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Original paper

Automated Electronic Safe Guards for Homes and Offices Using State-of-the-art-Technology

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ABSTRACT: This paper presents the concept of home and office automation, it is geared towards designing a system that switches ON and OFF electrical appliances and also a proper security surveillance from a remote location over a GSM link. In this paper, microcontroller, Passive Infrared (PIR) Sensor and GSM Module are used. The designed program is applied in MPLAB software for simulation and the result obtained from this after a systematic design methodology has been carried out shows that electrical appliances at homes and offices as well intruder monitoring can be achieved as long as there exist a GSM coverage. Thus, the results of practical circuit show the proper functions and verify the reliable home automation within a reasonable cost.

Keywords: Microcontroller, GSM Module, PIR Sensor, Programming Language
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INTRODUCTION

Safety of our homes and offices is as important as the food we eat. Most times electrical appliances are major causes of fire outbreak in our homes and offices, this is because, sometimes we tend to forget to put off our electrical appliances before leaving the home or office. Thus, the possibility of returning home or office in order to put off our appliances becomes very difficult due to distance or fatigue.

Similarly, everybody likes to keep an eye on his or her properties even from a distance if possible, therefore this paper provides a solution to these problems by designing an automated system that enables one to realize this dream.

This paper examines the use of GSM network and a microcontroller based system to control electrical appliances and intruder presence in our homes and offices. The mobile phone needed for this must not necessarily be a smart phone; the application can even be done on old mobile phones like Nokia 3310, Nokia 2210 etc as long as the phone can access a mobile network and can send or receive text messages. Some of the advantages of using a GSM link include:

- Improved spectrum efficiency
- International roaming
- Low-cost mobile sets and base stations (BSs)
- High-quality speech
- Compatibility with Integrated Services Digital
- Support for new services.

Related works

El-Medany (2008) describes a home automation system employing FPGA, GSM, Internet, and Speech Recognition. The home gateway in this system is the internet, which requires a personal computer (PC). However, it is difficult to manage the PC and keep it 'ON' all the time, consuming more power.

In an effort to develop an automated home or intelligent system, Jayashri (2013) offered two solutions in his project, one of which is based on GSM technology and the other employs a web camera to identify intruders. First, the security system makes use of an indoor web camera that is controlled by software that is installed on a PC and communicates over the Internet.

Any intruder moving in front of the camera's field of view or focal length is detected. The second security mechanism is SMS-based and sends an SMS to the owner using GSM technology. The proposed technology aims to provide sufficient home security against burglars and fire. The device sends an SMS to the emergency number that has been given to the system if any of the aforementioned scenarios occur while the owners are away from their residences.

Lee (2010) introduced a wireless network protocol that provides a bidirectional communication channel between a gateway and a control device, emphasizing the importance of wireless sensor networks in controlling home appliances.

Nikhil (2012) created a security system with a password secured door system to monitor his car from burglars. The door lock is password protected by an LED-based resistive screen input panel that operates by detecting differences in light intensity collected by the photo diode and reflected by the finger. IR Laser sensors detect any obstruction while monitoring windows and doors at night or while away.

Saddam (2013) tried many techniques to control appliances in an attempt to design a home automation system, including DTMF, IR Remote controlled, Bluetooth controlled, and PC controlled home automation.

DTMF (Dual Tone Multiple Frequency)

This is an earlier technology used to control electrical appliances, in this case, the cell phone is connected to the DTMF decoder using aux wire, thus, and when say a key is pressed on the dial pad of the mobile phone, the DTMF decodes this tone and generates a digital output. This design has a setback since the mobile phone is connected to the DTMF decoder using wire; this makes it difficult to control appliances at a distance.

Bluetooth technology

Saddam (2013) created home and office automation for electrical appliance control utilizing Bluetooth technology a few years ago. In this type of technology, the microcontroller is interfaced with a Bluetooth module, and thus data are sent and received to and from a smart phone with Bluetooth feature. A Bluetooth serial interface module and a Bluetooth adaptor comprise the Bluetooth module. The Bluetooth serial module converts a serial port to a Bluetooth connection. Electrical appliances are turned "ON" and "OFF" in this design when the Bluetooth button in the Android Smartphone's Bluetooth application is tapped. As a result, this technology is incompatible with older mobile phones such as the Nokia 3310, which lack a Bluetooth application. It also has a distance limitation of 15 metres.

Infrared (IR) Remote controlled

This is another technology earlier used to control electrical appliances at homes and offices. it is an Infrared Remote controlled automation system using Arduino. This technology requires an Infrared transmitter and receiver, when a bottom is pressed on the Infrared remote, the remote through the infrared receiver sends the code in the form of encoded pulses at a frequency of 38 kHz to the Arduino (which is a microcontroller based system). These pulse are received by IR Sensor and read by the Arduino, the Arduino decodes the received pulses into a hex value and compares the decoded value with the predefined hex value of the pressed button. Thus, if it matches, then, Arduino performs the relative operation corresponding to that result. But this design has a major drawback of Line of Sight because for there to be a communication, the IR devices must be on a line of sight. Thus, this makes it difficult to control appliances from a distance (Visa, 2011).

PC controlled home/office automation using Arduino

To control the electrical appliances in this design, serial communication is utilized. The Arduino board is interfaced to the computer for serial communication, the command is transferred from the computer to the Arduino board, and the Arduino transmits a command to the pins where the relays are connected. This design also has a significant drawback in that it cannot control an appliance from a distance. If we also link the system to the internet, there is the additional cost of establishing internet connection at both ends. Visa (2011) employed the premise that if a robber attempts to rob a car, the system instantly demobilizes the automobile by disconnecting the ignition key supply from the car battery. This now makes it hard for anyone to even start the car, let alone drive it. When a theft attempt is made through the car doors or boot, the system sends a message to the car owner while also activating the alarm. Cars are tracked using this system regardless of where they are, as long as there is GSM network connectivity.

RESEARCH METHODOLOGY

To fulfil the design goal of this paper, the automation system for the control of electrical appliances and intruder or security monitoring employs a GSM module to wirelessly connect the microcontroller to the mobile phone at different places. The block diagrams below will

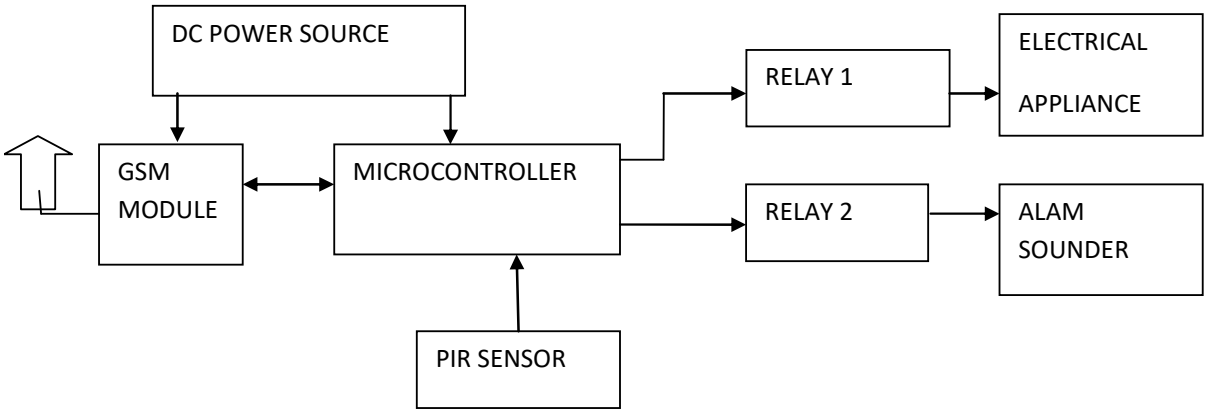

Figure 1: Block Diagram.

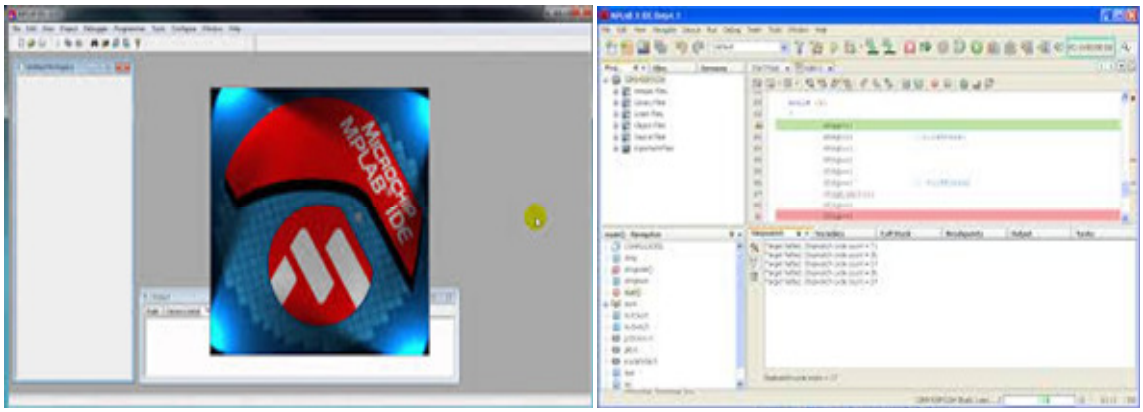

Figure 2: MPLAB IDE

be utilized for systematic design technique (Figure

Operational principles

This is a two-in-one technology that combines an electrical appliance switching system and a security surveillance system. The switch that controls the appliances is connected to the relay 1 when executing the task of a switching system. The microcontroller circuitry is powered by a 5 volt DC supply while the GSM module is powered by a 12 volt DC supply from a battery. It is important to state that the 5 volt supply to the microcontroller comes from the same battery but with a 5 volt voltage regulator to produce the required 5 volts. The GSM module (SIM900) is a complete Quad-band GSM/GPRS Module that delivers GSM/GPRS 850/900/1800/1900 MHZ performance for voice and data with low power consumption.

The microcontroller is programmed with the necessary commands for proper communication with the GSM module. The GSM module has a SIM card that enables communication between the mobile phone and the GSM module, and is connected to a specific network of choice. When a message is sent to the SIM card number on the GSM module, the module receives it and sends it to the microcontroller. The microcontroller in turn reads this SMS and extracts the most important commands from the receive strings and stores them in a variable. Then the microcontroller compares this string with the predefined string and if they match, it sends a signal to the pin where the relay is connected to energize the relay and turn on the device either ON or OFF. Therefore, with this technology, you can be in another place and control your electrical appliances wirelessly as long as there is a GSM network available. It is sufficient to send a normal text message with the word 'SWITCH ON " or " SWITCH OFF ' to the card number SIM in the GSM module.

Similarly, in the case of home/office security surveillance, a Passive Infrared Sensor is installed at the entry and is linked to the microcontroller. The PIR sensor, also known as a motion detection sensor, is a pyroelectric device that detects motion by monitoring changes in the infrared intensity generated by a surrounding object.

When an intruder approaches the PIR sensor, the sensor detects infrared radiation from him or her. When the PIR sensor detects motion, the output goes high; this signal is detected by the microcontroller, which then communicates with the GSM module via serial

Figure 3: PIR Sensor.

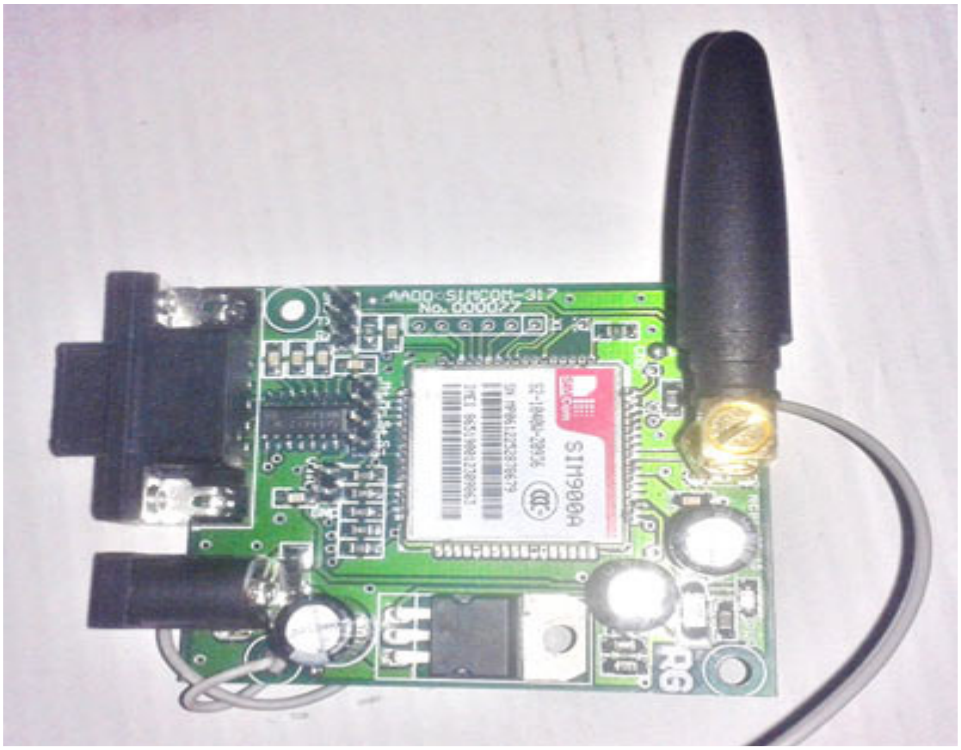

Figure 4: GSM Module.

communication to make a phone call to the preprogrammed mobile number (i.e., to you) while also sending a signal to the pin connecting relay 2 to sound the alarm; once the alarm is sounded, people in the vicinity are alerted for action, and you are as well. It is important to say that it is irrelevant accepting the call from your home/office microcontroller based system; it is only to alert you of the presence of an intruder in your home or office.

The design is realized in two parts: software and hardware. As demonstrated in (Figure 2), the software design employs a programme or set of codes produced in C-language in an MPLAP IDE, which is then transmitted to the microcontroller through a programmer. The hardware is another aspect; (Figure 3) depicts the PIR sensor, (Figure 4) depicts the GSM module, and (Figure 5) depicts the numerous connections from the microcontroller to the GSM module, PIR sensor, relays, appliances, and the alarm.

RESULTS AND DISCUSSION

This section displays the results of a proper design technique that was used. This technique was tested using the most recent smartphone technology, yielding

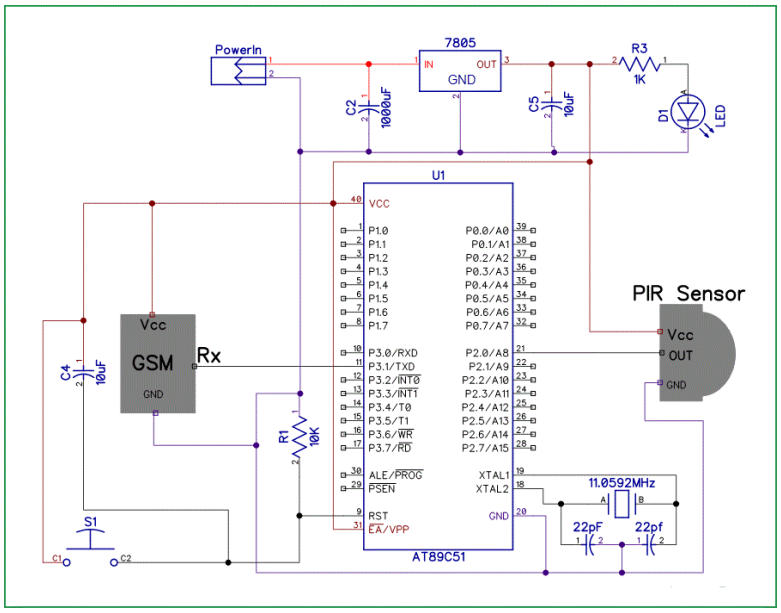

Figure 5: Hardware Connection.

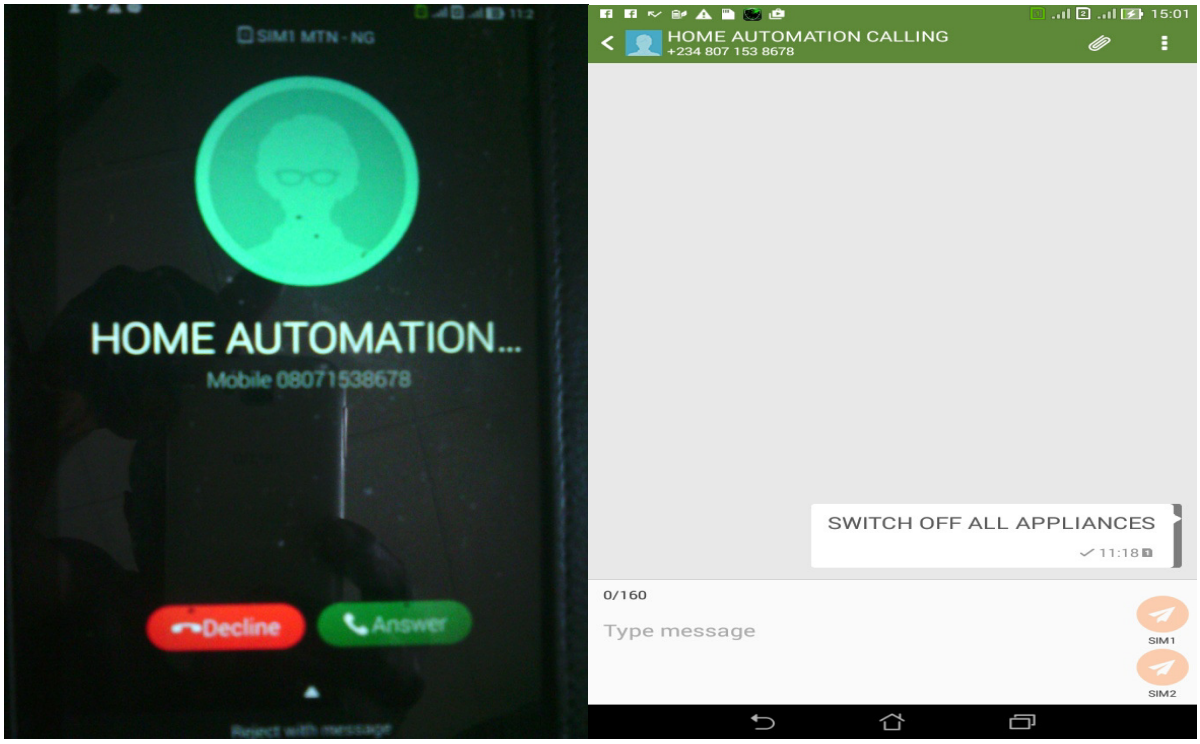

Figure 6: Home Automation Call.

an accurate result. This system is basic and straightforward to use. After receiving a message indicating a specific action from the microcontroller, the GSM technology responds quickly. The time it takes for an SMS to be sent to the home owner is mostly determined by the signal strength range provided by the cell tower. We created and evaluated the model in C; however, the same model can be improved with the help of a higher-level language, making it more portable. The result obtained after a systematic design methodology has been carried out shows that when an intruder crosses or approaches the region of the PIR Sensor, the sensor sends a signal to the microcontroller, which in turn gives a command to the GSM module to make a phone

call to the predefined number (home owner). Similarly, in the case of controlling electrical appliances, the house/office owner only sends a text message to the number of the SIM card on the GSM module as shown in (Figure 5). When this message gets the GSM module, a serial communication takes place between the GSM module and the microcontroller and the relay connecting the electrical appliances is operated to either switch OFF or switch ON the electrical appliances. It is important to say that the SIM card inside the module should have an airtime to enable it make phone call to the house/office owner. Thus, with this technology, the house/office owner can monitor his home/office from a distance as long as there is GSM coverage between these two locations (Figure 6).

Conclusion

The mobile network was used to design and test the GSM-based home/office automation system. Through GSM technology, the user can receive alerts from anywhere, making the system location independent. AT commands are utilized in this design as a flexible way to control and explore the mobile's services. The owner communicates with the home/office via SMS and phone calls, which have been tested with mobile networks and function on any mobile network.

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