TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

THAPATHALI CAMPUS

A Final Project Report

On

Smart Security Alert System

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Submitted To:

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING

THAPATHALI CAMPUS

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DECLARATION

We hereby declare that the report of the project "**Smart Security Alert System**" which is being submitted to the **Department of Electronics and Computer Engineering**, **IOE**, **Thapathali Campus,** in partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in **Electronics and Communication Engineering**, is a bona fide report of the work carried out by us. The materials contained in this report has not been submitted to any University or Institution for the award of any degree and we are the only author of this complete work and no sources other than the listed here have been used in this work.

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CERTIFICATE OF APPROVAL

The undersigned certify that they have read and recommended to the **Department of Electronics and Computer Engineering, IOE, Thapathali Campus**, a minor project work entitled "**Smart Security Alert System**" submitted by **James Shrestha, Krishna Bahadur Ojha, Krishna Rauniyar** and **Rajad Shakya** in partial fulfillment for the award of Bachelor's Degree in Electronics and Communication Engineering. The Project was carried out under special supervision and within the time frame prescribed by the syllabus.

We found the students to be hardworking, skilled and ready to undertake any related work to their field of study and hence we recommend the award of partial fulfillment of Bachelor's degree of Electronics and Communication Engineering.

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ABSTRACT

Smart Security Alert System (SSAS) is the project targeted to enhance security of shutter system. Every day we get to hear the violation of rules and regulation in the country that has made our country go back economically and with other aspects as well. For example, a local shop in Nepal uses the ordinary lock system which is way likely to be robbed as well as the sad part is only few of them gets caught and respective action is never taken instantly. So this is the device that can be easily implemented in the shutter of the local shop, departmental stores, furthermore in large industries as to enhance security. The best feature of this project is its ability to alert the owner about the attempt to break the locks of system by a call through use of GSM technology interfaced with ATmega32 microcontroller. Therefore immediate action can be taken on the spot and such loss of properties can be reduced then after. Wi-Fi module is used to verify the owner of the shop. Also, there exists many other security devices which can be implemented in the shops of Kathmandu but these devices are not easily affordable. But this device is cheap and affordable to any shop owner and easy to operate.

Keywords: Smart Security Alert System (SSAS), Global System of Mobile Communication (GSM), ATmega32 microcontroller, Wi-Fi module

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LIST OF ABBREVIATIONS

- SSAS Smart Security Alert System
- GSM Global System for Mobile Communication
- LCD Liquid Crystal Display
- WAP Wireless Application Protocol
- IP Internet Protocol
- PCB Printed Circuit Board
- SoC System on Chip
- TCP/IP Transmission Control Protocol/ Internet Protocol
- GPIO General purpose input output
- NTC Nepal Telecom
- SMS Short Message Service
- CCA Cooperative Collision Avoidance
- DSRC Dedicated Short Range Communication
- CISC Complex Instruction Set Computer
- RISC Reduced Instruction Set Computer
- USART Universal Synchronous Asynchronous Receiver Transmitter
- UART Universal Asynchronous Receiver Transmitter
- USI Universal Serial Interface
- USB Universal Serial Bus
- IP Internet Protocol
- LED Light Emitting Diode
- GPRS General Packet Radio Services
- I/O Input Output
- EEPROM Electrically Erasable Programmable Read-Only Memory
- ISP In-System Programming
- AVR Advanced Virtual RISC
- JTAG Joint Test Action Group

1 INTRODUCTION.

1.1 Background

The project is based on enhancing the use of available technology in the security system and its effective use to solve the arising problems of theft that occurs by breaking the lock systems of the firms. Mainly in the cities areas where there are presence of business firms like departmental stores and local shops there is seen increasing trend of theft when shops are closed at night. The project gives the owner affordable electronic mean that can notify them about any possible theft that occur in those firms which is done by breaking the lock system in those firms.

Security has always been the field of concern for every sectors. Though, the shutter system is widely used in firms it is not secure in its own without enhancement of other security measures. The main problem related to security is theft and robbery which has made in heavy loss of property. Mainly in city areas like Kathmandu due to lack of proper security system during night time when shops are closed the theft occurs causing the heavy loss in business and property which if not controlled might even affect the economy of the country.

The thief uses different techniques to break the lock of shutter mainly during night time when almost everyone is asleep. The theft occurred at that time is not noticed by the owner and neighbors due to which theft goes unnoticed and even police after theft has occurred find it difficult to track the thieves.

GSM technology is widely used in our country. With the service providers like NTC, NCELL, Smart Cell almost all people has access to GSM services in his cellphone to receive the SMS or Call. Making use of this to our advantage, our project works to make use of call service provided by GSM to alert the owner of the firms of possible theft.

This project alerts the owner during the time when lock is in process of breaking. Our device sense the attempt to open the lock of shutter by unauthorized person which results in ringing of buzzer that notify the locals about theft attempt. In the meantime through use of GSM module the owner gets notified by an alert call on their cellphone.

1.2 Motivation

Recently there seems to be increase in theft related crime that are targeted from small to big firms that have implemented shutter system. This problem if not solved wisely in time is sure to affect the business environment in country which has been source of income for many individual and the country. Solving the problem of security in shutter has been our motivation for doing this project. We are also motivated to complete the project making use of available reliable technology that is affordable by all concerned party.

1.3 Problem Definition

Shutter system is one of widely used lock system that are used in shops, stores garages etc. It is usually sturdy and strong due to which it is widely used in business firms. But those shutter once get breached the loss in the business is inevitable. So our project is based on developing the working module that can enhance the security of shutter. The project works to alert the business firm owner about the possible act to break his shutter system in the firm making alert call in his cellphone and ring the buzzer in the shop to alert the locals about the possible act of theft.

1.4 Objectives

The main objectives of the project are:

1. To alert the owner of the firms if any attempt of breaking shutter system takes place.
2. To develop the affordable module that can be readily installed in shutter that are already in use or new shutter to enhance additional feature in them.

1.5 Project Scopes and Application

The project works making use of GSM technology to alert the owner about any attempt to break the shutter system of their firm. As the service is widely used the project is economical and is affordable by almost all. As the project main objective is to alert owner about the breaking of the lock of the shutter, the project is applicable to all the firms where shutter is implemented.

1.6 Report Organizations

The material presented at the report is organized into ten chapters.

Chapter 1 is an introduction section which mainly describes the background, motivation to choose this project, problem definition of project, objective of the project, scope and application of the project.

Chapter 2 presents the brief summaries of the works that have already been carried out in the past related to this project.

Chapter 3 is related to the hardware and software requirement analysis which briefly describes why and where the above-mentioned hardware/ software requirements are used.

Chapter 4 explains how a particular sequence in which the work has been carried out along with detail procedures, block diagram of data flow diagram which describes the explanation of how the hardware and software are used to accomplish this project.

Chapter 5 contains the details of the implementation of the things that have been explained in the methodology. It describes how the system methodology is implemented.

Chapter 6 contains the result of our project.

Chapter 7 gives the information about the future enhancements that can be implemented in our project.

Chapter 8 contains the conclusion of our project.

Chapter 9 contains the additional information's such as project, budget, project timeline, circuit diagrams, PCB designs and module's specifications.

Chapter 10 contains the references from which we were able to complete the project.

2 LITERATURE REVIEW

Our Society is troubled with these unusual activities going on day by day especially related to theft. These are not permanently eradicable but can be minimized with some technological efforts. Looking at the past context the security system in shops and other areas are easily breakable because there was only the use of manpower not the electronics but nowadays the use of modern technologies have fortunately minimized the use of manpower. The use of such technology is a boon to the society and eventually can cause economic growth to the nation. Thus, the need of smart security is an absolute necessity now and in the near future.

2.1 GSM Module

Moon, Y.S.; Wong, K.; Ho, K.S. [1] has designed a prototype of a novel GSM mobile phone based automobile security system. Experimental results show that the approach is feasible even for the low bandwidth of the GSM network. Wall, R.W. [2] suggested Sprinklers and power lines for implementing precision agriculture for farm management requires improved sensing and control. It is also shown how to reduce operating costs for automating existing agricultural irrigation controls View.

Hui-Nien Hung, Yi-Bing Lin, Ming-Kun Lu, and Nan-Fu Peng [3] developed A Statistic Approach for Deriving the Short Message Transmission Delay Distributions which analyzes the short message transmission delays based on 40 000 measured data collected from commercial operation. AI-Ali A. R., & Rousan M., Mohandes M., [4] have designed GSM based distribution transformer monitoring system. The system can be also controlled and monitored from anywhere by using telephone line.

2.2 Ultrasonic Sensor

The first use for the concept of the ultrasonic waves was done by U.S. researcher Dr. Floyd Firestone of the University of Michigan applies for a U.S. invention patent for the first practical ultrasonic testing method. The patent is granted on 1942 under the title "Flaw Detecting Device and Measuring Instrument".

“Ultrasonic anti crashing system for automobiles” IEEE paper published in 2013, attempted to develop an anti-crash warning system combined with ultrasonic ranging

technology and sensor technology for automobiles. It mainly focusses on potholes in the road and its detection and hence automatic or manual reduction in the speed of the vehicle in order to avoid crashing.

In “Cooperative vehicle collision avoidance using inter-vehicle packet forwarding” IEEE paper publishes in 2005, [5] proposes a broadcast oriented packet forwarding mechanism for intra-platoon cooperative collision avoidance (CCA) using dedicated short range communication (DSRC) based wireless networks. Using an implicit acknowledgement strategy it is shown that with inter-vehicle spacing of nearly one second, the proposed mechanism is capable of saving up to 90 percent of vehicles in a platoon from chain crashes following emergency events at the front of the platoon.

2.3 AVR

In the fall of 2013, the Electrical Engineering department at the University of Minnesota Duluth reconfigured its microcontroller instructional laboratory to use the AVR ATmega32 microcontroller from Atmel for the first time. This change was prompted by pressure from students, who displayed considerable interest in the AVR family of processors due to its use in popular Arduino microcomputer systems. In response to this expressed interest from students, the microcontroller lab was redesigned around this new processor. Atmel’s ATmega32 is an 8-bit RISC processor, based on Harvard architecture. This new hardware replaced systems using Freescale’s S12 processor, which is a 16-bit CISC processor, based on Princeton architecture. Thus, this change was a fundamental shift on at least three axes of computer characteristics. Was this change a gain or a loss on each of those three axes? Experience this year with teaching the lab using the ATmega32 has been generally positive, and this paper reports that experience in making the switch from the S12 to the ATmega32. Despite the fundamental architectural differences between the former processor (S12) and the new processor (ATmega32), there are many similarities between the processors as well. The hardware features of the ATmega32 mimic the S12’s features almost exactly, although the ATmega32 generally contains less of each feature, such as memory, I/O ports, timing features, etc. Many of the resources of the S12 were unused and wasted in lab exercises in the past. The scaled-back ATmega32, with basically the same features but in less abundance, is a better match to the instructional needs of this lab. Students feel

they are getting a more complete exposure to the ATmega32, since nearly all the resources of the processor have been used in lab exercises, whereas many of the resources of the S12 were ignored in lab assignments because they exceeded the needs of the lab. This paper will address the adaptations that were made in the structure and pedagogy of the microcontroller course to implement the change in processors from the S12 to the ATmega32.

2.4 ESP8266

Somnath Singh [6] in his paper discussed about designing a web-based control of home appliances which allowed user to switch appliances on/off by clicking on a webpage specially designed to interact with those devices, by being anywhere in the world with a computer or a smart phone connected with the Internet. Miss. Aboli Mane used Blynk app in her project of home management system and security. Different sensors were connected with NodeMCU. With the help of Wi-Fi, NodeMCU was connected with Blynk app. On detection of any unwanted incident by different sensors, messages were sent to Blynk app.

3 REQUIREMENT ANALYSIS

3.1 Hardware Requirements Analysis

3.1.1 Microcontroller

The project requires the microcontroller as the main functional block. For microcontroller we used ATmega32. ATmega32 is a high-performance low power microchip AVR RISC-based microcontroller. It combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 54/69 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for boundary-scan and on-chip debugging/programming, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a universal serial interface (USI) with start condition detector, an 8-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, SPI serial port, and five software selectable power saving modes. The device operates between 1.8-5.5 volts

3.1.2 Wi-Fi Module

Wi-Fi module ESP8266 is required to control the operation of the microcontroller by the user before opening the shutter. ESP8266 is a commonly used Wi-Fi module having two GPIO pin. Microcontroller can be controlled by using the GPIO state. ESP8266 requires 3.3V which can be given by using AM1117 voltage converter. ESP8266 can be programmed to display web page by using its default server. When ESP8266 connect to the network the router provides a private IP address. When that IP address is browsed then web page can be reached.

3.1.3 GSM Module

The core objective of the project is to send the alert call to the owner if any unauthorized opening of shutter takes place. For this we require GSM Module in our project to make an alert call on user side. The GSM module used in the project is A9G GSM Module.

3.1.4 Ultrasonic Sensor

Our project needs to first identify the opening of the shutter. To identify opening of shutter ultrasonic sensor is used. The threshold height is given to ultrasonic sensor upon

exceeding this height the system detects opening of shutter. The Ultrasonic Sensor used in this project is HC-SR04. The triggering pulse in the sensor originates a wave from the transmitter part of it which is controlled by the microcontroller and after striking to an object it returns back to the receiving part of the sensor and the echo pin in the sensor functions at that time. During the process the distance to an object is calculated by the microcontroller interfaced with it. The HCSR04 has 4 pins: VCC, GND, TRIG and ECHO. VCC is a 5v power supply from the microcontroller. GND is a ground pin attached to ground on the microcontroller. TRIG should be attached to a GPIO pin that can be set to HIGH.

3.1.5 LCD Display

LCD is a 16 pin device which can be controlled by the microcontroller when interfaced with its control pin which are Register Select, Read Write and Enable pin. The data lines are connected to the microcontroller. The LCD is used to display the ongoing process in the system.

3.1.6 Buzzer

Buzzer is required to be connected to the system and it offer the feature to produce sound. It is connected to microcontroller so that when any unauthorized person open shutter microcontroller sends signal to make instantaneous alert.

3.2 Software requirement

3.2.1 Proteus 8.0

The Proteus Design Suite is widely used in different areas and fields such as industry, schools for learning purposes, etc. It lets us design the circuit and also design the schematic view of the PCB. It also gives circuit simulation. To design our circuit in most efficient way, we need Proteus. It not only helps us in designing the circuit as well as the schematic view of the circuit, it also lets us see the 3D modelling of the circuit after connecting it in the PCB (Printed Circuit Board).

3.2.2 Atmel Studio

In this project we use Atmel studio 7.0 to code in Atmega32 microcontroller. It is an Integrated Development Platform (IDP). It gives us seamless and easy to use environment to write, build and debug a program written in C/C++. It comes with its own integrated C compiler the AVR GNU C Compiler (GCC). It provides support for 500+ Atmel AVR and Atmel SMART ARM devices. It converts C file into HEX file which is used to burn program into AVR microcontroller.

4 SYSTEM ARCHITECTURE AND METHODOLOGY

The challenges we will faced during system design is the increase in accuracy with reasonable price. Our system is movable and isolated system therefore the power supply to the system is the major challenge. The system includes data processing part and sending message and call to owner of the shop. The first step system checks either lock is open or not. If lock is open then message and call is forwarded to user.

4.1 System Block Diagram

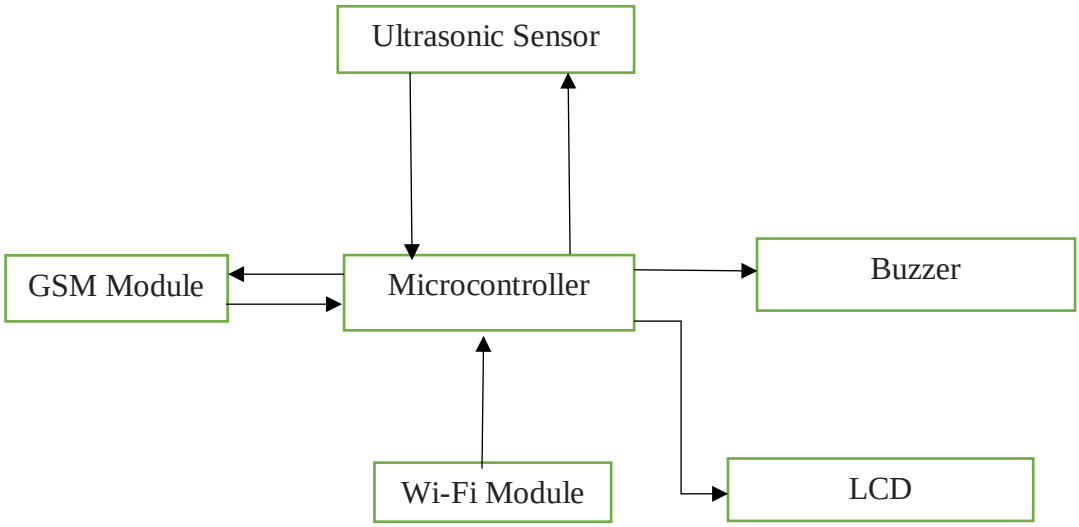

Figure 1: System Block Diagram

4.1.1 Microcontroller

AVR ATMega32 is interfaced with A9G GSM module using UART protocol. The UART protocol is generally used to communicate these two devices with same set of rules they will possess in each operation. It's a two way communication in which AT command is send by the microcontroller for making calls and receiving on the other hand. Thus the same works for HC-SR04 Ultrasonic sensor in which with the help of serial communication, sensor is able to communicate with the microcontroller. Furthermore microcontroller is interfaced with ESP8266 Wi-Fi module. Lastly it has control over buzzer and LCD which when receives the command burst out with loud sound and information of the call going and being received respectively.

4.1.2 Ultrasonic Sensor

HC-SR04 Ultrasonic sensor is interfaced with AVR ATMega32. With the help of serial communication it is able to interact with the microcontroller. The triggering pulse in the sensor originates a wave from the transmitter part of it which is controlled by the microcontroller and after striking to an object it returns back to the receiving part of the sensor and the echo pin in the sensor functions at that time. During the process the distance to an object is calculated by the microcontroller interfaced with it. The HC-SR04 has 4 pins: VCC, GND, TRIG and ECHO. VCC is a 5v power supply from the microcontroller. GND is a ground pin attached to ground on the microcontroller. TRIG should be attached to a GPIO pin that can be set to HIGH.

4.1.3 GSM Module

A9G GSM module is interfaced with microcontroller using UART protocol. The UART protocol is generally used to communicate these two devices with same set of rules they will possess in each operation. It's a two way communication in which AT command is send by the microcontroller for making calls and receiving on the other hand. When the microcontroller gets the information about the unauthorized lifting of the shutter to certain level determined by the ultrasonic sensor then it sends the command to GSM for making call to be said in a simple word. Then after this process GSM makes call to the owner of the shop for the urgent alert about the theft going to take place.

4.1.4 Wi-Fi Module

ESP8266 Wi-Fi module connected to the microcontroller using GPIO-2 pin. Microcontroller operates at 5V but ESP8266 operates at 3.3V therefore a voltage divider of 10K and 10K resistor to connect GPIO-2 pin to the PORTD PIN2 of microcontroller. When ESP8266 is connected to the network, GPIO-2 pin should HIGH therefore initially the GPIO-2 is disconnected to the microcontroller using BC547 transistor and a 1K resistor is used to eliminate the base current so that only high state of GPIO-2 pin can send signal to the microcontroller. When ESP8266 is connected to the network Router assign an IP address. ESP8266 provides a default server for user. ESP8266 is programmed to show a simple web page of having one button and some text. When the button is clicked the index value goes greater than zero and then the GPIO-2 pin is set high.

4.1.5 Buzzer

When the sensor gets active after the shutter exceeds the specified level from the ground then the buzzer gets active which is controlled by the microcontroller. It has the feature to produce sound which is needed to alert the local people and police.

4.1.6 LCD Display

LCD is a 16 pin device and those contains GND, VCC, V0, Control pins, Data lines pins, A and K. LCD is controlled by the microcontroller as it is interfaced with its control pin and those are Register Select, Read Write and Enable pin. The data lines are connected to the microcontroller. V0 pin is used to control the contrast of the display. And the A and K are used for the backlight display.

4.2 Flowchart

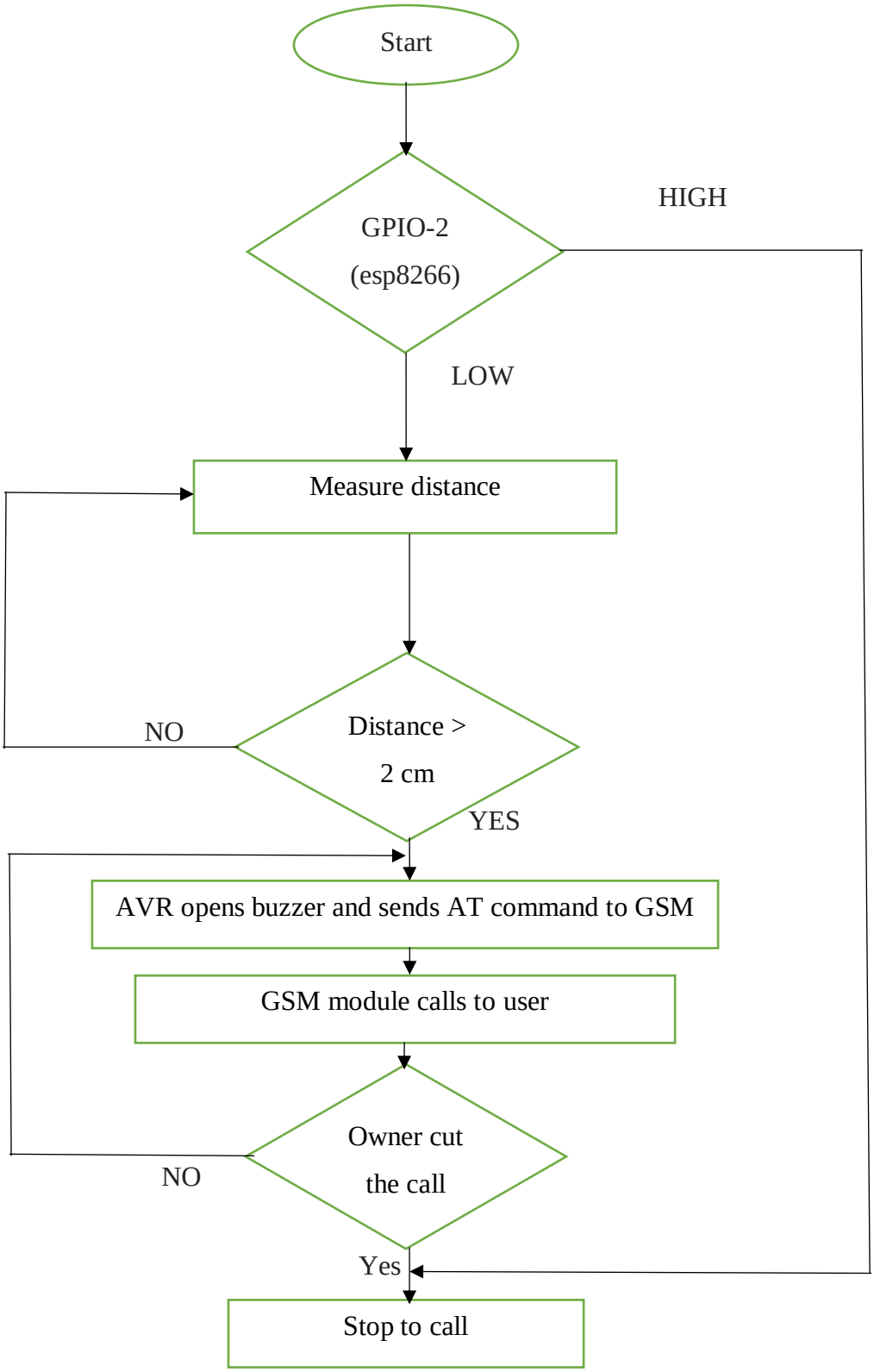

Figure 2: Flowchart of the System

5 IMPLEMENTATION DETAILS

AVR ATMega32 is interfaced with A9G GSM module using UART protocol. The UART protocol is generally used to communicate these two devices with same set of rules they will possess in each operation. It's a two way communication in which AT command is send by the microcontroller for making calls and receiving on the other hand. AVR do not require any calibration. TX and RX pin of Atmega32 is connected to the IO0 (RX) and IO1 (TX) pin of the GSM module respectively to communicate between microcontroller and GSM module. AVR sends each character one by one using the USART data register and receive command response of GSM module using same register. When GSM call to the user it returns +CIEV:"CALL", 1, which is received by the microcontroller and display "sending…" to the LCD. When the user reject the call then GSM returns BUSY and that is received by the microcontroller and stop the continuous calling if user doesn't response the call then NO CARRIER return value of GSM is received by microcontroller and continuous the call until. Microcontroller and A9G GSM are powered by 9V battery using the buck converter. Buck converter LM2596s module regulates the 9V input to the 5V output.

AVR ATMega32 is then connected to HC-SR04 which is the ultrasonic sensor designed to operate with sonar to calculate distance to an object. No any calibration is required by the sensor. It uses serial communication to interact with AVR. The triggering pulse in the sensor originates a wave from the transmitter part of it which is controlled by the microcontroller and after striking to an object it returns back to the receiving part of the sensor and the echo pin in the sensor functions at that time. During the process the distance to an object is calculated by the microcontroller interfaced with it. The HC-SR04 has 4 pins: VCC, GND, TRIG and ECHO. VCC is a 5v power supply from the buck converter LM2596s module. GND is a ground pin attached to ground on the microcontroller. TRIG should be attached to a GPIO pin that can be set to HIGH. Microcontroller sends a pulse for 5 sec by making high the PORTA PINA0 to the TRIG pin of ultrasonic sensor. When TRIG gets high the ultrasonic sensor generate the ultrasonic sound and when reflected ultrasonic sound is detected by the ultrasonic sensor the ECO pin of ultrasonic sensor gets high and that information is detected by using PORTD PIN6 of the microcontroller. The time taken by the ultrasonic sensor to receive sound generated by it is calculated by using the frequency 1MHZ.

AVR ATMega32 is connected to the ESP8266 to get the information that the user is going to open the shutter. ESP8266 is powered by using the AM1117 3.3V converter module.AM1117 module is connected to the 5V output of the buck converter to input of AM1117 converter to get constant 3.3v. GPIO- 2 pin of ESP8266 is connected to the microcontroller of PORTD PIN2 using transistor and the voltage divider of 10k and 10k resistor so that 5V of Atmega32 do not harm the ESP8266. GPIO-2 pin is initially disconnected from the microcontroller by using the transistor so that the Wi-Fi module gets connect to the network and transistor is controlled by using the PORTD PIN3 of the microcontroller. One 1k resistor is used at base of the transistor to eliminate the problem due to base voltage. ESP8266 is programmed to connect to wireless network and display the web page that we code in the esp8266 program. When user of the system browses the IP address given to the ESP8266 then the web page opens. When the user clicks the OFF button then the GPIO-2 pin of ESP8266 is set high. When GPIO-2 pin of ESP8266 gets high the microcontroller blinks and buzzer sounds three times and program execution goes out from loop and system stops.

Others component like buzzer and LCD display is connected to the microcontroller to make the system well operative and to know the state of the system. 16x2 LCD has total 16 pins: VSS, VDD, V0, RS, RW, E, (D0 to D7), A and K. LCD is used as 8 bit mode, where eight data pins from D0 to D7 are connected to the microcontroller pin from PC0 to PC7 respectively. Three controller pins: RS, RW, E are connected to PORTA PIN5, PIN6, and PIN7 respectively. V0 pin of LCD is used to control contrast of the LCD, therefore V0 pin is connected to the 100k potentiometer with the 100 ohm resistor in series. All kind of operation happening on the system is displayed on the LCD. Buzzer and LED is used to give instant alert when any unauthorized person open the shutter. Buzzer and LED are connected in parallel to each other and their anode pin is connected to the PORTA PINA1 of the microcontroller.

5.1 Hardware Components

5.1.1 AVR ATmega32

ATmega32 is a high-performance low power microchip AVR RISC-based microcontroller. It combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 54/69 general purpose I/O lines, 32 general

purpose working registers, a JTAG interface for boundary-scan and on-chip debugging/programming, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a universal serial interface (USI) with start condition detector, an 8-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, SPI serial port, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

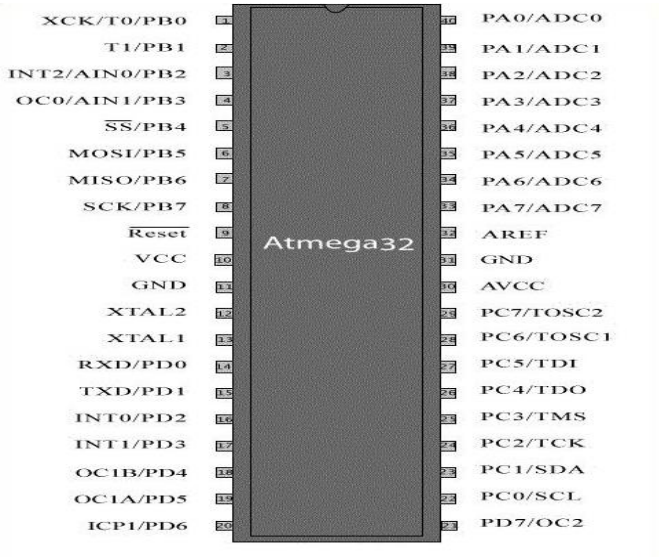

Figure 3: ATmega32 Pin Out.

5.1.2 HC-SR04 Ultrasonic Sensor

HC-SR04 is an ultrasonic sensor mainly used to determine the distance of the target object. It measures accurate distance using a non-contact technology – A technology that involves no physical contact between sensor and object. Transmitter and receiver are two main parts of the sensor where former converts an electrical signal to ultrasonic waves while later converts that ultrasonic signals back to electrical signals. These ultrasonic waves are nothing but sound signals that can be measured and displayed at the receiving end. Following table shows the main features of this ultrasonic sensor. It gives precise measurement details and comes with accuracy (resolution) around 3mm,

terming there might be a slight difference in the calculated distance from the object and the actual distance.

How does it work?

The HC-SR04 Ultrasonic (US) sensor is an ultrasonic transducer that comes with 4 pin interface named as VCC, Trigger, Echo, and Ground. It is very useful for accurate distance measurement of the target object and mainly works on the sound waves. As we connect the module to 5V and initialize the input pin, it starts transmitting the sound waves which then travel through the air and hit the required object. These waves hit and bounce back from the object and then collected by the receiver of the module. Distance is directly proportional to the time these waves require to come back at the receiving end. The more the time taken, more the distance will be. The waves will be generating if the Trig pin is kept high for 10 µs. These waves will travel at the speed of sound, creating 8 cycle sonic burst that will be collected in the Echo pin. The echo pin remains turned on for the time these waves take to travel and bounce back to the receiving end. Following formula is used to calculate the distance of the object.

$S = (V \times t)/2$

Where S is the required distance, V is the speed of sound and t is the time sound waves take to come back after hitting the object. We need to divide the value by 2 because time will be double as the waves travel and bounce back from the initial point. Dividing it by 2 will give the actual distance of the target object.

Figure 4: Ultrasonic Sensor

5.1.3 Liquid Crystal Display

LCD (Liquid Crystal Display) is an electronic display system. A 16x2 LCD display is a very basic system and commonly used in various devices and circuits. LCD's are preferred over seven segments and other multi segment LEDs. A 16x2 LCD means it can display 16 characters per line and 2 such lines are there. In this LCD every character is displayed in 5x7 pixel matrix. LCD possesses two registers: Data and Command registers. The command register stores the command instructions given to the LCD. A command can be defined as an instruction given to LCD to do a predefined task. For example, initializing the LCD, clearing the screen, controlling the cursor position, controlling the display etc. The data register stores the data which is displayed on the LCD screen. The data is the ASCII value of the character which is displayed on the LCD screen.

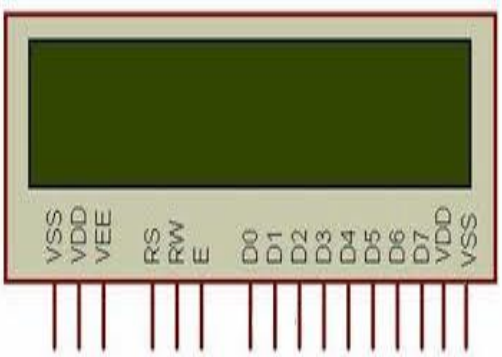

Figure 5: LCD

5.1.4 A9G GSM Module

The A9G development board is a multifunctional development board. It has the basic phone/ SMS, GPRS networking communications. There are lithium battery charge management, microphone, speaker interface, USB communication interface, multiple user keys/ led, TF card slot, acceleration sensor, SPI interface, I2C2 interface, ADC interface on the boards, so you can develop different functions with this board. This board has camera expansion board, so you can connect an external 30W/ 200W camera.

A9G development board can be used for various peripherals prototype development verification, such as remote monitoring intercom with GSM and microphone/ speakers, remote monitoring camera with GPRS + TF + camera extension board.

Features

- Supports voice call and SMS message.
- Supports GSM/ GPRS frequency: 850/ 900/ 1800/ 1900 MHz
- Supports GSM07.07, 07. 05 AT commands.
- Supports 3 serial ports, one download serial port, one AT command port.

Specifications

- Size: 19.2mm x 18.8mm x 3mm
- Working temperature: -30 ℃-80℃
- Working voltage: 3.5v – 4.2v (it's best to power by 4v)
- Power voltage: >3.5v
- Low power consumption:
- Sensitivity:
- GPIO level: 2.8v

Power on

- A9G development board can be powered by USB or lithium battery.
- It does not require any operation when powered 1-2s.
- Rst Key button to reset.
- The module enters AT command mode by default.

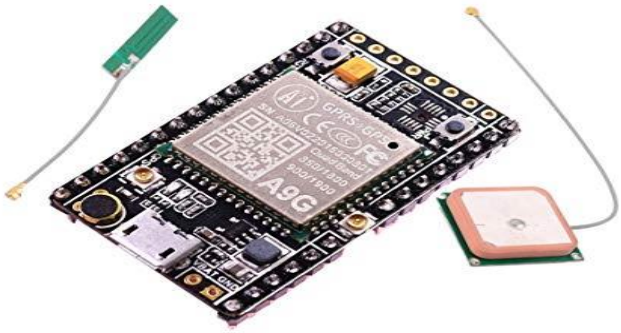

Figure 6: GSM module

5.1.5 ESP8266 WIFI Module

ESP8266 is a Wi-Fi SOC (system on a chip). It is a highly integrated chip designed to provide full internet connectivity in a small package. ESP8266 can be used as an external Wi-Fi module, using the standard AT Command set Firmware by connecting it to any microcontroller using the serial UART, or directly serve as a Wi-Fi-enabled microcontroller, by programming a new firmware using the provided SDK. The GPIO pins allow Analog and Digital IO, SPI, I2C, etc. It has integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area.

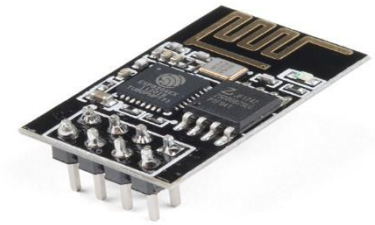

Figure 7: ESP8266 Wi-Fi Module

ESP8266-01 Features

- Low cost, compact and powerful Wi-Fi Module.
- Power Supply: +3.3V only
- Current Consumption: 100mA
- I/O Voltage: 3.6V (max)
- I/O source current: 12mA (max)
- 512kB Flash Memory
- Supports Deep sleep (<10uA)
- Supports serial communication hence compatible with many development platform like Arduino.

6 RESULTS AND ANALYSIS

The project was completed and we were able to accomplish our main objective of the project that was to make an alert call to the owner of the shutter. The result of the project can be explained as following.

The ultrasonic sensor successfully detected the opening of the shutter. The procedure was the ultrasonic sensor was in constant work of measuring the height given to it named as threshold height. The threshold height given is 2 cm. Upon exceeding the height which is sensed by ultrasonic sensor (HC-SR04) the microcontroller identifies it as the trigger to carry out further task identifying the act of theft

After exceeding the height of 2 cm microcontroller further sends AT command to the GSM Module to make an alert call and signals the buzzer to start ringing. The GSM Module then makes an alert call to the specified number. GSM Module continuously makes the attempt to make an alert call until connection between owner number and GSM Module is made. The call is continuously made until owner acknowledges the call. After the call is acknowledged by the owner the system goes down.

LCD works fine. It displays the ongoing process in the system. Following pictures illustrates the result of our project.

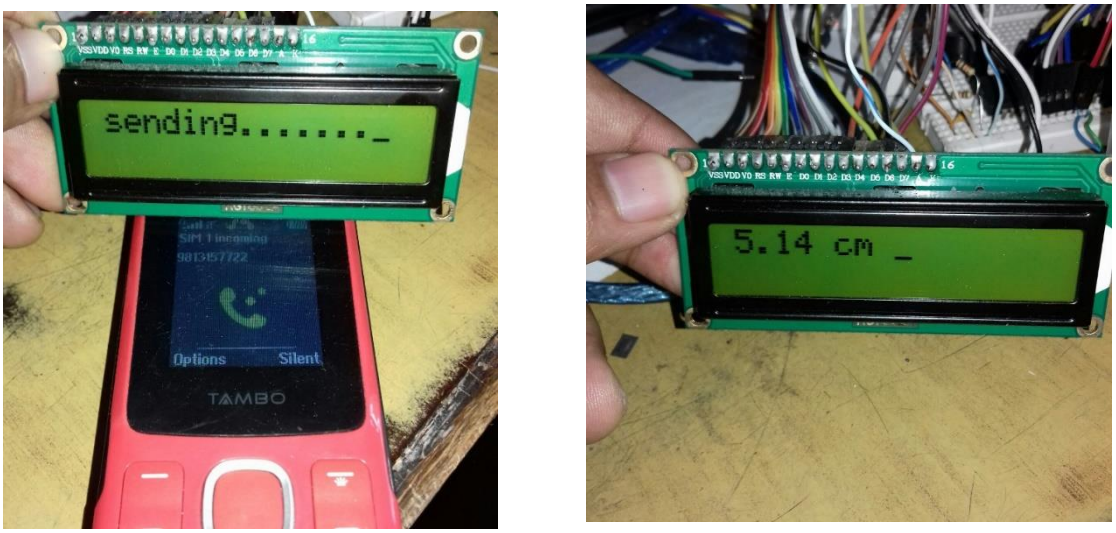

Figure 8: Calling Owner and reading ultrasonic sensor data in LCD

7 FUTURE ENHANCEMENT

Since only few pins of AVR is used and the rest of them are rendered useless, so for the future enhancement of this project, we can use rest of the pins available in the microcontroller to get data from different devices, sensors to make it more accurate.

In the case of GSM module since only TX and RX pins are used and interfaced with AVR the rest of them can be used for mic, real time clock with alarm management. High-quality speech, short message service (SMS).

For the ultrasonic sensor we have just used it for one direction, however we can use it in both the direction to make it more secure.

In the case of Wi-Fi module we have just used to verify one user through a button and the change of IP. In the future we can make an android application to run the local hotspot with various features like password, fingerprint scanner to verify the owner of the business firm.

8 CONCLUSION

So, our final product can send smart alert to the shop owner via a phone call. Here, our system first detects if the shutter is opened or not by ultrasonic sensor. Here our threshold distance is 2cm, if shutter is pulled over this height a call is ringed to the owner using GSM module and if owner declines the call, the system will turn off. If the owner is opening the shutter, the system can also be turned off through a webpage with a button on it. So, it can be concluded that our system can be implemented in any shutter in affordable price. Hence, the project smart alert system can alert the owner and help catch the thieves efficiently.

9 APPENDICES

9.1 Project Budget

S.N	COMPONENTS	QUANTITY	PRICE (NRS)
1.	AVR ATmega32	1	900
2.	GSM Module A9G	1	2000
3.	ESP8266 Wi-Fi Module	1	500
4.	LCD	1	300
5.	Miscellaneous	-	1000
	Total		4700

Table 1: Cost Estimation

9.2 Project Timeline

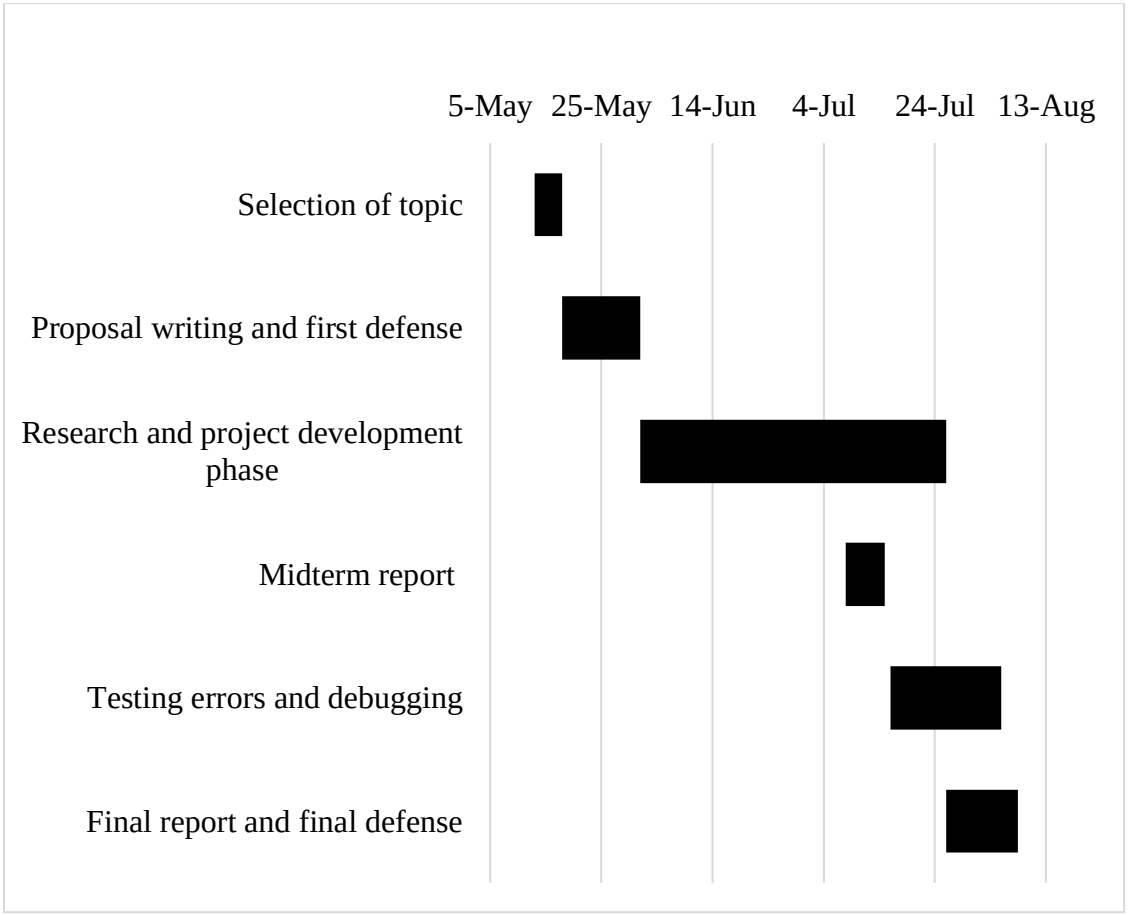

Figure 9: Gantt chart

9.3 Circuit Design Diagrams

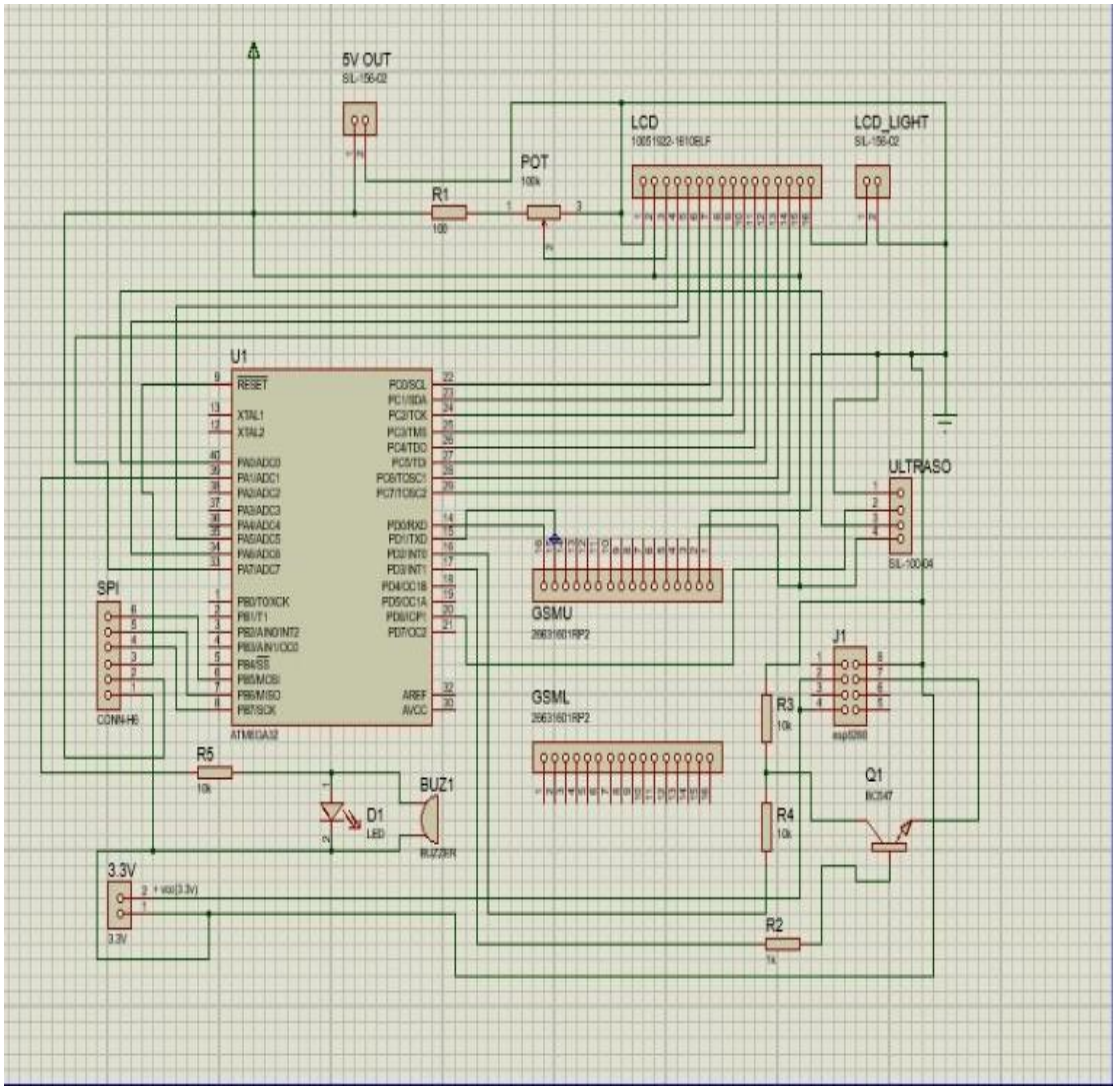

Figure 10: Circuit Design Diagram

9.4 PCB Design

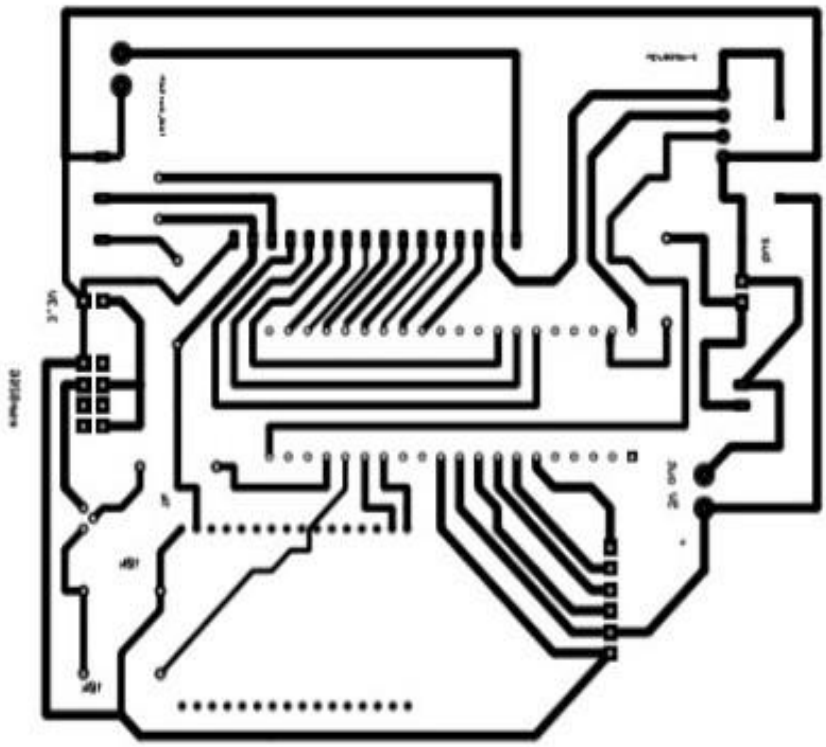

Figure 11: PCB Design

9.5 Module Specification

9.5.1 GSM A9G

- Size: 19.2mm x 18.8mm x 3mm
- Working temperature: -30 ℃-80℃
- Working voltage: 3.5v – 4.2v (it's best to power by 4v)
- Power voltage: >3.5v
- Low power consumption:
- Sensitivity:
- GPIO level: 2.8v

9.5.2 Ultrasonic Sensor HC SR04

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

9.5.3 AVR ATMega32

- CPU: 8 bit AVR
- Number of pins: 40
- Operating Voltage: +4.5 to +5.5v
- Number of I/O pins: 32
- Communication Interface: JTAG Interface
- ADC Module: 8 Channels, 10 bit resolution ADC
- Timer Module: Two 8 bit Counter, One 16 bit Counter
- Analog Comparator: 1
- CPU Speed: 16 MIPS
- RAM Bytes: 2KB
- DATA EEPROM: 1024 Bytes
- Operating Temperature: -55^0 C to $+125^0$ C

9.5.4 ESP8266

- Low cost, compact and powerful Wi-Fi Module.
- Power Supply: +3.3V only
- Current Consumption: 100mA
- I/O Voltage: 3.6V (max)
- I/O source current: 12mA (max)
- 512kB Flash Memory
- Supports Deep sleep (<10uA)
- Supports serial communication hence compatible with many development platforms like Arduino.

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