing (CISC) instruction set. Any circuit must have a power source; therefore, any ripples must be eliminated using a capacitive filter before the voltage regulator (7805) regulates it to +5V, which is necessary for the microcontroller and other components to function properly. This project uses a robotic platform to automatically locate and aim at a stationary target, a moving target, and a laser. The stepper motor is equipped with an ultrasonic sensor. It is the stimulation of radiation emission to amplify light. Active sensing often involves target acquisition and tracking, such as ultrasonic and later laser fire. The cost and complexity of manipulator control can be greatly decreased by having the capability to track targets inside the manipulation range. Another benefit of this research is that it determines whether the target is hostile and shoots the laser appropriately. A robotic platform is controlled by an RF transmitter and receiver module. Wireless data transmission from the input side is accomplished by an RF transmitter. It uses 434 MHz to operate. The encoder HT12E transforms parallel data into serial form at the transmitter side since we require serial data for transmission. and that serial data is transformed into parallel form by the receiver-side decoder HT12D [6]. Definition: - A foundation A missile is a weapon made to be fired from the ground with the intention of destroying other missiles or airplanes. It is one kind of antiaircraft system; in contemporary armed forces, antiaircraft guns are pushed into specialized duties since missiles have mostly superseded other types of dedicated antiaircraft weapons. The Second World War saw the first significant attempts at SAM development, while no working systems were released. The first operational systems were introduced by most major forces in the second half of the 1950s as a result of continued development during the 1940s and 1950s. Throughout the 1960s and 1970s, smaller systems that were appropriate for close-quarters work developed into more contemporary, man-portable devices. In order to provide a layered defense that has forced gun-based systems into the shortest-range roles, ship-borne systems evolved in a similar manner to land-based versions. They began as long-range weapons and gradually moved toward smaller designs. An extensive analysis of current systems leads to the proposal of an Arduino-based radar system in this article. Because it uses less power than other radar-based systems, this work has an edge over them. A simple ultrasonic sensor is mounted on a servo motor, which rotates at a specific angle and speed, to form the basis of the system. The digital input and output pins of the Arduino are linked to this ultrasonic sensor, and the servomotor is similarly connected to these pins. It can detect things in three different ranges. If an unwelcome individual is identified in the 0°–6° range, the Bob motor will sound a warning. A DC motor and a 120°–180° buzzer are utilized to target the undesirable person in the 60°–120° range [8]. In this work, we developed a simple radar using an ultrasonic sensor. Without touching, it measures angles from 15 to 165 degrees and lengths from 3 to 40 cm [12]–[14]. The sensors are powered by a tiny motor, and the data is shown on a PC screen via specialized software [15]–[17]. The goal of this project is to construct a working ultrasonic radar system that can monitor a given area. Since its creation, ultrasonic sensing technology has been applied in many different fields, including production lines, home security systems, robot proximity detection, and distance and tank level monitoring. Technical problems can now be resolved more rapidly and cheaply without compromising stability, quality, or safety thanks to a variety of applications [18], [19]. Radar research and development has been tremendously successful, and it has changed computers profoundly. Radar researchers will eventually be able to design, develop, and improve security and user interfaces in addition to meeting the required performance standards in a variety of settings [20]–[23]. An ultrasonic radar is an object detection system that uses ultrasonic waves in place of electromagnetic waves to determine the location, velocity, direction, and altitude of both moving and stationary objects, including cars, ships, airplanes, weather formations, and terrain [24]. Ultrasonic Sensors are the primary parts of any ultrasonic radar. Similar to radar or sonar, ultrasonic sensors assess a target's characteristics by deciphering the echoes of radio or sound waves. In order to measure the presence of any obstacles in front of the sensor and to ascertain the range and angle at which the obstacle is detected by the sensor, this project uses an ultrasonic sensor that is connected to a Raspberry Pi board. The signal from the sensor is then provided to a laptop screen [25], [26]. The Christian Doppler effect was initially defined in 1842 as the apparent change in frequency or pitch that happens as a sound source moves toward or away from the listener, or as the listener moves toward or away from the sound source. Milenko et al.'s 2010 publication details a database of radar echoes from various targets. The database is available to the public. In order to gather basic data that can be used for classification, this study used spectrum analysis [27], [28]. Our radar system was constructed with an Arduino microcontroller and makes use of the object's echolocation. Arduino is an open-source electronics platform with user-friendly hardware and software. Arduino boards can read a variety of inputs, including ultrasonic sensors. An ultrasonic sensor is a type of proximity sensor that measures an object's distance. It detects the object by generating ultrasonic waves and receiving back reflected waves, which it then converts into an electrical signal. These sound waves travel at a speed that is faster than human hearing. Its two main components are the transmitter and the receiver. The transmitter creates sound using a piezoelectric crystal, and the receiver hears it after it has gone to and from the target. is a transducer that sends signals about things; it communicates data to the user and calculates the distance of an object using an Arduino. Here, a servo motor is in use. The servo motor is just a regular DC motor that may be made to rotate at a specific angle by using an additional servo mechanism. This motor will only turn in the predetermined steps before coming to an end. A servo motor operates independently of power input, in contrast to a typical electric motor. The servo motor's operation will be determined by the signal. Our project makes use of it to detect objects at a 180-degree angle. These components are used to produce an ultrasonic radar module design that is based on Arduino [9]. For purposes of security and safety, Passive Forward Scattering Radar (PFSR) is an excellent device that can be utilized to detect ground-moving targets, particularly in hazardous locations. PFSR has several limitations in that it cannot estimate height or identify small targets, such a drone flying in the sky, even if it can detect any moving target. Although a drone is a useful tool made possible by modern technology, it can also be extremely dangerous because it may fly in the air and penetrate places that are off-limits, potentially interfering with border security measures. This system can be improved by integrating with PFSR by utilizing an ultrasonic range sensor to interface with the Raspberry Pi (RPi) and by applying the Internet of Things (IoT) through the use of the mobile application Telegram as a security alarm system. The goal of this project is to enhance the PFSR system by adding a remote measuring device with an ultrasonic range sensor. The ultrasonic range sensor requires less electricity to operate and can measure a great distance when placed close to the PFSR system. Ultrasonic range sensors aren't self-sufficient, so the RPi was utilized as an operational host to facilitate data collection and operation. The gathered information was then stored as Comma-Separated Values (CSV) files in order to be notified later via the Telegram mobile app. The ultrasonic range sensor system can in fact support the PFSR system, according to a comparison of the data gathered from the two systems [29]. This article presents the concept, technology, and military applications of the Internet of Things (IoT). The authors first provide a brief assessment of cases of partial deployment of the technology in air and missile defense (AMD) systems before making the case that, when implemented as a system solution, IoT may boost the capability of the entire system. Using an analytical approach, the air and missile defense system has been split into four subsystems. Each of these subsystems has been evaluated to see how implementing IoT solutions could improve it and ultimately enhance the AMD system as a whole. The air and missile defense systems are broken down into four subsystems in this research, and each one is theoretically analyzed to determine how IoT technologies might improve it overall by strengthening the subsystems. Better IoT device performance can arise from the IoT's ability to streamline processes across a range of sectors [30]. Ultrasonic radar, alternatively referred to as sonar systems or ultrasonic sensors, is a technology that uses ultrasonic waves to identify and detect things. It functions at frequencies above 20 kHz, which is above the range of human hearing. Ultrasonic radar systems work by sending out ultrasonic waves, then measuring the echoes that return to identify an object's distance, direction, and occasionally even its size. Ultrasonic radar operates on the basis of time-of-flight readings. Emitted ultrasonic waves go through the atmosphere. The waves return to the sensor after reflecting off of objects. The speed of sound can be used to calculate the distance to the objects by timing the length of time it takes for the waves to complete one round trip. The components of an ultrasonic radar system are a transducer that generates ultrasonic waves and a receiver that picks up echoes. Ultrasonic waves are created by the transducer from electrical energy, and the receiver transforms the ultrasonic signals it receives back into electrical signals for processing later. Depending on the application, these radar systems can be set up in a variety of ways, including single- or multiple-point readings. They are frequently utilized in obstacle avoidance systems, robotics, industrial automation, and object identification and distance measuring. For the purpose of detecting objects in non-contact settings and environments with particular sensing needs, ultrasonic radar offers a dependable and affordable option. In conclusion, ultrasonic radar is a technique that locates and detects objects using ultrasonic waves. It is a useful tool in many different industries since it provides precise and effective sensing capabilities for a variety of applications [31].

III. THE BENEFITS AND DRAWBACKS OF GPS-GUIDED VERSUS LASER-GUIDED MISSILES

Each type of guided missile, whether laser or GPS, has pros and cons of its own. Because they are guided by a laser beam that is aimed at the target by a laser designator, laser-guided missiles often have a better degree of accuracy than GPS-guided missiles. This makes them suitable for use in scenarios where GPS guidance would be less reliable, including crowded metropolitan areas where GPS signals might be distorted. However, because they need a laser designator to direct them, laser-guided missiles are susceptible to countermeasures like smoke or fog. In contrast, GPS-guided missiles do not need a laser designator because they are guided by signals from GPS satellites. Because of this, they may be deployed more successfully in a variety of circumstances and are more user-friendly and versatile than laser-guided missiles. However, electronic jamming and other countermeasures can interfere with GPS signals, reducing their accuracy. The particular mission and the surrounding conditions will determine the preferred type of missile used by the U.S. Air Force. The Air Force employs both kinds of missiles, choosing the best one depending on the mission's particular requirements [33].

CONCLUSION

Numerous articles have been reviewed in the course of this research. Their most recent technical advancement has been shown in action, and its ramifications have been thoroughly investigated [32]. There is also a thorough discussion of the benefits and drawbacks of laser-guided missiles over GPS-guided missiles.

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