Ultrasonic Radars based Military Security System for Identification of Trespassers

Pagidipalli Krishnaiah, Dathrak Rakesh, Banavathu Jyothi

Department of Electrical and Electronics Engineering

Sree Dattha Group of Institutions, Hyderabad, Telangana, India.

Abstract

The purpose of this project is to design and construct automatic missile detection and destroying system. This system is designed to detect the target (missile) moving in multiple directions. The target destroying system moves automatically in the direction of missile and fires it upon fixing the target. This system consists of an intelligent sonar-based object tracking system that continuously monitors the target. Upon detecting the target, it sends the target's location to a Central Control System. The Central Control System takes the action of moving the firing mechanism in the direction of target (missile). Upon fixing the direction, it sends the control command to firing system for attacking the target. In this project we are making use of ultrasonic radar system and a DC geared motor driven firing unit interfaced with a Microcontroller based control unit. The ultrasonic sensor movement is maintained by the servo motor fixed within it. The servo motor is made to revolve through fixed angles; if object is detected then the angle position is sent as the input to the launcher fixed servo motor. The launcher will release the missile fixed within it because the Ultrasonic sensors covers larger sensing distance, and it can detect the target in all the lighting conditions (day or night). The programming of Microcontroller is done using Embedded 'C'.

Keywords: Military security, Trespassers identification, ultrasonic radars.

1. Introduction

The purpose of this project is to design and construct automatic missile detection and destroying system. This system is designed to detect the target (missile) moving in multiple directions. The target destroying system moves automatically in the direction of missile and fires it upon fixing the target. This system consists of an intelligent sonar-based object tracking system that continuously monitors the target. Upon detecting the target, it sends the target's location to a Central Control System. The Central Control System takes the action of moving the firing mechanism in the direction of target (missile). Upon fixing the direction, it sends the control command to firing system for attacking the target. In this project we are making use of ultrasonic radar system and a dc motor driven firing unit interfaced with a Microcontroller based control unit. We prefer ultrasonic sensor to IR sensor, because the Ultrasonic sensors covers larger sensing distance, and it can detect the target in all the lighting conditions (day or night). The programming of Microcontroller is done using Embedded 'C'.

An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors and Microcontrollers Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result. The Missile tracking and auto collision system using RPI PICO Microcontroller is an exclusive project that can move

the target aiming gun according to the instructions given by microcontroller and alerts through LCD when any missile is being detected by it. The thesis explains the implementation of "Missile tracking and auto collision system" using RPI PICO microcontroller. RADAR is an object detection system which uses Microwaves. Microwaves are nothing but the radio waves. It uses microwaves to determine the Range, Altitude and Direction or Speed of objects. The radar dish or antenna transmits pulses of radio waves or microwaves which bounce off any object in their path. RADAR systems come in a variety of sizes and have different performance specifications. Some RADAR systems are used for air-traffic control at airports and others are used for long range surveillance and early-warning systems. A RADAR system is the heart of a missile guidance system.

Technology in 21st century puts an emphasis on making the devices autonomous, be it self-driving car or a defence system all are being made autonomous. In this modern era there is an advancement in radar system also having privileges over the existing systems. The term RADAR itself, not the actual development, was coined in 1940 by United States Navy as an acronym for Radio Detection and Ranging. A radar system is the heart of a missile guidance system. Small portable radar systems that can be maintained and operated by one person are available as well as systems that occupy several large rooms. Radar was secretly developed by several nations before and during the World War II. The term RADAR itself, not the actual development, was coined in 1940 by United States Navy as an acronym for Radio Detection and Ranging. The modern uses of radar are highly diverse, including air traffic control, radar, astronomy, air-defence systems, antimissile systems, marine radars to locate landmarks and other ships; aircraft anticollision systems; ocean surveillance systems, outer space surveillance and rendezvous systems; meteorological precipitation monitoring; altimetry and flight control precipitation monitoring; altimetry and flight control systems; guided missile target locating systems; and ground penetrating radar for geological observations. High tech radar systems are associated with digital signal processing and are capable extracting useful information from very high noise levels.

2. Literature Survey

Missile Detection by Ultrasonic and Auto Destroy System. (May 2014). Samir Chopra, Suman Bharti, Tarun Singh Negi, Prof. P.D Kulkarni, in this paper they are attempting to make a robotic platform along with a stepper motor fitted with ultrasonic sensor is used to automatically locate and aim at a moving target and successfully destroys it. The control system is ATmega32 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption [1]. This system takes decision to detect and destroy the moving missile. It sends control signal to firing unit to destroy missile. The Ultrasonic transceiver (Transmitter & Receiver) detects missile object and displays the missile direction on LCD through Microcontroller. If there is any target within the detection range, the application will turn ON the Laser gun to the nearest detected target and fires. A buzzer alarms when any of the ultrasonic sensor identifies the missile to alert the nearest people. They have introduced wireless camera for taking the visuals at war field. A RF transmitter and receiver are used for controlling robotic platform [2]. Microcontroller Based Missile Detection and Destroying System. (July 2014) S. Nagakishore Bhavanam, Acharya Nagarjuna the proposed paper describes that this project consists of an intelligent sonar based object tracking system and DC geared motor driven firing unit interfaced with microcontroller based control unit is used. ultrasonic sensor is preferred instead of IR sensor, because the Ultrasonic sensors can cover large distances and it can detect target in all the lighting conditions (day or night). Atmel 89c52 microcontroller is used as a control unit. As the target(missile) is detected the control unit sends commands to firing unit to destroys the target. The programming of microcontroller is done

using embedded 'c' language [3]. Missile Detection and Auto Destroy System on a Robot Platform. (2015) Ms. Palwe Pooja Balasaheb, Ms. Shinde Tejashree Anil, Ms. Sonawane Chaitali Shivajirao, Prof. S. M. Bhilegaonkar. This paper proposes a missile detection and auto destroy system on Robot Platform. A microcontroller ATmega16 for loading embedded C program. The ATmega16 is 40 pin IC which has four port like port A, port B, port C and port D. .AT mega16 is 8-bit microcontroller and it is based on RISC architecture. It works on 16MHz frequency. It has low power consumption and inbuilt analog to digital converter. This microcontroller executes powerful instruction in single clock cycle. Stepper motor and ultrasonic sensor are mounted hence sensor rotate continuously rotate in 360-degree direction. If any obstacle come in between ultrasonic ray that time stepper motor will stop, and Laser gun gets on. Sensor also measures the distance and it is displayed by using LCD display. Here Laser is used for destroying purpose as obstacle is detected. Robotic Platform movement in all required direction it means forward, backward, left, right etc. for that RF transmitter for sending wireless data, RF receiver for receiving data and motor driver IC for movement of robot according to our input data [4]. Automatic Missile Detector Using Ultrasonic Proximity Detector. (April 2016) Narayan Thakkar, Shubham Sahu, Shrushti Sindhemeshram, Roshan Kumar. This proposed system uses 8051 Microcontroller as a central control system to send control command to targeting system to attack the target (missile) via laser. The Intel MCS-51 (commonly termed 8051) is an internally Harvard architecture, complex instruction set computing (CISC) instruction set, single chip microcontroller series developed by Intel in 1980 for use in embedded systems. power supply is very important for any circuit, so the ripples present are removed using a capacitive filter and it is then regulated to +5V using a voltage regulator 7805 which is required for the proper operation of the microcontroller and other components. In this project a robotic platform along with a stepper motor fitted with ultrasonic sensor is used to automatically locate and aim at a stationary target, moving target and firing a laser. It is Light Amplification by Stimulated Emission of Radiation. Target acquisition and tracking are frequent domains of active sensing such as Ultra-sound, and then LASER firing. The ability to track targets at manipulation range can significantly reduce the cost and complexity of manipulator control. This research has an additional advantage that it checks the target is hostile or not and accordingly fire the laser. A RF transmitter and receiver modules are used for controlling robotic platform RF Transmitter is use for transmitting the wireless data from input side. It operates at 434MHz frequency. For communication purpose we need serial data, so we use Encoder HT12E, it converts parallel data into serial form at transmitter side. and at receiver side decoder HT12D converts that serial data in to parallel form [6]. Definition: - A ground Missile is a missile designed to be launched from the ground to destroy aircraft or other missiles. It is one type of antiaircraft system; in modern armed forces missiles have replaced most other forms of dedicated antiaircraft weapons, with antiaircraft guns pushed into specialized roles. The first serious attempts at SAM development took place during World War II, although no operational systems were introduced. Further development through the 1940s and 50s led to the first operational systems being introduced by most major forces during the second half of the 1950s. Smaller systems, suitable for close-range work, evolved though the 1960s and 70s, to modern systems that are man portable. Ship borne systems followed the evolution of land-based models, starting with long-range weapons and steadily evolving toward smaller designs to provide a layered defense that have pushed gun-based systems into the shortest-range roles.

3. Proposed System

RpI Pico is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller

board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog input/output (I/O) pins that can interface to various expansion boards (termed shields) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the RPI Pico project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages C. The projected system uses an ultrasonic module interface to microcontroller of RPI PICO family. An ultrasonic transducer encompasses a transmitter, and the receiver is worn. The transmitted waves had been meditated from the object and acquired by way of the transducer again. the overall time taken for sending the waves to receive it become calculated by way of taking into apprehension the rate of sound. Then the distance is calculated via the program going for walks at the microcontroller and displayed on an liquid crystal displayed (liquid crystal display) display screen interfaced to the microcontroller.

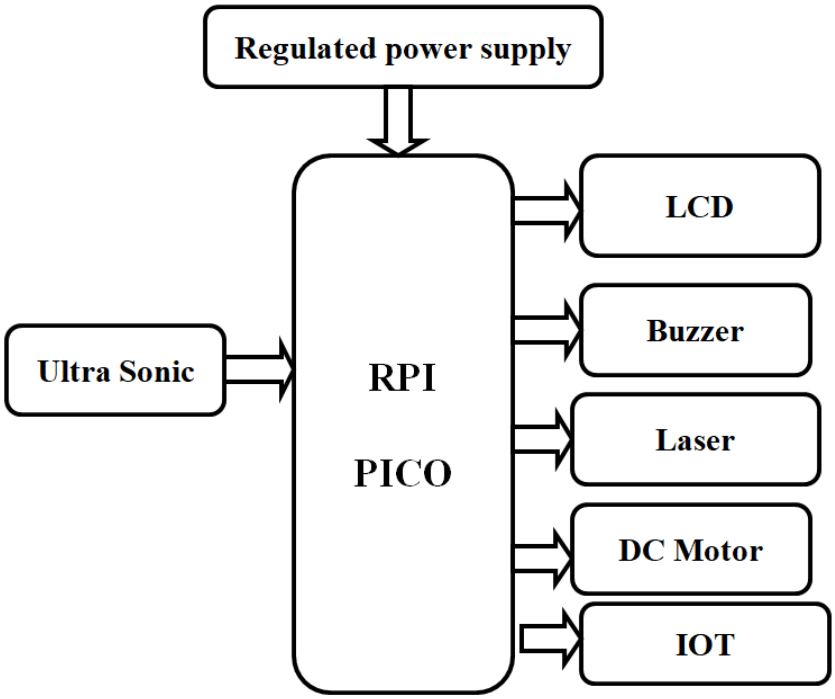


Fig. 1: Block diagram of proposed system.

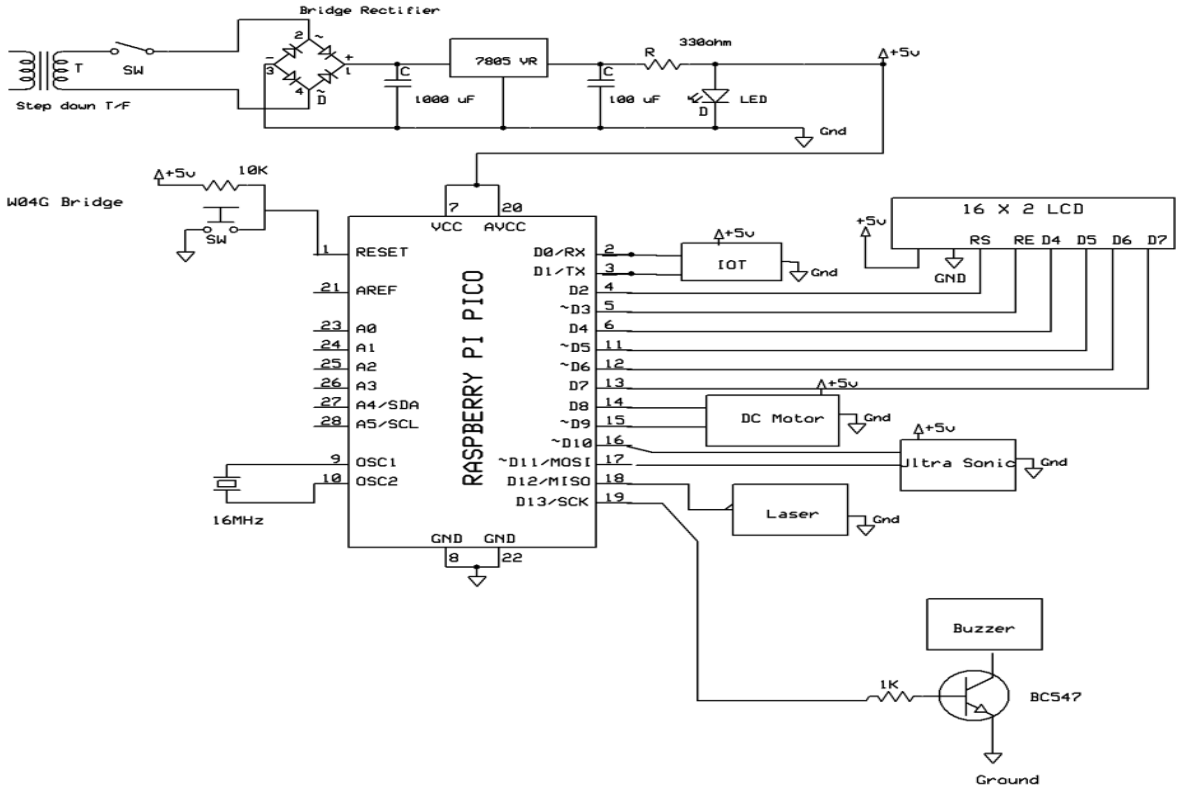


Fig. 2: schematic diagram of Missile tracking and auto collision system.

Working: In this project missile detection And auto destroy system we implemented using ultrasonic sensor which is rotate clockwise and anti-clockwise directions repeatedly. In this both directions if we find any object in this way then buzzer automatically alerts and laser gun fires the object automatically and object range will be displays on LCD and IOT server for security.

3.1 Hardware Description

3.1.1 Raspberry Pi Pico

Pico provides minimal (yet flexible) external circuitry to support the RP2040 chip: flash (Winbond W25Q16JV), crystal, power supplies and decoupling, and USB connector. The majority of the RP2040 microcontroller pins are brought to the user IO pins on the left and right edge of the board. Four RP2040 IO are used for internal functions - driving an LED, onboard Switched Mode Power Supply (SMPS) power control and sensing the system voltages. Pico has been designed to use either soldered 0.1" pin-headers (it is one 0.1" pitch wider than a standard 40-pin DIP package) or can be used as a surface mountable 'module', as the user IO pins are also castellated. There are SMT pads underneath the USB connector and BOOTSEL button, which allow these signals to be accessed if used as a reflow soldered SMT module

Fig. 3: RASPBERRY PI PICO ddevelopment Board

3.1.2 Regulated Power Supply

Power supply is a supply of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. A power supply may include a power distribution system as well as primary or secondary sources of

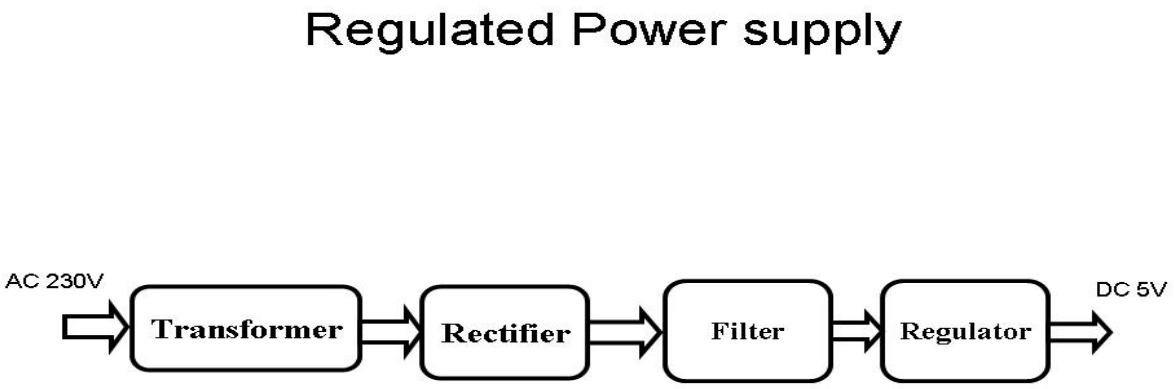


Fig. 4: Regulated power supply.

3.1.3 LED

A light-emitting diode (LED) is a semiconductor light source. LED's are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LED's emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. The internal structure and parts of a led are shown in Fig. 5 and 6 respectively.

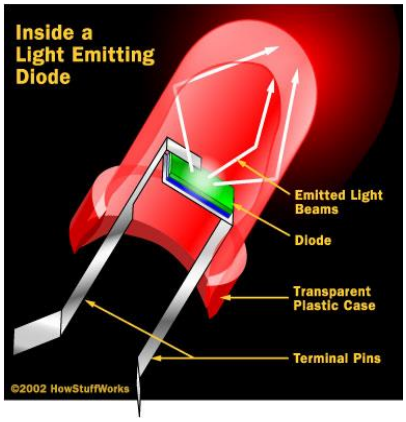


Fig. 5: Inside a LED

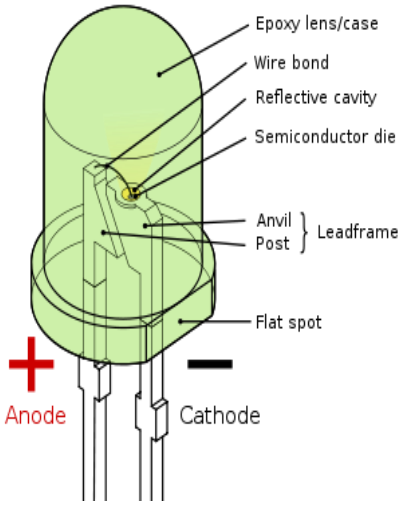


Fig. 6: Parts of a LED

3.1.4 Ultrasonic sensor

Ultrasonic sensors emit short, high-frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they are reflected back as echo signals to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo. As the distance to an object is determined by measuring the time of flight and not by the intensity of the sound, ultrasonic sensors are excellent at suppressing background interference.

Fig. 6: Ultrasonic sensor module

3.1.5 LCD DISPLAY

LCD Background: One of the most common devices attached to a micro controller is an LCD display. Some of the most common LCD's connected to the many microcontrollers are 16x2 and 20x2 displays. This means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

Basic 16x 2 Characters LCD

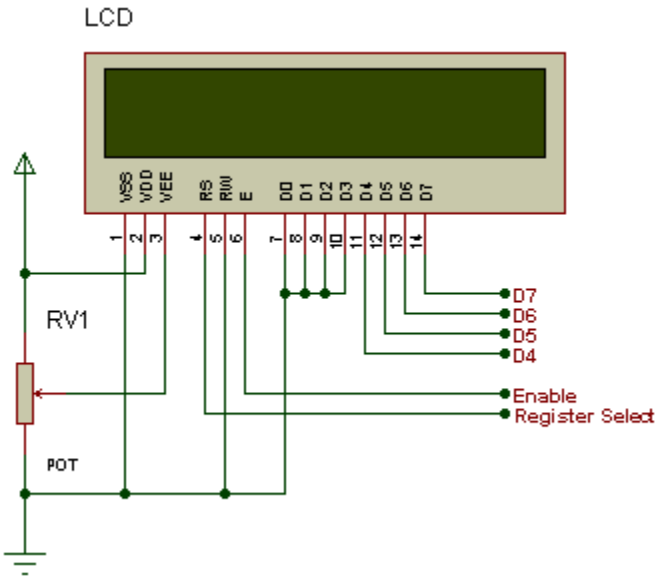


Fig. 7: LCD pin diagram.

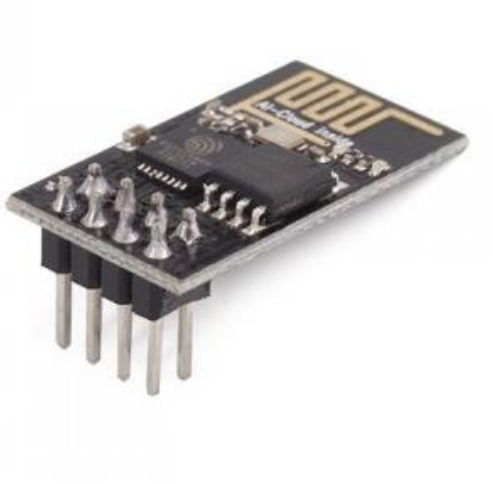
3.1.6 D.C. Motor

A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The reverse process, producing electrical energy from mechanical energy, is accomplished by an alternator, generator, or dynamo. Many types of electric motors can be run as generators, and vice versa. The input of a DC motor is current/voltage, and its output is torque (speed).

Fig. 8: DC motor.

3.1.7 ESP8266 Module

Espressif Systems' Smart Connectivity Platform (ESCP) of high performance wireless SOCs, for mobile platform designers, provides unsurpassed ability to embed Wi-Fi capabilities within other systems, at the lowest cost with the greatest functionality



3.2 Advantages and Disadvantages

3.2.1 Advantages

1. Automatic missile tracking using sonar sensor.
2. Fast response.
3. Efficient and low-cost design.
4. Low power consumption.
5. Automatic target aiming for auto collision

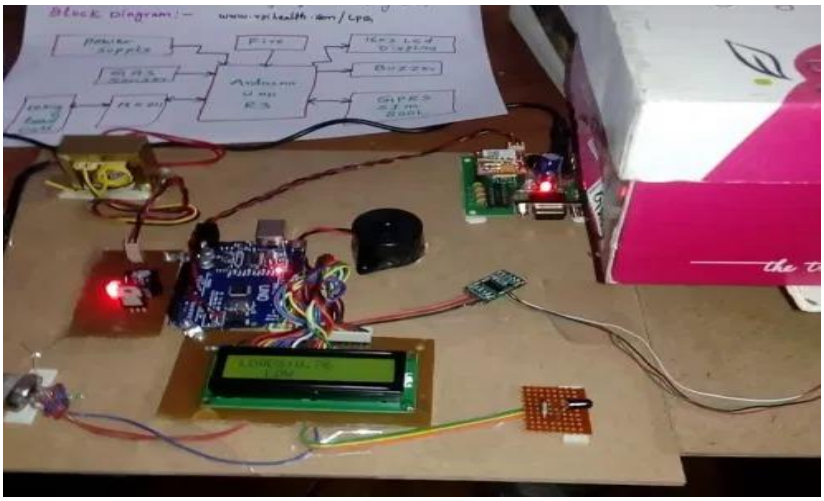
3.2.2 Disadvantages

1. Status and feedback of target is not obtained.
2. Limited distance.

3.2.3 Applications

1. It can be used in places where humans cannot work.
2. Mainly in military applications, the system plays a vital role for detection of missiles.
3. Can be used in mines.

4. Results



5. Conclusion

The project "**Military security system for identification of Trespassers using Ultrasonic Radars**" was designed such that the design and construct automatic missile detection and destroying system. This system is designed to detect the target (missile) moving in multiple directions. The target destroying system moves automatically in the direction of missile and fires it upon fixing the target.

5.1 Future Scope

The project "Missile tracking and auto collision system" is mainly intended to operate design and construct automatic missile detection and destroying system. The system is designed to detect the target (missile) moving in multiple directions. The target destroying system moves automatically in the direction of missile and fires it upon fixing the target. In future we can add GSM to this project is that the status of target properties is not known. This can eliminate by having a GSM module, which gives the status of target. We can also add Ultrasonic module, which is used for obstacle detection with GSM module which gives respective information. By connecting wireless camera to the system, then we can see the outer world from our personal computer only by using GPRS and GPS. We can use this system at so many fields and we can use to handle so many situations.

References

[1] Wang Shaokun, Xiao Xiao, Zhao Hongwei the Wireless Remote Control Car System Based On ARM9, College of Software, Department of Computer Science and Technology, Jilin University, JLU, Changchun, China, 2011 International Conference on Instrumentation, Measurement, Computer, Communication and Control

[2] B.Suchitha Samuel, B.Bharathi, J.Mrudula, Department of Electronics& Communication Engineering, Geethanjali College of Engineering and Technology, Keesara, Andhra Pradesh, India, Design of PC Controlled Automatic Solar Tracker Robot, Vol. 2, Issue 10, October 2013, International Journal of Innovative Research in Science, Engineering and Technology.

[3] Muhammad Ali Mazidi and Janice Gillispie Mazidi "The 8051 Microcontroller and Embedded systems", Pearson Education.

[4] Fu-Kuang Yeh, Kai-Yuan Cheng, and Li-Chen Fu." Variable Structure-Based Nonlinear Missile Guidance/Autopilot Design with Highly Maneuverable Actuators "IEEE transaction on control systems technology, vol.12, no.6, november 2004.

[5] Harvey, C., and Stein, G. (June 2014), "Missile Flight control system," IEEE Trans. Autom. Control AC-23(3), 378–387 (June 2014).

[6] A.Hla Myo Tun, S.San Hlaing Oo, C.Myint Myint Yi," Analysis of Phase Lead Compensator Design for Laser Guided Missile System using MATLAB"

[7] B. Kada,"Outer-Loop Sliding Mode Control Approach to Longitudinal Autopilot Missile Design"IFAC World Congress Milano, September 2, 2011

[8] Masahiko Saito,Mayur Palankar(2015), "Embedded Systems - Missile Detection/ Interception,"IEEE transactions of Missile system 2015.

[9] Reichert, R. T. (2014), "Dynamic Scheduling of Modern-Robust-Control Autopilot Designs for Missiles," IEEE Control Systems Magazine 12(5), 35–42 (2014).

[10] Yang Xin, Bo Qingwei and Zhou Changsheng, "Design and Analysis of Servo Actuator Control System Based on ARM," 6th International Conference on Machinery, Materials, Environment, Biotechnology and Computer (MMEBC 2016).