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Radar Based Security System Using Arduino

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Abstract: *The application of radio detection and ranging in different places such as military installation, commercial use is done with the help of Radar Based Security System which uses electromagnetic waves for detection of different physical components such as distance,speed, position, range, in field of navigation. In this work, it is proposed an Arduino based Radar system, after thorough study of existing systems. This work has advantage over other radar- based systems as it reduces power consumption. The system consist a basic ultrasonic sensor placed upon a servo motor which rotates at a certain angle and speed. This Ultrasonic sensor is connected to Arduino digital input output pins and servomotor also connected to digital input output pins. It hasan Extension of detecting the objects in 3 ranges: in 0°-6° range if unwanted person is detected Bob motor is used to alert. In 60°-120° range DC motor and 120°-180° Buzzer are used to attack the unwanted person.*

Keywords: Embedded system, Radar Based Security System, Ultrasonic sensor, Arduino.

I. INTRODUCTION

The project aim of "Radar-Based Security Using Arduino" is to design and implement a security system that utilizes radar technology and the Arduino microcontroller platform to detect and potentially deter intruders or unauthorized individuals in a specific area. Radar-based securitysystems offer several advantages over traditional security methods, as they can operate in variousweather conditions and provide a non-contact way of detecting motion and presence. The project objectives for a "Radar-Based Security Using Arduino" project are focused on developing a security system that employs radar technology and the Arduino platform to enhance security measures through accurate motion detection and appropriate response mechanisms. Here are the specific project objectives. Radar-based security systems have gained significant attention in recent years, owing to their ability to provide efficient and non-invasive surveillance in various applications. This literature review focuses on radar-based security systems implemented using Arduino microcontrollers. These projects leverage the affordability and versatility of Arduino platforms to develop cost-effective and customizable radar solutions for security purposes. [1] Several studies have explored the feasibility of using Arduino-based radar systems for perimeter security. Researchers have utilized ultrasonic or microwave radar sensors to detect intruders or objects within a designated area. These radar systems offer advantages such as low power consumption and compact size, making them suitable for both indoor and outdoor security applications. Additionally, Arduino's open-source nature allows for easy integration with other sensors and communication modules, enabling real-time alerts and remote monitoring [2] Moreover, these radar-based security projects often incorporate machine learning algorithms for object classification and tracking. Machine learning models are trained to distinguish betweenvarious objects and human intruders, enhancing the system's accuracy and reducing false alarms.Such implementations have demonstrated promising results in terms of intrusion detection and threat assessment, making them valuable in security-sensitive environments. [3]

II. EMBEDDED SYSTEM (ES)

An embedded system is a special-purpose computer system designed to perform one or a few dedicated functions, sometimes with real-time computing constraints.[4] It is usually embedded as part of a complete device including hardware and mechanical parts [5]. In contrast,a general- purpose computer, such as a personal computer, can do many different tasks dependingon programming. Embedded systems have become very important today as they control many of the common devices we use.[6]

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In general, "embedded system" is not an exactly defined term, as many systems have someelement of programmability. [7]For example, Handheld computers share some elements with embedded systems such as the operating systems and microprocessors which power them but are not truly embedded systems, because they allow different applications to be load and peripherals to be connected.[8]

An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a particular kind of application device. Industrial machines, automobiles, medical equipment, cameras, household appliances, airplanes, vending machines are among the myriad possible hosts of an embedded system.

Embedded systems that are programmable are provided with a programming interface, and embedded systems programming is a specialized occupation [10]. Certain operating systems or language platforms are tailored for the embedded market, such as Embedded Java and Windows XP Embedded. However, some low-end consumer products use very inexpensive microprocessors and limited storage, with the application and operating system both part of a single program. The program is written permanently into the system's memory in this case, rather than being loaded into RAM (random access memory), as programs on a personal computer.[11]

III. EXISTING SYSTEM

The system consist a basic ultrasonic sensor placed upon a servo motor which rotates at a certainangle and speed. This ultrasonic sensor is connected to Arduino digital input output pins and servo motor also connected to digital input output pins.

IV. PROPOSED METHOD

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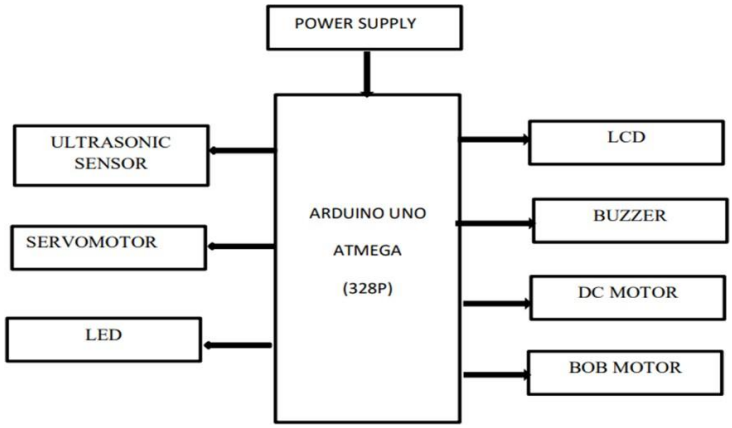

Fig: Block diagram of the proposed method

V. HARDWARE & SOFTWARE EMPLOYED

Hardware

Arduino Uno Micro Controller:

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet).It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.[9]

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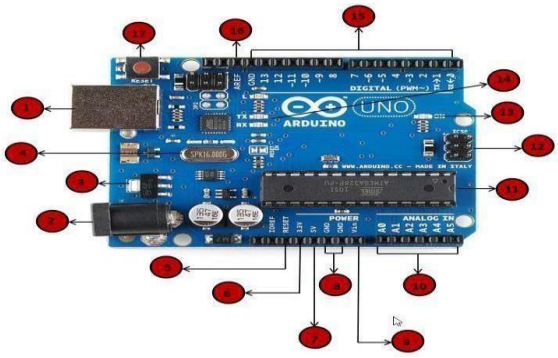

Figure 2: Arduino Board

LCD

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or lector[4].Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other

Figure 5: 2x16 LCD Display

Buzzer

An audio signaling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren

Fig: Buzzer

Servo Motor

A servomotor, often referred to simply as a servo, is a specialized type of electric motor used in various applications where precise control of position, velocity, and acceleration is required. Servomotors are commonly used in robotics, industrial automation, aerospace, remote- controlled vehicles, and other applications where accurate and controlled motion is essential.

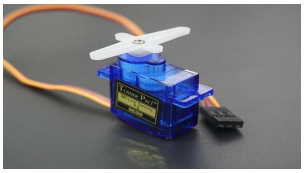

Fig: Servo meter

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HC-SR04 Ultrasonic Sensor

The Ultrasonic sensor has 4 pins. VCC and GND go to 5V and GND pins on the Arduino,and the Trig and Echo go to any digital Arduino pin. Using the Trig pin we send the ultrasound wave from the transmitter, and with the Echo pin we listen for the reflected signal. HC-SR04 ultrasonic sensor uses SONAR to determine the distance of an object just like the bats do. It offersexcellent non-contact range detection with high accuracy and stable readings in The an easy-to- use package from 2 cm to 400 cm or 1" to 13 feet.

Fig: ultrasonic sensor

Bob Motor

A Bob motor has a gear assembly attached to the motor . The speed of motor is counted in termsof rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasingthe torque and reducing the speed.

Fig: Bob Motor

Dc Motor

A DC (Direct Current) motor is an electrical device that converts electrical energy into mechanical energy through the interaction of magnetic fields. These motors are commonly used in a wide range of applications, from small household appliances to industrial machinery, due to their simplicity, controllability, and reliability

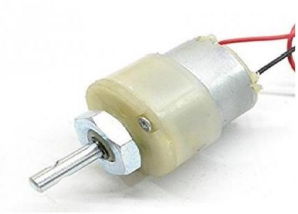

Fig: Dc Motor

Relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw (changeover) switch contacts. Relays are usuallly SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. For further informationabout switch contacts and the terms used to describe them please see the page on switches.

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Fig: Relay Switch

Software:

Arduino IDE:

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (erred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), whichis used to write and upload the computer code to the physical board.

Arduino programming structure

In this chapter, we will study in depth, the Arduino program structure and we will learnmore new terminologies used in the Arduino world. The Arduino software is open-source. Thesource code for the Java environment is released under the GPL and the C/C++ microcontrollerlibraries are under the LGPL.[11]

Sketch: The first new terminology is the Arduino program called "**sketch**".

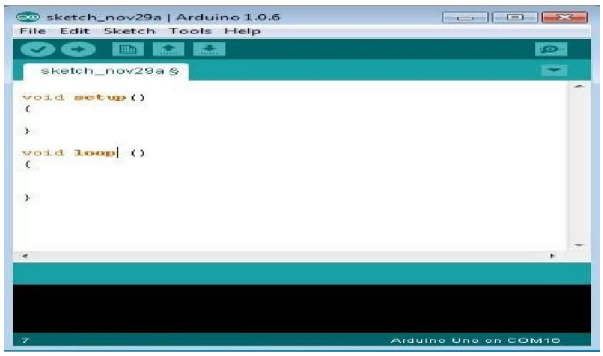
Structure

Arduino programs can be divided in three main parts: **Structure**, **Values** (variables and constants), and **Functions**. In this tutorial, we will learn about the Arduino software program, step by step, and how we can write the program without any syntax or compilation error.

Let us start with the **Structure**. Software structure consist of two main functions:

Setup( ) function

Loop( ) function




```
Void setup ( )
{
}
```

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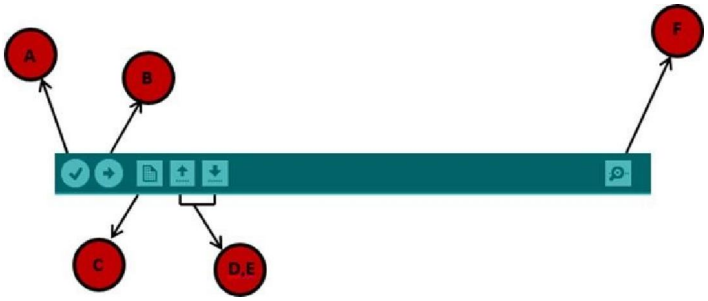
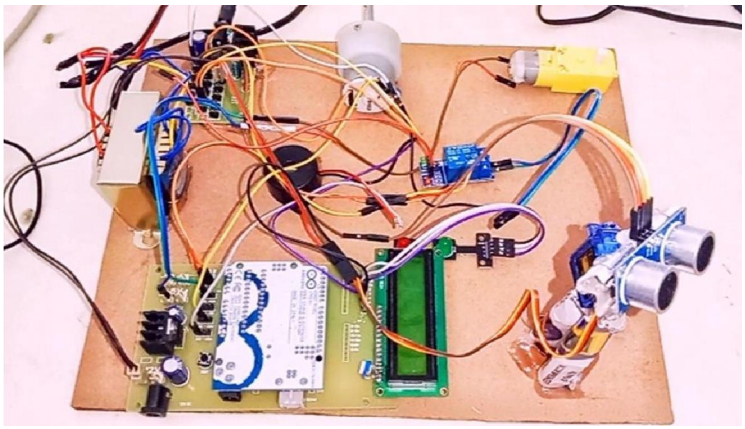


A- Used to check if there is any compilation error.
B- Used to upload a program to the Arduino board.
C- Shortcut used to create a new sketch.
D- Used to directly open one of the example sketches.
E- Used to save your sketch.
F- Serial monitor used to receive serial data from the board and send the serial data to the board.

VI. RESULTS



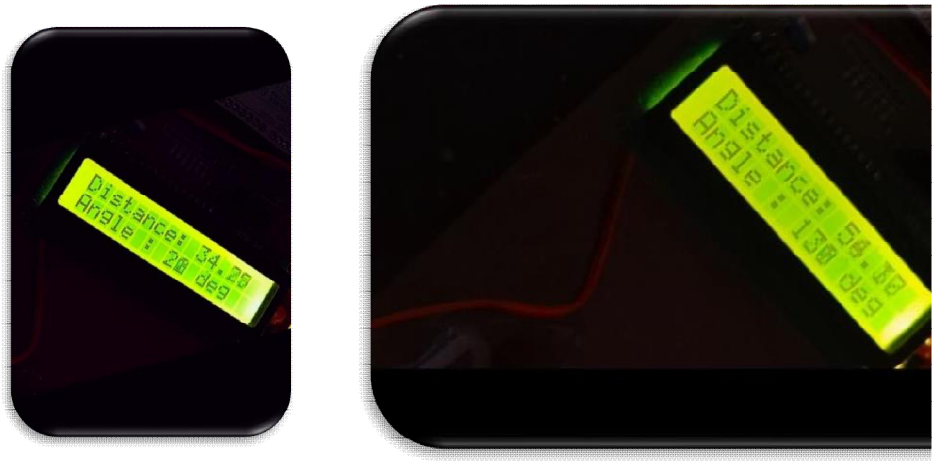


Fig: Final Result

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VII. CONCLUSION

In conclusion, a radar-based security project using Arduino presents a fascinating opportunity for experimentation and learning in the field of security systems. It allows for customization, cost-effectiveness, and valuable hands-on experience in electronics and programming. However,it is essential to consider its limitations, including limited range, resolution, susceptibility to interference, and constrained processing power. Therefore, while Arduino-based radar projects are excellent for educational purposes and small-scale security applications, they may not be the most suitable choice for complex or critical security environments, where more advanced and specialized radar solutions are typically preferred.

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