ISSN No:-2456-2165

Design of a Secure Mobile and GSM Notification System

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Abstract:- The rate of robbery is increasing and there is need to work towards securing people's properties against losses. In the past, windows and doors where closed when leaving the home to prevent loss of property. However, the availability of technology has made the old-fashioned security techniques no longer reliable. In this research, the idea of designing a secure mobile and GSM notification system for normal households has been proposed. The proposed system is designed using an affordable and effective home security system using the Global System for Mobile Communication (GSM) network with Short Message Service (SMS). The main aim of the system is to help in informing the home owner of the current security status of the house using short messaging technology and email. With this security homes are kept safe from being a convenient target for intruders. We designed a block and circuit diagram to help the experimentation of the system. The system was built in C programming language using both hardware and software tools. The code was written in Arduino software and then uploaded to the hardware, the Arduino Mega 2560 microcontroller. Testing was done and the response of the system was fine sending both SMS and Email when connected to internet.

Keywords:- *Secure, SMS, Notification, GSM, Arduino, Home Security.*

I. INTRODUCTION

Security systems are an essential part of the contemporary house. The first home security systems were implemented in the early 1900s. They were typically expensive and difficult to maintain. As technology has evolved over the last century, so have home security systems. Surprisingly, early home security systems were expensive. But they were not effective. There was a great need to develop an affordable and reliable secure notification system that would meet the security needs of the occupants, just as there was a need for an effective and low-cost system that would meet the security concerns of homeowners.

Home security has evolved over the past years. It will continue to evolve as technology improves. This system focuses primarily on providing security to the user in the form of an alert in the event of an attempted intrusion. The system is SMS based to improve living standards. This system provides an answer to the problems that homeowners are faced with on a regular basis. Arduino software was used to integrate the system with a microcontroller and a GSM network interface. The system is activated when the PIR sensor detects an obstacle in its field of view and then it sends its status to the micro-controller unit. After receiving the update, the microcontroller unit automatically switches on the light. The user then enters the PIN. The keypad sends the command to the microcontroller, which, if the PIN is correct, commands the servomotor to open the door and the GSM to send an authorized access message to the user. If the PIN is incorrect, it sends an alert message.

A PIR sensor detects motion by detecting the change in infrared or radiant heat emitted by nearby objects. When the PIR sensor detects motion, its output becomes high. A standard PIR sensor has a range of approximately six meters. The Um interface, also known as the air interface or radio link, connects the mobile station to the base station subsystem. The A interface connects the Base Station Subsystem to the Mobile Services Switching Centre.

The mobile station (MS) consists of the terminal and a smart card called the subscriber identity module (SIM). The SIM card enables personal mobility by allowing the user to use subscription services regardless of the terminal. By inserting the SIM card into another GSM terminal, the user can receive calls, make calls and receive other services such as SMS (Short Message Service). The International Mobile Equipment Identity (IMEI) uniquely identifies mobile devices. The International Mobile Subscriber Identity (IMSI) is required to identify the subscriber to the system, a secret key for authentication and other information is stored on the SIM card. The IMEI and IMSI are autonomous, allowing personal mobility.

II. MOTIVATION

Robberies are on the increase these days, so everyone wants to take precautions. They usually occur throughout the day because people are busy with their daily routines; adults are at work; young people are studying. As a result, there is a need for a notification system that can detect attempted break-ins and immediately send an alert to the homeowner so they can take precautions.

III. RELATED WORK

The researchers conducted a literature review to gather ideas about notification systems. Various journals, articles, and papers from the internet as well as books were consulted

to accomplish the research successfully. Rajani (2017) Stated that GSM (Global System for Mobile Communication) is a digital cellular technology that is open and usable for mobile data and voice services. A GSM modem is a type of modem that uses a SIM card and runs via a mobile operator subscription. A GSM modem connected to a machine allows it to share information over the mobile network. SMS and MMS messages can also be sent and received using GSM modems. GSM modules are controlled by AT commands. ATD commands are used to make phone calls. PIR (Passive Infrared) sensors help to detect human movement. PIR stands for Passive Infrared Sensor and detects infrared heat. Every living object has a temperature higher than absolute zero and produces heat in the form of radiation. It's infrared radiation. Because these rays are emitted in infrared wavelengths, the human eye cannot detect them. A PIR sensor senses heat and generates an output when a person comes within its range and no heat (infrared) radiation is emitted by the PIR sensor module. Passive things are those things that do not produce any voltages or energy of their own. They simply take measurements. So, we can say that this type of detector is a passive infrared sensor because it doesn't produce any heat of its own. It can only measure the radiation given off by things around it. It measures the radiation and does the necessary calculations.

Santoso (2014) designed and implemented a system that included PIR sensors for obstacle detection, a GSM module for communication with a GSM phone, an analogue camera for image capture, and a memory card for storage. Two Arduino Uno microcontrollers were used to run the whole system. The system takes all the data from two PIR sensors, analyses it and, using a GSM module, sends an SMS to the associated phone number. Two PIR sensors were used to improve the accuracy of obstacle detection in the perimeter of the sensors. When the PIR sensors detect an obstacle in the perimeter, the microcontroller captures the image using a serial camera and stores it on an SD card, after which the Arduino microcontroller triggers the buzzer alarm and sends an SMS to the homeowner's mobile phone via the GSM module. The system was made up of several components, including a control unit, an interface, a GSM module and sensors.

Nicohlus (2011) implemented a GSM-Based Home Intrusion Detection System that in the event of a break-in, it sends a short message to the homeowner's mobile phone number. This was used to notify and alert the homeowner of a likely intruder. It is helpful when the homeowner is away or asleep. It was set up to store the homeowner's phone number to which the device will send a short message informing them of an intrusion. To send text messages, the device must use a GSM modem, which requires a SIM card. The device should be positioned near likely points of entry for intruders, such as doors and windows. When the door or window is opened, the device is triggered and immediately sends a pre-programmed SMS message. If security systems are triggered but no action is taken, they become irrelevant and completely ineffective. This happens when the system detects an intrusion, but no one is aware of it. A likely explanation for this is that the security manager is away from the system (at work or school).

This design bridges the gap between the security system and its manager, the distance between the two when the manager is not in the house. It is vital that the security manager is alerted immediately if the home is compromised.

A GSM cellular transceiver, as specified by Frenette (2013), is required for wireless communication to a cellular service in range, such as a cell tower. If a transceiver exists and is connected in data communication with the security system (e.g., in conjunction with the control panel), the aforementioned publication shows a bridging system in which calls initiated on one or more perimeter telephone sets, which are normally paired with the public telephone network (PSTN), are instead paired with the cellular transceiver set up for the alarm system.

When the Public Switched Telephone Network (PSTN) is unavailable, calls of all types (including alarm calls) can be made via the cellular GSM network. If the PSTN is unavailable, the GSM network can be used as an alternative communication method. The GSM protocol is a digital communications and packet data switching protocol. A radio modem is used to send and receive audio signals after they have been processed and numerically compressed. A GSM system can be connected to a General Packet Radio Service (GPRS) core network, which allows Internet packet traffic to be treated as TCP/IP traffic.

According to Frank (2013), security has been necessary for human existence since the beginning of time. This is partly because of the link between population and resources. As populations grew in early communities, the need for autonomy often led to the exploration and control of vulnerable groups.

Oke (2013), stated that the design and development of a programmable electronic digital lock have addressed the problems associated with the continuous production of electronic devices without a suitable locking system. Undoubtedly, this will provide an opportunity to extend the life of such electronic devices, as well as provide adequate security and required protection of data, files, electronic devices and a host of functions such as computers, televisions and, most importantly, provide a method to restrict and prevent unauthorized persons from gaining access to a car via the ignition system.

Audette (2009) implemented a low-cost wireless home security system using GSM/GPRS that includes wireless security sensor nodes and a GSM/GPRS gateway. It includes these aspects: Low cost, minimal energy consumption, easy installation, fast response and simple user interface, with the GSM modem generally acting as a bridge between the user and the sensor. The system uses three types of sensors: door security nodes, infrared sensor nodes and fire alarm nodes. Filters, amplifiers, analogue-digital converters and interfaces for communication are all part of this design. The system uses a wireless transceiver unit to transmit information between the

gateway and the sensor. Each sensor node is equipped with a microprocessor and a wireless transmitter unit. The work of the microprocessor is to receive and interpret the signal from the sensor node and to determine the current state of the node. The system also includes a sleep timer and a switch-mode pump circuit to save energy.

Gaikwad (2013) developed a system that, once the unlock code is known, sends an SMS to the homeowner's mobile phone. They have to start the system by pressing and holding the '0' button on the hexadecimal keypad. If an unauthorized person tries to press even the first button of the total unlock code, the FPGA-based UART is activated and causes the GSM module to send the SMS to the homeowner's phone.

Amunullah (2013) designed a system using innovative technology, an incoming number verification system, to protect the management and security systems. Since traditional security systems do not use passwords, there was a possibility of hacking or breaking the system. They used the selected mobile number without verification, which prevents the door from being unlocked.

Scourias (2011) discussed the Global System for Mobile Communications (GSM) architecture and stated that it is split into 3 broad parts: the Mobile Station, which is used by the subscriber, the Base Station Subsystem, which manages the radio connection with the Mobile Station, and the Network Subsystem, the central component of which is the Mobile Services Switching Center, that executes call switching between the mobile and different fixed or mobile network users, as well as handling mobility. The SIM card gives the user access to subscription services regardless of the terminal. By inserting the SIM card into a GSM module, the user can send and receive calls and other subscription services such as SMS (Short Message Service).

Sisman (2005) developed a security system that, once installed in areas where security is to be established, generates specific alerts by switching to a warning mode when it detects unusual movement in a specific area using its sensors. The system comprises a central unit that has a microprocessor-equipped electronic card with a GSM modem and at least one SIM card; and is managed by a GSM-based mobile unit with a SIM card.

IV. METHODOLOGY

The functions and services requirements were identified, and the system was designed to meet them. Once the design was complete, a prototype was tested to ensure that the new design worked as expected before it was implemented. The importance of this phase was to find out what the user wanted or needed from the modern home security system in order to gain a clear understanding of the early system and its limitations. The sources of data were considered in this study to determine which data would be used in the analysis and design of the secure mobile and GSM notification system. More attention was paid to the earlier security system to identify both its strengths and weaknesses and how these weaknesses should be addressed in this modern system. This system was built in C using both hardware and software tools. The programming code was written in Arduino software and then uploaded to the hardware, the Arduino Mega 2560 microcontroller. Each tool used to develop this system was thoroughly tested before being assembled. The Arduino IDE was tested first by writing simple codes, then after the sub-parts of the system. The PIR sensor was tested by placing a finger close to the door the light was automatically switched on after the predefined key was entered and the door was automatically opened by the servo motor and an authorized access message was sent to the number, after another key was tried, an alert message was sent by the Arduino microprocessor via GSM to the preloaded number saying that there was an illegal intrusion attempt in the house. The various components used in the design of the model were verified and validated using the verification process carried out. These components include KEYPAD, PIR sensors, GSM module, servo motor, LED, LCD, ARDUINO (software and board), breadboard, jumpers and mobile phone.

V. SYSTEM BLOCK DESIGN

This system consists of a sensor that monitors the area and gives an output when a person moves around it. The output of the sensor is given to the microcontroller, when it gets an input from the sensor it produces a light using a LED, after that, the person is supposed to enter the key (using a keypad and LCD) so that the door can open automatically (using a servo motor), the key is given to the microcontroller, if the key is correct the door will open and it sends a command to tell the GSM module to send authorized access message to the preloaded number, otherwise the door will not open and an alert message will be sent.

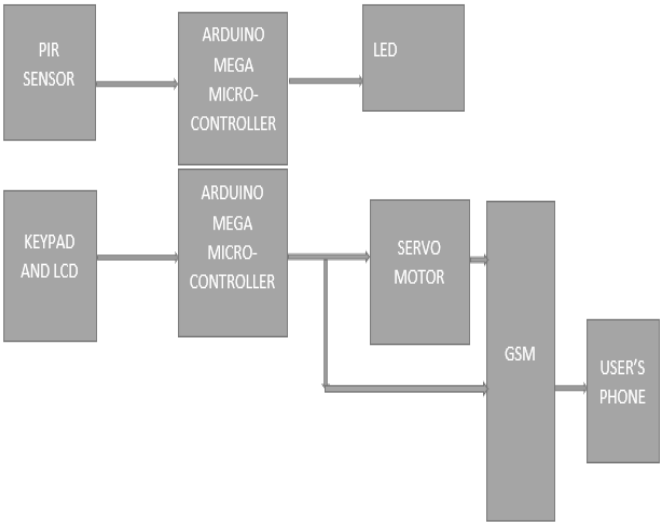

Fig 1 Block Diagram

ISSN No:-2456-2165

VI. CIRCUIT DIAGRAM

The circuit diagram was designed using a simulator called Proteus.

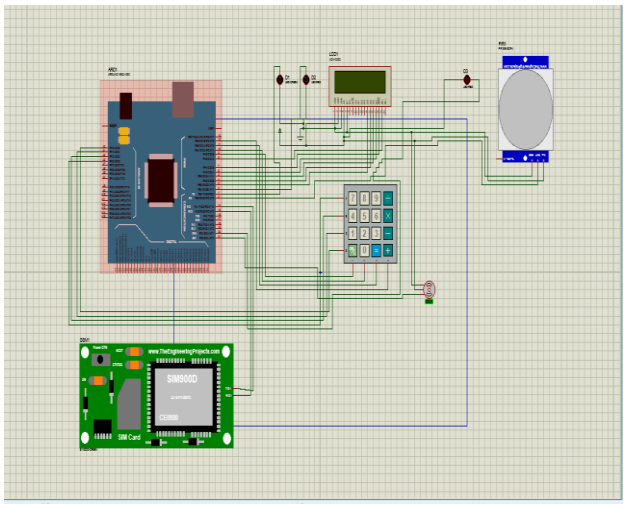

Fig 2 Circuit Diagram

This system is a GSM notification system using mobile technology. It is built around an Arduino microcontroller. A PIR motion sensor, LED, LCD, keypad, servo motor and GSM are connected to the microcontroller. The entire system is battery-operated, which makes it portable. Error-free code is sent to the microcontroller. A breadboard is the easiest way to connect all the parts of the system to the microcontroller. This helps to make temporary connections to test everything out.

➢ *Step 1: Connect the PIR sensor to the Arduino:*
- *Connect the Vcc pin of the PIR sensor to the positive (5V) terminal of the Arduino.*
- *Connect the GND pin of the PIR sensor to any Arduino ground pin.*
- *Connect the output pin of the PIR sensor to Arduino pin A2.*

➢ *Step 2: Connect the LED to the Arduino:*
- *Connect the positive terminal of the LED (the longer lead) to Arduino pin 23.*
- *Connect the LED's negative terminal (shorter lead) to any ground pin.*

➢ *Step 3: Connect the LCD to the Arduino:*
- *Connect the following pins to your Arduino to connect your* LCD screen:

✓ *Connect GND to any ground pin on the Arduino board.*
✓ *VCC to 5V of the ARDUINO board*
✓ *VO to any ground pin of the ARDUINO board*
✓ *RS to pin 22*
✓ *R/W to any ground pin of the ARDUINO board*
✓ *E to pin 23*
✓ *D4 to pin 24*
✓ *D5 to pin 25*
✓ *D6 to pin 26*
✓ *D7 to pin 27*
✓ *A to any ground pin of the ARDUINO board*
✓ *-K to 5V of the ARDUINO board*

➢ *Step 4: Connect the keyboard to the Arduino:*
- *Connect the first 4 wires, which are for Row, to pins 4, 5, 6 and 7 respectively.*
- *The following 4 wires, which are for Column, are connected to pins 8, 9, 10 and 11 respectively.*

➢ *Step 5: Connect the servo motor to the Arduino:*
- *Red=Power to 5V*
- *Grey=Ground to GND*
- *Yellow=Signal to pin 3*

➢ *Step 6: Connect the GSM to the Arduino:*
- *Rx of GSM to Tx of Arduino*
- *Tx from GSM to Rx from Arduino*
- *VCC to 5V*
- *GND to ground*

➢ *Step 7: Programming the Arduino*
- *Download the Arduino IDE 1.8.1 from https://www.arduino.cc/en/main/software.*
- *Connect Arduino to a computer with a USB cable.*
- *Open the Arduino IDE, and select the correct board from Tools- Boards.*
- *Select the correct port from Tools- Serial Port*
- *Write your code in the Arduino Sketch Page*
- *Click the Upload icon or go to File Upload.*

VII. SYSTEM PROTOTYPE

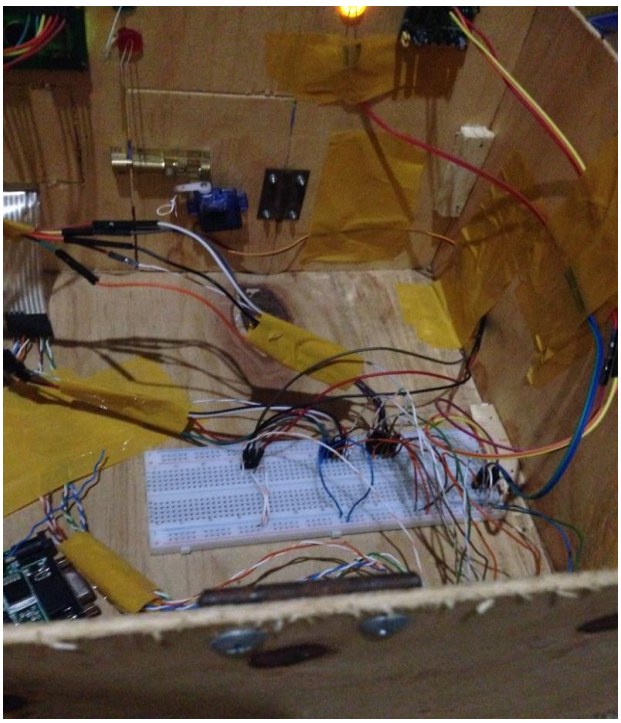

Fig 3: The Prototype Design

ISSN No:-2456-2165

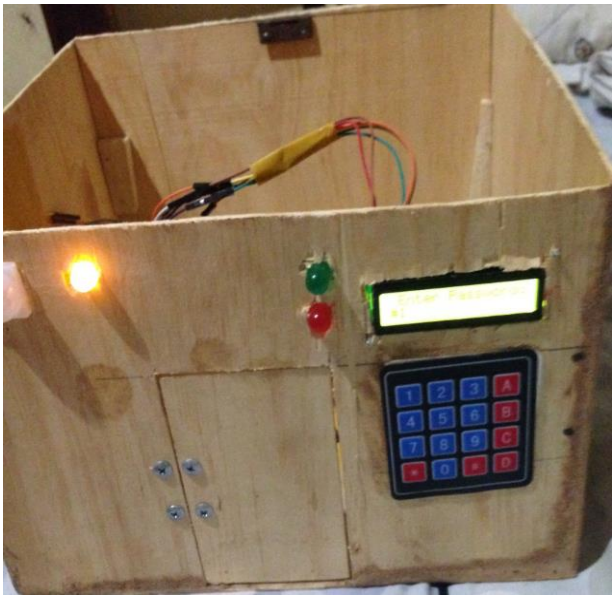

Fig 4: The Working Prototype

VIII. CONCLUSION & FUTURE WORK

Such a system will get a lot of attention in the coming decades. People are more concerned about how to protect themselves. The Arduino microcontroller is used in this low-cost and flexible home security system. SMS is a cheap and easy way to notify users of a potential intrusion into their homes. Since most people have a mobile phone with them most of the time, using a mobile phone as the user device to receive alerts means that they do not have to carry an additional device. Overall, Arduino is easy to learn and program. We can protect our homes by using this type of technology. This makes the system both reliable and cost-effective. A dedicated camera module can also be added to a system for added security. When someone approaches the door, the camera starts to capture the image and store it on an SD card. The fingerprint system can be installed, as well as buttons to lock and unlock the door from inside the house.

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