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## USR RADAR SECURITY SYSTEM WITH SMS ALERT

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**Abstract:** Radio Detection and Ranging (RADAR) is an Object/Target detecting device which is used for monitoring a particular area. The fundamental need of RADAR system is to provide security. It can be used to detect Objects/Targets like Aircraft, Spacecraft, Missiles, Vehicles, Weather formation and so on. It consists of Trans-receiver and a processor or a controller. RADAR can be of many types. Ultrasonic RADAR is an object detecting system that is used to monitor a short range of particular area or place. This paper presents finding of both angle and distance of the Object/Target with SMS alert (with the help of GSM module). This device includes an Arduino that is interfaced to an Ultrasonic Sensor mounted on a Servo Motor. As we are using Servo Motor this radar system covers area up to 180 degree. This system is programmed using embedded C, and the result is observed on display.

**Keywords:** RADAR, USR, SMS Alert, Servo Motor, Display.

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**Introduction:** RADAR stands for Radio Detection and Ranging, it have a number of defense as well as civil applications. It is basically an EM system which is used to detect the location and distance of an object from the point where the RADAR is placed. To track aircrafts on the ground, in the air and to guide planes for smooth and safe landings radar is used. This falls under one of the application of radar in Air traffic control. Radar is also used by police to detect the speed of the passing vehicles. It is also used by Geologists to map the Earth and other planets. Major application of radar is in Military, used for surveillance. To track storms, hurricanes and tornadoes Meteorologists uses radar. The energy is radiated into space, the echo or reflected signal from the objects is study and monitored to find the distance and location of that objects. It operates in the Ultra High Frequency and in microwave range.

The RADAR system mainly consists of a transmitter to radiate energy into space by an antenna. It gets reflected or reradiated in many directions, when that signal strikes any object or target. This echo or reflected back signal is received by the radar antenna, it is processed to determine the object or target geographical statistics. The range is determined by the total time taken by the signal to travel i.e., from the RADAR system to the target and back. The signal covers  $2R$  distance. The location of the target is measured in angle, from the direction of maximum amplitude echo signal. To measure location and range of moving objects is also determined. Doppler Effect is used for detecting range and location of moving targets.

**USR Radar Security System Block Diagram:** The actual radar systems consist of high power transmitters and receivers, large antenna, complex systems like DSP's for processing data and huge displays. This Arduino based USR (Ultrasonic Short Range) RADAR circuit demonstrates the working of

a radar system. USR RADAR uses ultrasonic waves for Object detection and measuring object distance and location (angle). Calculations are displayed on the 2x16 LCD screen interfaced to arduino and that information will be sent to the Authorized person with the help of GSM module. It can detect multiple objects distances and corresponding locations and all are displayed one by one on the same LCD screen. The block diagram of an USR RADAR Security System is shown Figure 1.1. The system includes an Arduino Nano board, an Ultrasonic Sensor, LCD Screen, Servo Motor, GSM Module and Power Supply.

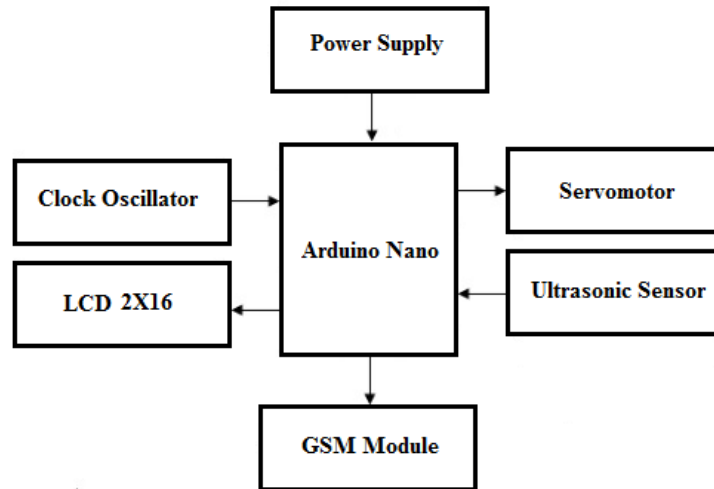


Figure 1.1: USR RADAR Security System Block Diagram

**Requisites of USR Radar Security System:**

**Ultrasonic Sensor (HC-SR04):** The Vcc pin is 1<sup>st</sup> pin which is connected to +5V power supply, it powers the sensor. The 2<sup>nd</sup> pin is an Input pin known as Trigger pin, to initialize measurement by sending ultrasonic wave this pin has to be kept high for 10µs. Echo pin is 3<sup>rd</sup> pin, it is an Output pin. This pin is high for a period of time which will be equal to the time taken for the ultrasonic wave to return back to the sensor. 4<sup>th</sup> pin is Ground. Measuring Distance is 2cm to 450cm (Theoretical), 2cm to 80cm (Practical) with Accuracy of 3mm, it covers <15° angle. It operates at 40Hz Frequency with operating Current <15mA.

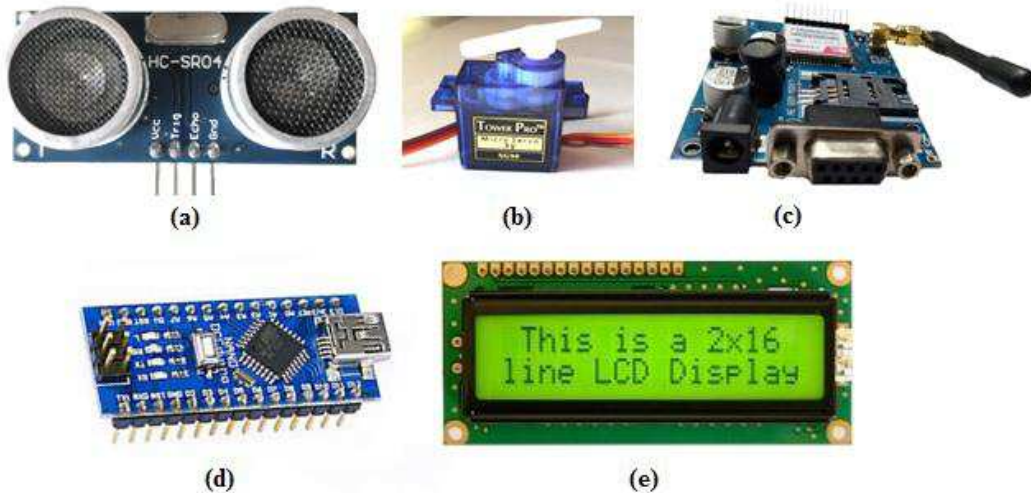


Figure 1.2: (a) Ultrasonic Sensor (HC-SR04), (b) Servo Motor (Sg90), (c) GSM Module, (d) Arduino Nano, (e) LCD Screen

**Servo Motor (Sg90):** The Brown wire is ground; it is connected to the ground of system. The Red wire is supply wire, it Powers the servomotor. Operates at +5V supply. The Orange wire is used for giving PWM signal to drive the motor. The torque produced by sg90 is about 2.5kg/cm, Operates at a speed of 0.1s/60°. It's gear type is Plastic, rotation of motor is from 0° to 180°. The weight of servomotor s90 is very small and is about 9gm.

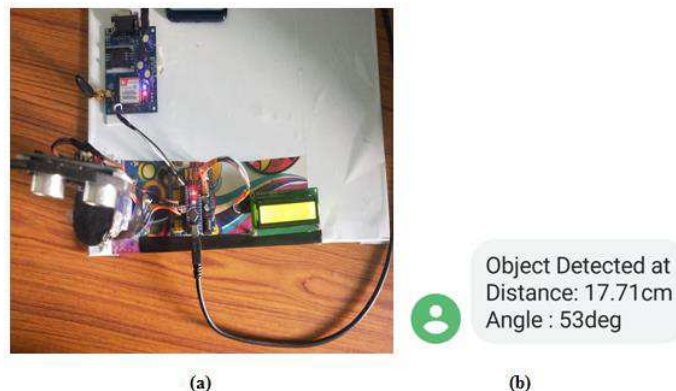
**GSM Module:** It operates at Dual-Band GSM/GPRS 900/ 1800 MHz frequencies. It has RS232 interface for direct communication with computer or Micro Controller Unit kit. Baud rate is Configurable. 29302WU IC is used for Power control. It has ESD Compliance and also enable with Speaker and MIC socket. It has slid in SIM card tray With Stub antenna and SMA connector. It operates with 12V DC. To work with this module AT commands are required. While handling this Module Precautions to be taken are Avoid placing circuit boards on a metal surface, Avoid holding IC when it is Switched ON. Hold edges while handling with circuit boards, if possible use anti static gloves.

**LCD Screen:** LCD means Liquid Crystal Display. It is very helpful in providing user interface as well as for debugging purpose. The most common type of Liquid Crystal Display controller is HITACHI 44780 which provides a simple interface. Interface these LCD's is very simple as well as they are cost effective. The most commonly used ALPHANUMERIC LCD displays are 1x16 (Single Line & 16 characters per line), 2x16 (Double Line & 16 characters per line) & 4x20 (four lines & Twenty characters per line). It has 3 control lines and 8 data lines. Operates with +5v supply.

**Power Supply:** to operate electronic devices DC power supply is required. For that +5v and +12v adaptors are used for powering the devices, they are used according to their power requirement.

**Arduino Nano board and Arduino Software (IDE):** To program Arduino Nano, Arduino Software (IDE) is required. It is an Integrated Development Environment that is common to all Arduino boards. This IDE runs on both online and offline. The detailed specification of the Arduino Nano board is: it contains ATmega328 Microcontroller operates with +5V power supply. The Input Voltage range is from 7V to 12 V (Recommended), the input voltage is greater than 6V and it should not exceed +20V. Arduino Nano has 8 Analog Input Pins and 14 Digital I/O Pins, of which 6 provide PWM Output. The DC Current at each I/O Pin is 40 mA. ATmega328 has 2KB SRAM, 1KB EEPROM, 32KB Flash Memory of which 2KB used by boot loader. 16 MHz Clock frequency is used for Arduino Nano. The dimensions of Arduino Nano is 0.73" x 1.70".

**Results:** All the required components are interface to Arduino Nano, controlling them and processing data is done by Arduino Nano. An Ultrasonic sensor is mounted on Servomotor, Servomotor rotation lies in between 0° to 180° and object distance is measured from the echo signal received by Ultrasonic sensor. The figure shown below is implementation of USR Security System. The transmitter in Ultrasonic sensor transmits an ultrasonic wave with frequency 40Hz, the transmitted wave travels in air, it gets back when objected by any material i.e., it reflects back toward the sensor this reflected wave is received by the Ultrasonic receiver module.



**Figure 1.3:** (a) Experimental Setup and (b) Received message

The distance is calculated by using the formulae **Distance = Time × Speed**, Speed and time should be known. Since US wave is used, it is known that the universal speed of Ultrasonic wave is 330m/s(at room conditions). The inbuilt circuitry on the module will calculate the time taken for the US wave to come back. The echo pin turns on high for that same particular amount of time (calculated by inbuilt circuitry), this way time taken is known. The distance is simply calculated by the microcontroller. A 50Hz PWM signal should be produced. Therefore the total time period is 20ms, in which the Ton (turn on time) should be 1ms to 2ms and Toff (turn off time) should be 19ms to 18ms respectively. The angle depends on Ton i.e., angle is 0° for 1ms Ton, it is 90° for 1.5ms Ton and 180° for 2ms Ton. When any object is then the calculated distance and angle which is displayed on LCD Screen is sent to mobile number (included in code) with the help of GSM Module shown in figure 1.3.

**Conclusion:** An USR Security System was designed and implemented experimentally for detecting objects using Ultrasonic waves and to measure the distance. An Arduino Nano device was used as a controller in the design to process the data and control the other requirements such as servomotor, ultrasonic sensor and GSM module for measurement of objects or obstacles placed at different angle. As the servomotor rotation lies in between 0° to 180°, this device covers only 180° and measures up to 2m practically. If the object is detected then “Object detected at distance (in cm) and Angle (in deg)” is sent to the mobile number (included in code) with the help of GSM Module so that no continuous monitoring of display by the human is required. As the detected object’s detection and angle is delivered by GSM Module. This System mainly used for providing Security.

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