Full Research Paper

Design of an Automated Home Security System with Remote Monitoring Capability

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ABSTRACT

The continuous improvement in technology underscores the critical need for an efficient home security system to address the prevailing security concerns (such as intrusion and fire outbreaks) in homes. Noticeably, automated home security systems that rely on PIR sensors, smoke sensors, microcontrollers, and android enabled remote monitoring features have huge advantages over manual systems. These automated systems increase the possibility of eradicating security fears in homes by providing homeowners with a good sense of security each time they are away from their homes. This paper reviewed some of the existing techniques previously used to implement advanced home security systems and present a system that notifies homeowners in the event of an intrusion or fire incident in their homes. In addition, the system provides homeowners with a remote monitoring feature via an Android application to stream live events using the cameras or channels provided in the DVR.

Keywords: Remote Monitoring, Home security system, Surveillance Cameras, Buzzers, Microcontroller, GSM and Android technology.

1. INTRODUCTION

The deployment of security systems in a home becomes important lately due to the continuous increase in the crime rate. These security systems are installed in homes mainly to keep intruders away and to protect against unforeseen disasters. Nevertheless, the earliest home security systems, such as door shakers, are inefficient and difficult to monitor. Also, the continuous improvement in technology implies that a more efficient home security system can be implemented to address the security concern in homes [1]. This home security system will work without minding whether the owner is within or outside the home premises. In so doing, a home can transform into an intelligent home [2] that can be remotely monitored. Some of the basic components needed to implement automated home security systems are sensors (motion sensors to detect intrusion, a smoke sensor for smoke detection), Surveillance Cameras, Buzzers, Microcontroller, GSM, and Android technology. With these components, automated home security systems that use sensors to detect intrusion, touch, and smoke can be realized. These automated home security systems will have SMS features to alert the homeowner or appropriate agencies, e.g., the Police or Fire brigade, if there is a disaster.

Although users' expectations are ever-changing, an efficient automated home security system that eradicates the fear of home security will provide homeowners with a good judgment of security, improved productivity, and a relaxed mind. This paper reviewed some of the existing techniques previously used to implement advanced home security systems and propose a system that builds on the existing techniques.

2. BACKROUND AND RELATED WORKS

2.1. Background Technologies
2.1.1. Motion Sensors
A motion sensor or detector is a vital component of a security system because; it helps detect intrusion in homes.

Figure 13: PIR Motion Detection Sensor

Motion sensors are flexible because they can be activated or deactivated if the need arises. Some of the events that activate a sensor include doors and windows being opened or closed, a broken door or window, movement in an area, proximity, and touch, etc. These events may be monitored using one or more sensor technologies described next.

❖ **Passive Infrared (PIR):** They are the most widely used motion detection sensors in home security systems. The sensor is activated if it detects body heat. The various types include Contact Motion Sensors and Pet Immune Motion Sensors:

❖ **Contact Motion Sensors:** It is used to detect contact motion, such as doors and windows being opened or closed, broken doors, or windows

❖ **Pet Immune Motion Sensors:** In some cases, homeowners prevent the security system from reacting to motion by known pets, i.e., it prevents the system from activating if it detects motion by pets within a certain weight.

2.1.2. Microwave (MW): This sensor detects motion by using Doppler radar to emit microwave pulses and measure the reflection of the moving objects; however, this could be very expensive to implement.

2.1.3. Wireless Motion Sensors: It uses a wireless connection to communicate with other system components, and it is very easy to set up.

2.1.4. Video Motion Sensors: The sensor is incorporated with a video camera, and if motion is detected, the sensor starts recording using the embedded camera. This technique saves up a substantial amount of memory by ignoring unimportant footage since it will only record if a moving object triggers it.

2.1.5. Dual Technology Motion Sensors: Dual technology motion detection sensor works by combining multiple technologies. For example, a pet immune motion sensor may be combined with a microwave sensor to enhance the motion detection accuracy.

2.1.6. Smoke Sensors
A Smoke sensor is an integral component in the design of security systems. It is used to detect smoke or fire in a building.

Figure 14: Smoke Sensor

Smoke detectors may be wired together to cover the different areas or regions in a home, monitored with a single controller. In this design, if there is a fire outbreak in any of the coverage areas or regions, the controller can identify the precise detector or area affected and, after that, alert the homeowners, fire brigade (via SMS), and monitoring devices (For example, it activates the buzzer). This method can be very effective in preventing situations where the fire brigade or homeowners manually trace the affected area, resulting in a delay that may prove disastrous in the long run.

2.1.7. Buzzers

In a home security system, the buzzer is used to make a warming sound or alarm if the motion sensor detects intrusion to a restricted area or the smoke sensor detects smoke in a coverage area. Although a false alarm may be triggered by an event such as an air quality lesser than 1000 PPM (Adequate air quality) however, the sensors themselves may be configured to respond only to a level of activity, e.g., The Buzzer can be triggered if the smoke sensor detects an air quality in an area that is greater than 1000 PPM.

Figure 15: Buzzers

2.1.8. Surveillance Camera

A Surveillance camera may be used to monitor the behavior and activities inside or outside of a home. Multiple Surveillance cameras may be used to cover the different home areas, which can be monitored with an LCD screen connected to a Digital Video Recorder (DVR). The DVR comes in different varieties depending on the number of channels (cameras) required, and it can be configured to delete older footage when the memory is almost full. A newer model of surveillance cameras comes with wireless features.

Figure 16: Surveillance Camera

2.1.9. Global System for Mobile Communication (GSM)

GSM allows SMS communication via a GSM module such as SIM900A, ELEMENTZ, and UART. The home security system can be configured to allow the microcontroller to send an SMS to homeowners or security agencies if any monitoring device is in a state of alarm either due to Intrusion, smoke, or touch. This technique has proven to be very efficient recently.

2.1.10. Microcontroller

To implement an automated home security system, it is essential to use a microcontroller to monitor sensory devices like smoke, touch, and motion detectors. A microcontroller can be programmed so that whenever an event triggers a sensing device, it sends out a control signal to the monitoring devices like the buzzer, or it sends SMS to the homeowners or the security agencies. The four main types are 8051, Renesas, AVR, and PIC microcontroller. The choice depends largely on the cost, features of the microcontroller, and complexity of the system being designed.

Figure 17: 8051 Microcontroller

2.2. RELATED WORKS

Automated home security systems have huge advantages over manual systems. For example, it is easy to detect an intrusion or fire outbreak in an automated system than a manually designed home security system [3]. Although many business solutions to home security challenges, such as ADT, Vivint, SimpliSafe, and Frontpoint, exist, some researchers have provided some solutions through research work.

In paper [4], a home security system that uses a GSM network is featured. They connected a GMS module and PIC16F76 microcontroller through a MAX232 interface in order to send SMS to homeowners and security agencies if there is a disaster. Paper [5] presents two approaches to home automation and security systems. First, they implemented a system based on Arduino, which uses the Atmega2 microcontroller and PIR sensor to detect and increment a counter while a person enters the house; after that, it activates the alarm or causes the bulbs to glow. The bulb stops glowing whenever the person leaves the house.

Thus, it makes the system to be power efficient. Secondly, they implemented a system based on GMS and android applications. The system is designed to send SMS to homeowners informing them about the presence of an intruder. Afterward, it activates an alarm which can be remotely turned on or off using an android application.

Paper [6] designed an advanced security system named Invisible Eye, which uses a single camera to record the footage of a room if the presence of an intruder activates it. This system avoids a situation whereby multiple cameras are used to record the footage of empty rooms, which may use up a huge amount of available memory. In Paper [7], a system that detects intrusion via Laser Rays is implemented. The system uses a Light Dependent Resistor (LDR) sensor and laser light source to detect intrusion so that if an intruder steps between the light source and the LDR, the resistance of the LDR becomes upto1 mega-ohm, thus activating the buzzers.

Paper [8] implements a Home Security System based on the Internet of Things. They incorporated a microcontroller with FAVORIOT (a platform that provides support for Internet of Things projects) to integrate and store the data from sensors in an online database. Also, they provided a BLNK application to help homeowners monitor their homes from any location in the world.

3. RESEACH METHODOLODY

The developed system uses PIR and smoke sensors to protect the restricted area. For instance, assume regions A, B, and C of home are restricted. Each region has a surveillance camera which is activated when an intrusion is detected, i.e., if the PIR sensor in the restricted region A is ON, the microcontroller receives a signal, and simultaneously, the microcontroller activates the surveillance camera in restricted region A; it activates the buzzer and sends out SMS to the homeowner and the police informing them of the exact region where an intrusion was detected.

 In the case of a fire outbreak, if the smoke detector is ON, a signal is sent to the microcontroller, which activates the buzzer, sends out SMS to the homeowner and fire brigade with information on the exact region where smoke or fire was detected. This home security system provides a remote monitoring feature via an Android application such as Swann View. To allow for remote monitoring, the Digital Video Recorder (DVR) is assigned a port number and an IP address from the IP pool of the router. Next, a user account is created for the homeowner in the DVR remote settings, and finally, port forwarding is configured for the router.

With this configuration, if there is a notification for an intrusion or fire incident in the home, the homeowner logs in to the Android application with the preconfigured or account information and streams the live event via the cameras or channel provided in the DVR. This system will work even when there is a power failure because a rechargeable battery is used as a power supply. Figures 6 and 7 provides a graphical description of this developed system.
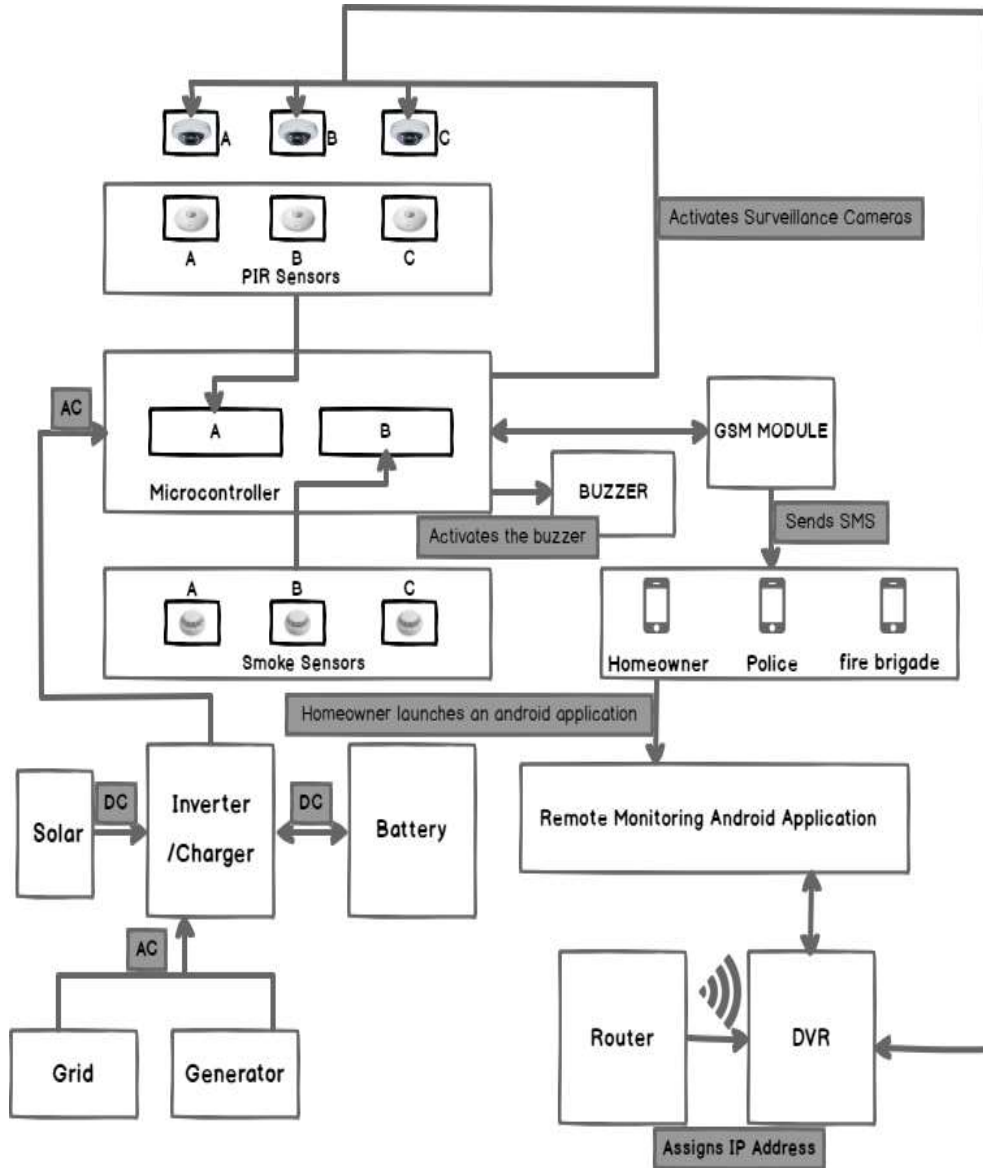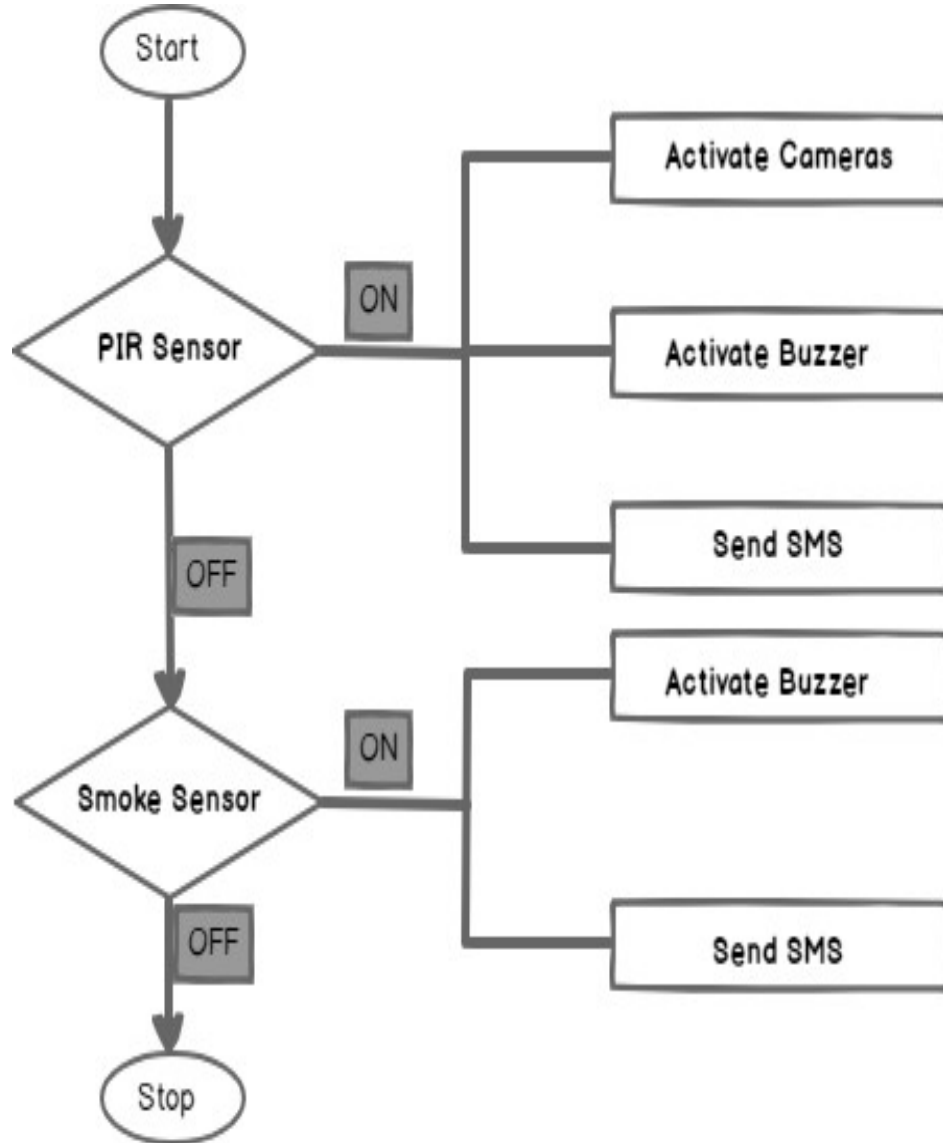
Figure 6: Developed System Design

Figure7: Flow Chart of the developed System

4. RESULTS

This home security system provides a remote monitoring feature via an Android application such as Swann View. To allow for remote monitoring, the Digital Video Recorder (DVR) is assigned a port number and an IP address from the IP pool of the router. Next, a user account is created for the homeowner in the DVR remote settings, and finally, port forwarding is configured for the router.

With this configuration, if there is a notification for an intrusion or fire incident in the home, the homeowner logs in to the Android application with the preconfigured or account information and streams the live event via the cameras or channel provided in the DVR. There are currently various bespoke Android applications available on the Google play store that provide the functionalities needed for remote monitoring. For example, SwannView, CCTV Smart Viewer, MEye, iViewer, etc. In addition to notifying the homeowner, the security or monitoring agencies are also notified via SMS when there is an intrusion or fire outbreak. While the Police are notified when there is an intrusion, the Fire brigade is notified when there is a fire outbreak.

5. CONCLUSION

Some homeowners are insensitive about the usefulness of a home security system. Unquestionably, a well-designed automated home security system is useful to homeowners because they can easily monitor the activities in their homes even when they are away. This paper has explored the technologies needed in designing security systems and proposes a methodology to realize an intelligent home. The authors hope to implement the proposed system as explained in section 4.0. The author is also exploring options in developing a customized android application that will provide robust features such as an option to turn off the buzzer when a false alarm is detected.

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