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RESEARCH ARTICLE



Enhancing Home Security Using SMS-based Intruder Detection System

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Abstract: Lifestyle in the modern society along with human behavior and thinking is changing dramatically with the advancement of technology, and the concept of a simple home is changing into a smart home. Home security has been a major issue where crime is increasing and everybody wants to take proper measure to prevent intrusion, besides homes the system is also implemented in business premises and office. This research project aims at the design and construction of a Short Message Service (SMS)-based intruder detection system, this system consists of controller, receiver and sensor circuit. This system unlike the traditional magnetic switch alarms equipped on doors and windows has incorporated motion sensors so that a short message service, SMS is sent to the house owner on any attempt of a break. This project is built using a programmed microcontroller interfaced with SIM 900 module, motion detectors and switches. The Passive Infrared (PIR) sensor which is the motion detector used in this project is placed at the roof of the prototype and a switch close to the door, so that when an intruder pass through the PIR or press the door switch a message is displayed on the liquid crystal display and SMS is sent to the phone numbers embedded in the C language program use to program the microcontroller.

Keywords: Passive Infrared, Detector, Intruder

I Introduction

Security is the degree of protection against danger, damage, loss or any criminal activity. Security can also be seen as a condition so that one can develop and progress freely. An important aspect of security includes Home Security. It is very important, because crime rate is increasing day by day. The advancement of technology has increased the safety and security of people along with their belongings. One of the reasons for the rise of the smart home is the increasing risk of burglary and robbery and the busy lifestyle [1].

The busy lifestyle of people is leading to the necessity of controlling the devices at home remotely and increasing the necessity of keeping surveillance over their homes. Mobile phones today are not just used to make calls. The use of mobile phones is changing with the development of technology and they can be used for different purposes. They can be used as clocks, calendars or controllers instead of being used just as phones. Today smart phones are available in the market with different applications and hardware which can be implemented without any further development or enhancement.

With the help of the GSM network, a mobile can be used to implement a smart home by controlling devices and getting alerts on robbery and burglary.

Traditional household security systems often require installation and detect based on opening of doors and windows. The increasing number of the stealing and house breaking cases especially when the people are not at home need a system that can tell them if anyone has attempted or trying to break into their home. Therefore the idea of a smart home system was proposed, to overcome the limitations of the systems already available in the market. The user can choose the number of sensors, types of sensors, the area of coverage of the systems along with the number.

The goal of the project is to implement a smart home system by controlling the electronic devices at home remotely with the help of a mobile device and getting alerts on intrusion or movement around the restricted premises. The SIM900-GPRS module and the microcontroller are used to communicate between the mobile phone and the devices and sensors installed at home. The mobile phone can be used as a controller from anywhere in the world if the GSM network is available. In addition, three sensors are used as a heat detector, motion detector and intrusion detector which trigger the alarm upon reaching the critical limit. The system is limited to the area with the GSM network available and the whole system does not work without the network

II Related Works

The author in [2] has developed a low cost GSM/GPRS based wireless home security system which includes wireless security sensor nodes and a GSM/GPRS gateway. It has the following features: (a) low cost, (b) low power consumption, (c) simple installation, (d) fast response and (e) simple user interface. In general, GSM modem acts as the interface between the users and the sensors nodes. There are 3 types of sensor nodes applied in the system which include the door security nodes, infrared sensor nodes, and fire alarm nodes. This architecture includes components such as filters, amplifiers, analog to digital converters and communication interfaces. The system used a wireless transceiver module to transfer data between gateway and sensor nodes. Every sensor node comprises a microprocessor and a wireless transceiver module. The function of the microprocessor is to receive and analyze the signal from the sensors' node as well as the current status of the nodes. This system also consists of a sleep timer and switch mode pump circuit, which reduces of the power consumption.

In [3] the author has developed a wireless security system where an alarm system is programmed in a graphical user interface (GUI). The system is used to monitor the RFID reader, RFID tag and the GSM terminal. The information obtained from the tag is sent to the server in a RF link that is exhibited in a GUI. If the laptop is stolen from the covered region, the alarm system will start to draw attention. Meanwhile, the laptop owner will be notified by an alert message. In addition, the alarm system will not be stopped until the laptop is put back in the covered region, or the program is stopped/terminated. RFID have been available for many years for reading bar codes RFID tag located several meters away. It is increasingly being used in other applications ranging from inventory management to anti-counterfeiting protection. In a wireless security system (WSS) [4], a RFID tag is attached to the laptop and RFID reader is connected to server. If the laptop is stolen from the reader, the alarm system will be triggered to draw attention with loud noise. The laptop owner will be notified with short messaging service (SMS) from the server via GSM module system in a few seconds. Alternatively, it can be improved with Bluetooth technology which is embedded in most of mobile laptop today. The GSM terminal is used as the SMS interface to send messages. Generally the notebook acts as the base station to run the program. Usually GSM terminal comes with a RS232 connector to external terminal equipment, and the Subscriber Identity Module (SIM) cardholder and the external connector.

Z Bing et al in [5] has developed a security system against asset theft by using radio frequency identification technology. The system consists of five main parts: (a) RFID reader and tag, (b) GUI, (c) database system, (d) CCTV and (e) wireless transmitter and receiver. The RFID reader is installed at the entrance of the campus and the tags are attached on/in student ID cards and their properties. The program of the developed system has the capabilities of investigating the identification process, database management and controlling function of the hardware. GUI is used in a vehicle security system where the information is controlled via the GUI. The system is activated when the tag is read while the motorcycle is being located within the effective range. The system will automatically record this incident and exhibit the information on the monitor. Any theft occurrence will turn the monitor on automatically with the alarm signal which alerts other systems. When the burglar occurs, the CCTV will also be started for recording is immediately. The motorcycle engine is shut off automatically when the asset theft occurs however this requires a further investigation.

The system described in [6] monitors everything by moving cameras. The system can increase the efficiency of monitoring and can eliminate the blind spots of fixed cameras. In this system, a mobile manipulator is developed which is equipped with cameras at the arm end for purpose of monitoring. The system is based on SMS technology using any GSM modem/mobile. The proposed remote control system works from anywhere in the world.

The proposed system has been designed to work with GSM technology, which will generate a message, every time an intruder tries to get unauthorized access of the property. GSM being one of the most popular and used means of mobile communication makes it viable and unique in a way that many of the systems/applications designed can be made to work with GSM because it is used worldwide, implemented and followed standards. The proposed system, on intrusion, triggers the intrusion to the owner via SMS and continues to do so with a constant interval of time. One of the distinguished features the system provides is that it allows the owner to prompt an action via SMS from a far off place.

III Methodology

The methodology used in the proposed model is to develop a prototype model of a house, in the prototype an interface of mercury switches, motion detectors, and GSM module is being developed with a microcontroller. The communication between the microcontroller and other components of the system takes place serially. The microcontroller continuously receives data from the mercury switches and the motion detectors, takes decision on the basis of the readings collected onto the microcontroller. On intrusion the microcontroller will generate a message to the owner or to a set of predefined numbers stating the sort of an intrusion that has been made.

System Architecture

As shown in figure 1, the system comprises two units. The microcontroller unit consists of four sensors and the sim900 module. The outputs of all the sensors are connected to ADC. One IR is connected at window and other is at door. The data from the sensors is continually processed by the microcontroller and an alert is sent to the mobile station if something is sensed or something reaches beyond the limit in case of a motion detector. These three units of the system are responsible for the security of a home.

The Sim900 GPRS/GSM module acts as the mediator between the microcontroller unit and the mobile station and is responsible for the communication between them. This unit is responsible for sending information from the microcontroller to the mobile station and for sending the instruction from the mobile station to the microcontroller. The instruction sent by the user from the mobile station is executed by the microcontroller. In addition to the microcontroller unit, the second unit of the system is the mobile station which is just a mobile phone. It does not require any special feature or any special application for the mobile phone to be a part of the system. Any mobile phone supporting the messaging application is suitable for the system. The instruction to the microcontroller is sent by using text messages and the alert from the microcontroller is received as a text as well. The system acts as a smart home system providing security to the home as well as providing a remote management system for the devices inside the home.

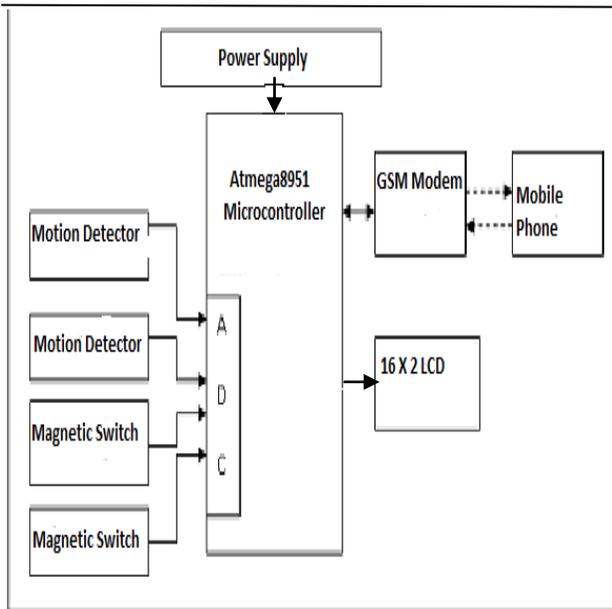


Figure 1 System Architecture of the GSM-based Alert system

IV System Design

Hardware Design

The complete circuit for the project was obtained from the integration of these various units of the project together as shown in Figure 2. For our prototype model instead of a big house we used a small design, which had door and window like a normal house. Figure 3 shows the inside of our designed model

The magnetic switches/sensors were placed at the door, and the motion detectors were placed in front of the house and behind the house. After activating the system, when one would try to open window or door, or when an intruder approaches the house, an SMS will be immediately generated by the system and send to the owner.

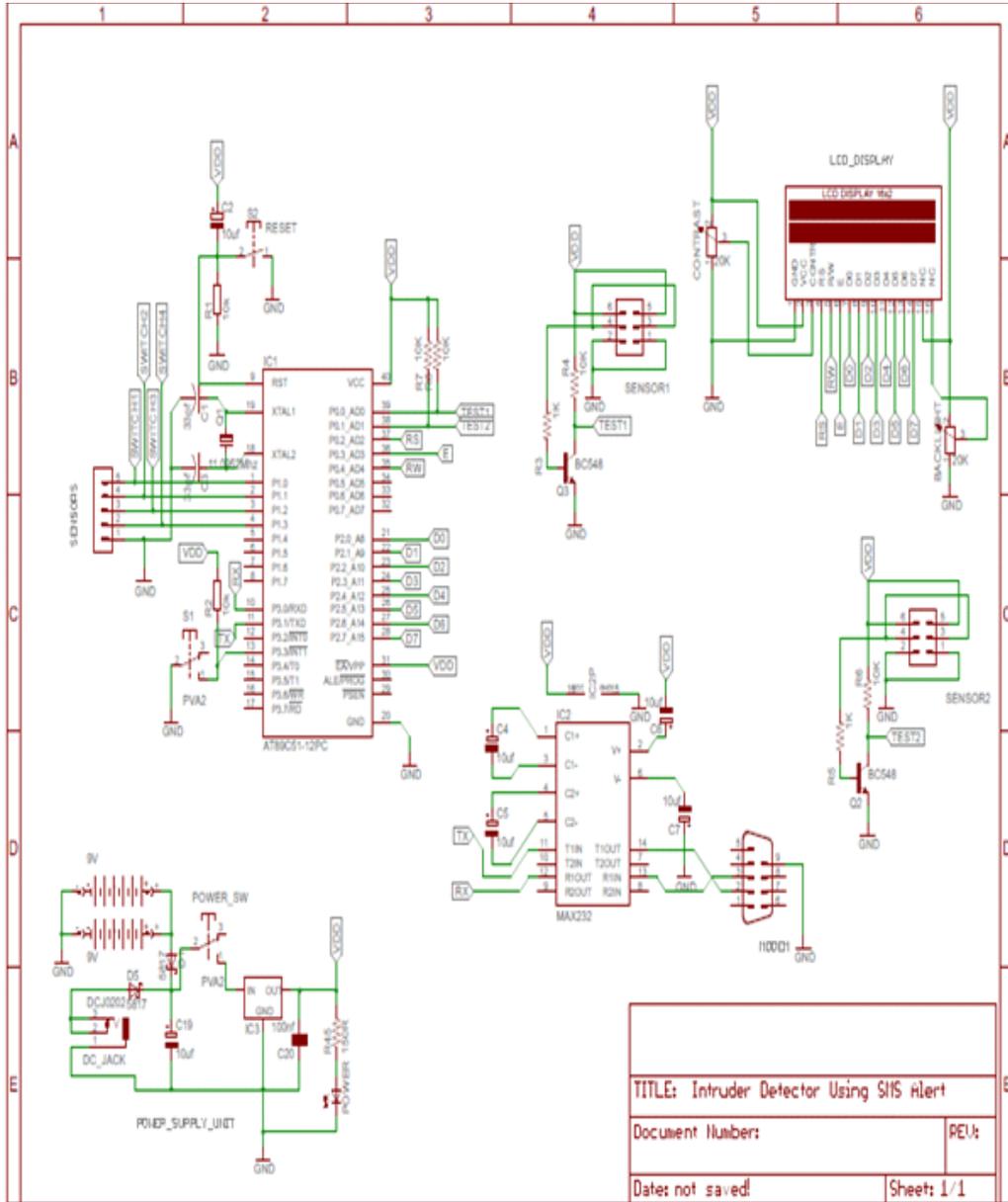


Figure 2 Circuit Diagram for the Project



Figure 3: Internal connections of the designed model

Software Design

The software design of the project consists of writing computer programme for the microcontroller to implement the desire intruder system. This includes the program codes to implement and interface the various sub-unit of the system with the microcontroller. Basically the programs are written in C language and implemented on the microcontroller

- **Interfacing Sim900 GPRS/GSM Module**

The Sim900 module is an important part of the system responsible for communication between the microcontroller and the mobile phone. AT commands are instructions used to control a module. AT is the abbreviation for ATTENTION commands. Every command line starts with “AT”, that is why module commands are called AT commands. Starting the command line with AT informs the module that a command is coming, AT commands are used to interface the module as well as to configure it. Figure 4 shows the block diagram description of the implementation

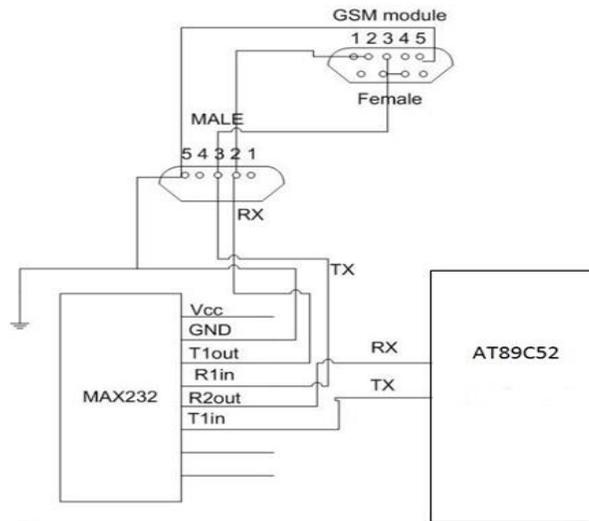


Figure 4 Interfacing GSM Module

- **Interfacing and Implementing Sensors**

There are different areas which have to be monitored frequently and devices which have to be checked in and around the house. The doors and windows need to be monitored from burglars if they try to open them as well as the movement of strangers around the house premises should be monitored. The monitoring of a stranger’s movement and

the opening and closing of doors and windows are done by the designated sensors. The sensors could be implemented as different types of detectors according to the necessity of the application and the human desire. The operation of sensors is managed by software. Since there are different types of sensors, they are interfaced according to the output and properties of the sensor. The external circuit for interfacing the sensor for the application depends on the type of the sensor and it is not a must as some of the sensors do not need it and the output can be driven directly and used on the application.

- **Interfacing the display unit**

The display unit used for the design is the Liquid Crystal Display (LCD) because of its ability to display numbers, character, and graphics, the ease of programming for characters and graphics and low power consumption. Figure 5 shows the LCD used.

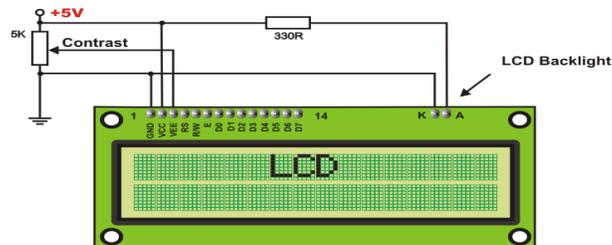


Figure 5: Liquid Crystal Display

V Testing

After the integration of the various sub-units of the system the complete prototype of the house was developed as shown in figures 6 and 7 show various angles of the model showing the placement of the sensors used.



Figure 6: Top view of the designed model



Figure 7: Side view of the designed model

When all the various sub-units have been integrated and tested to ensure that they work together and independently, the entire system was tested using various strategies. These include; opening and closing of the door and window, moving around the house and moving over the house. At each of these instances, the user mobile numbers that have been programmed in the microcontroller during the software design stage received the pre-configured message, informing them of the presence of an intruder and detected intruder. Figure 8 shows a snapshot of the received SMS by one of the user mobile device.

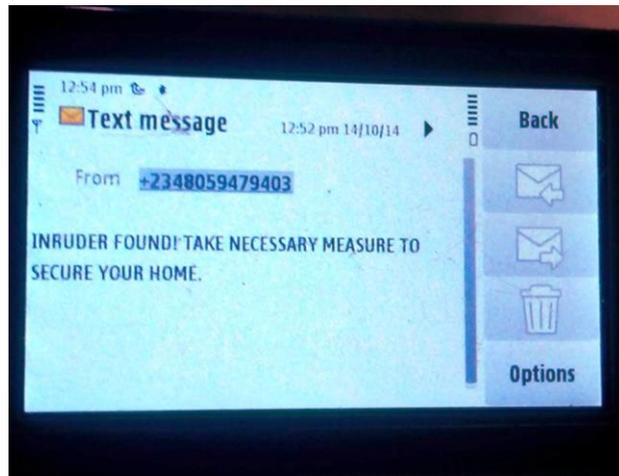


Figure 8: Snapshot of the received message during testing

VI Conclusion

The security system described in this project is capable of detecting intruders. The system informs the authorized owner of an unauthorized intrusion via SMS no matter where the person is, except if the person is in the region where there is no network coverage at the time of intrusion. The commonly available systems today are one where the intrusion is detected via alarms making out sounds.

The system is very beneficial for people who want to safe guard their properties and restrict access. This system is very affordable and easily operated, so that anybody whether rich or comfortable, young or old can make use of this system.

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