Transactions on Engineering and Computing Sciences - Vol. 11, No. 4
Publication Date: August 25, 2023
DOI:10.14738/tecs.114.14975.
Akter, M., Abu Baker, M., & Shorif Uddin, M. (2023). Smart Home Security System. Transactions on Engineering and Computing Sciences, 11(4). 11-18.

SERVICES FOR SCIENCE AND EDUCATION

Smart Home Security System

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ABSTRACT

Nowadays, the main concern of people is security. Security is essential not only for the safeguarding of an increasing number of crimes but also for daily accidents. Automated security systems are a wonderful addition to today's home where safety is a major problem. For a comfortable and secure home, appropriate steps would be taken in this present situation through technical innovation. We have developed a security system using sensors to detect any security breaches and send a warning signal via a buzzer of high intensity, flashing red lights, sending messages, and calling the phone of the house owner. For the detection of gas leakage in the house, the system has used a gas sensor. It also has smoke and fire sensors to guard against a fire blast in the house. Our system has features for the detection of intrusion by using a passive infrared sensor (PIR sensor). It also has a sound sensor to detect massive sounds and a temperature sensor to detect the high temperature in the house. All of the mentioned sensors are properly connected to a centralized Arduino Uno *microcontroller board* which will produce a correct output in case of any tragedy.

Keywords: Security, Sensors, Buzzer, Arduino Uno, Messages and Phone calls

INTRODUCTION

Recently, the home automation system finds enormous applications in ensuring security against any criminal as well as accidental incidents in the home environment. The earlier concept of relaxed living has changed widely because of the arrival of digital and wireless technology. Intelligent homes, or simply fully digital homes, pre-programmed for performing such predefined tasks, respond to particular situations according to user's requirements. So, researchers are trying to develop systems to keep our homes as smart as possible. Smart homes are expected to perform tasks such as control of temperature, lighting, control of entertainment, protection and response in case of an emergency, and many more. These would be controlled from close or distant.

People want to live safely in their own houses. They want safety from different incidents such as gas leakage, fire, LPG cylinder explosions, robbery, theft, physical attack, and so on. Nowadays, burglaries, violence against women and even killing are almost common incidents in homes [1]. There is another problem with finding the LPG gas cylinder leaking. This leakage can easily be stopped if it is detected on time, but if it is not, the fire will burst out quickly. LPG gas explosion can occasionally be so dangerous that a whole block of houses may be destroyed [2]. Such conditions are very unsafe and life-threatening in the houses. An electric short circuit is another common cause of the fire. Inappropriate grounding or old and exhausted wires can most likely cause a short circuit that finally causes a fire [3]. Candles and Oil lamps can also cause a fire. To avoid life-threatening injuries, early detection of all of these is very important. Even a small fire could turn into a major tragedy if it is not properly tended. We often hear about the thievery or robbery occurrences around us. We face many problems when security is affected because of any unauthorized person entering our home during off-time or closed-time or when the environment of our home goes wrong by gas leakage and by breaking up the fire. So, if we have some real-time detection and notification system, we will be able at least to try to control the situation.

The proposed system containing a GSM or GPRS system have five main modules. The first module consists of an intruder checkers module that consists of a variety of PIR sensors for detecting a person's presence in the home. The second module which detects gas leakage consists of LPG gas sensors. The third module is the module for fire detection which consists of fire sensors. The fourth module is the module for sound detection which consists of sound sensors. Finally, the fifth module is the module for high-temperature detection which consists of temperature sensors. The Arduino Uno *microcontroller board* is used as the base controller in this system. Arduino is an open-source hardware and it is widely used in many real-world application areas [4]. ArduinoUno *microcontroller board* collaborates with sensors to receive data from the environment and control other hardware to perform specific tasks. It can control motors, LEDs, sensors, and other devices.

A GSM unit or GPRS module is a chip or circuit used to communicate with a GSM or GPRS network between a mobile device or a computer machine [5]. Such modules consist of a GSM module or GPRS modem powered by a power supply circuit and networking interfaces (like RS-232, USB 2.0, and others) for the computer. A GSM modem may either be a dedicated modem unit with a serial, USB, or Bluetooth connection or a cell phone that can send a message or a call to the house owner in an emergency situation.

The main contributions of this work are as follows:

- Development of a smart security system so that people live in their homes in comfort.
- Detection of gas leakage, fire, sound, temperature, and intruders through this work.
- Design a low-cost system so that a homeowner can get a message or a call if there is any case of occurrence in his/her home.

The rest of the paper is organized as follows. Section II describes the literature review, Section III explains the proposed model, Section IV presents the results and discussion and finally, Section V concludes the paper.

LITERATURE REVIEW

Recently some researchers have developed some systems for home security. They have used several sensors, and several techniques and discussed technical challenges. The author [6] described a GSM-based home security system. Their system has three main modules that use a GSM modem. The first module consists of a locked keypad to lock the doors. The second module consists of PIR sensors to detect the intruder. Lastly, the third module consists of LPG gas sensors to detect the fire. But the system cannot detect temperature, gas leakage, or massive sound. Also, message sending and phone calling systems to the house owner are not accommodated.

The security system which used an open-source electronic platform that is used remotely is discussed in the research paper [7]. It consists of a manual siren alarm, protection, and an alarm scheme with a simple motion-sensing alarm that detects someone entering the area. It triggers a siren when an intruder is detected and notifies the approved individual via SMS (Short Message Service). The limitation of the system is that it can detect only intruders.

A security system for smart homes implemented using a GSM module and Microcontroller is described in the project [8]. The security system implemented here is a wireless network that includes a GSM modem and magnet with a relay that is a security node for the door. Suspicious activities are transmitted via GSM technology through SMS or Call to a remote user. The proposed model has not had the features of gas detection and other security options.

The development of a smart home security system is discussed in [9]. A security system has been developed that uses sensors to detect any security breaches and send out a high-intensity Buzzer warning signal. Three-level security systems have been assured in this paper. They have used NFC tags with Passwords and PIR motion sensors. But the system has not the features of fire, temperature, etc. Pawar et. al. [10] a home security system for intruders only. Hence, in this work, we propose a generalized home smart home security system containing the detection of intruders, gas leakage, fire incident, abnormal temperature, and sound

PROPOSED MODEL

The flow diagram of the proposed method is shown in Figure 1.

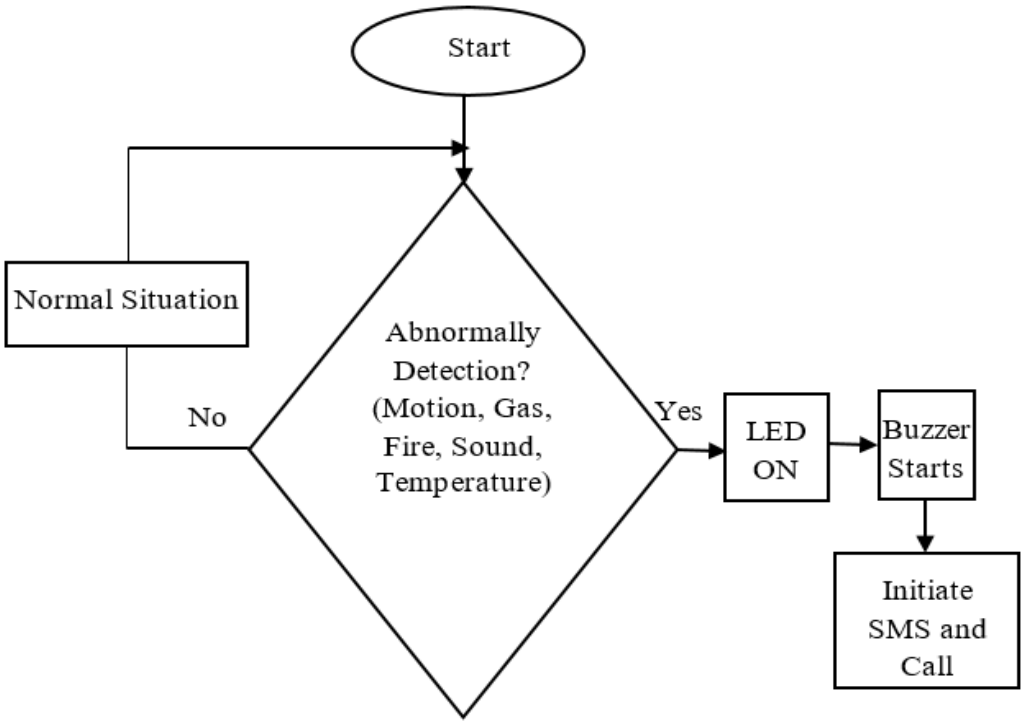


Figure 1: Flowchart of the home security system.

This system constructs with Arduino that contains a lot of code for a specific action. The action will be taken by the GSM modem i.e. to alert an owner about an intruder or threat to the home. It uses a PIR motion sensor to detect the intruder which is connected to the V_{cc} pin of the PIR sensor to the positive terminal of Arduino (5V). It also uses a gas sensor to detect gas leakage and a fire sensor to detect the fire, a sound sensor to detect massive sound, and a temperature sensor to detect temperature which are connected to Arduino. In any abnormal situation, an LED will blink a buzzer for ringing the alarm which is connected to Arduino and then the GPRS GSM module will send messages and calls to the owner of the house. The full connection of the system is shown in Figure 2.

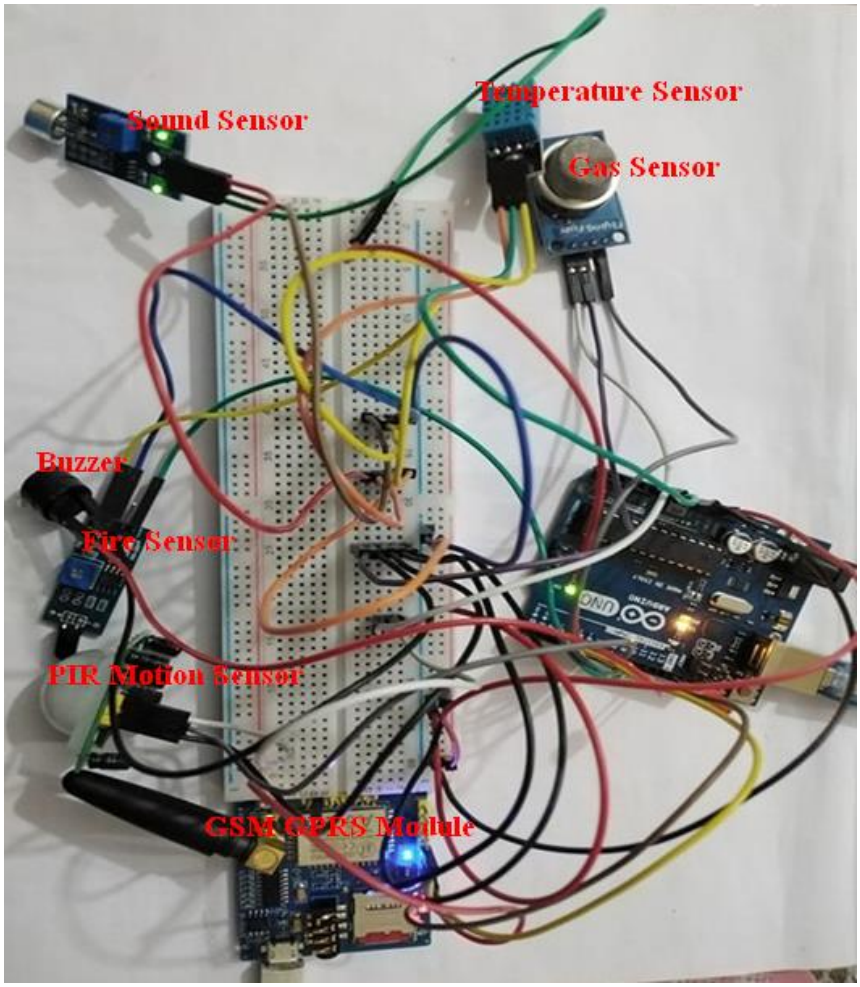


Figure 2: Full connection of the system.

Gas leaking in the house can be detected using the gas sensor. When the gas sensor detects the gas leakage, the system blinks the red light and triggers the alarm. For the detection of fire, we have also used a fire sensor fire in the house. When the fire sensor detects any fire in the house, the system flashes a red light and triggers the alarm at high volume. The system also sends messages with the house's current temperature and calls to house owners using the GPRS GSM module. The PIR motion sensor is used for the detection of intruders. When the PIR motion sensor detects any intruder in the house, the system blinks the red light and triggers the alarm with high volume. The system then sent messages and calls to house owners using the GPRS GSM module. The sound sensor is used to detect the massive sound. When the sound sensor detects any massive sound in the house, the system flashes a red light and triggers the alarm with high volume. The system then sent messages and calls to house owners using the GPRS GSM module. We used a DHT11 temperature sensor to detect the current temperature. When the DHT11 temperature sensor detects any temperature, which is greater than the defined temperature, the system then sent messages or calls to the house owner using the GPRS GSM module. Figures 3 and 4 show the message and a call to detect gas leakage, fire, massive sound, intruder, and temperature.

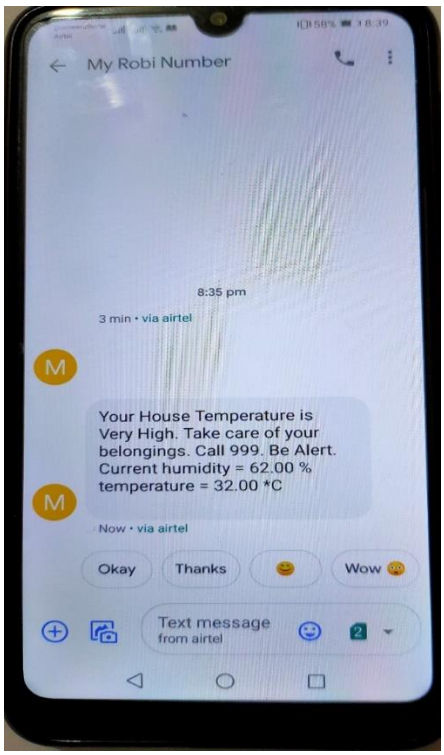


Fig 3: abnormal temperature detection message



Fig 4: Anomaly detection call: Gas leakage, fire incident, presence of an intruder, and abnormal temperature.

RESULTS AND DISCUSSION

We have implemented and tested our system and the obtained results are satisfactory. The system is very simple and user friendly which can be installed at an economical cost. It uses the GPRS GSM technology which gives a good response for a particular actionfrom the Arduino Uno after receiving a message. A survey was performed among 20 house owners. There are a total of 9 questions (8 questions are on functionalities and the rest is on usability). Among the owners, 10 were middle-income people whose houses contain 3 to 2 bedrooms, and 10 were high-income people whose houses contain 4 to 5 bedrooms. Among them, 18 respondents answered all of the questions "yes" and 2 of the respondents answered "no" to the question on usability: "Do you feel comfy when you leave your home using our system?" The proposed system received a high rate of "yes" in the survey. Table 1 shows the survey questionnaires and corresponding responses, and Figure 5 shows the survey response chart.

Table1: Survey questionnaires and corresponding responses

Questions	Yes	No
Functionality		
Does the PIR sensor detect the motion of humans or animals?	20	0
Does a Gas sensor detect gas leakage?	20	0
Does a Fire sensor detect fire?	20	0
Does the Sound sensor detect massive sound?	20	0
Does the Temperature sensor detect temperature?	20	0
Does the buzzer alarm when the sensor detects it?	20	0
Does the red light blink when the sensor detects it?	20	0
Does the system notify the user using SMS or call?	20	0
Usability		
Do you feel comfy when you leave your home using our system?	18	2

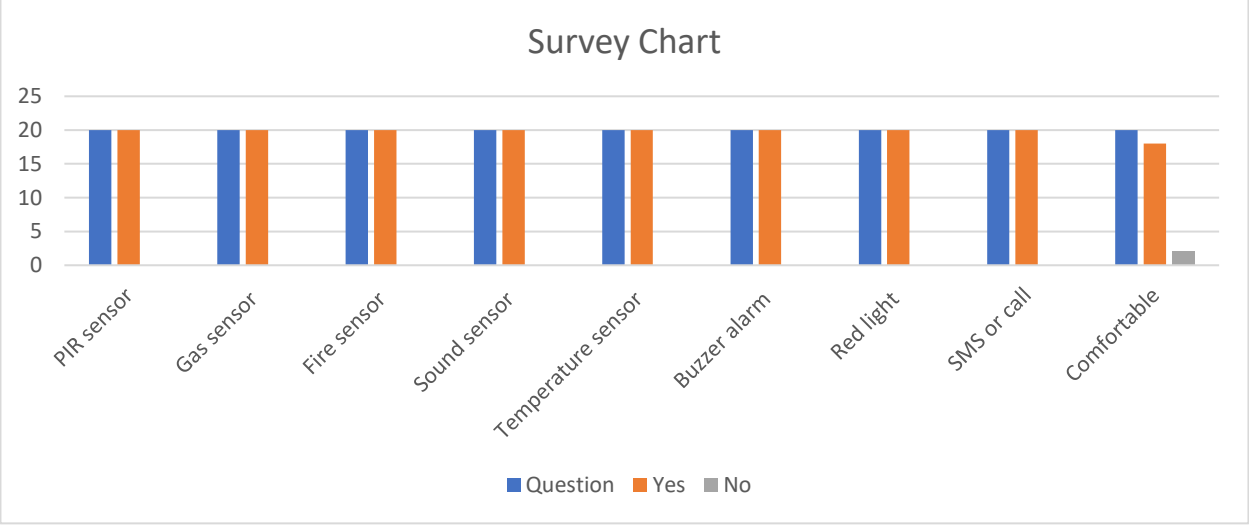


Fig 5: Survey Chart

CONCLUSION

We designed and tested our home security system with a mobile network. The user can get notifications through GSM technology. Many accidents happening because of fire and leakage of gas can be prohibited through our project in the homes. Using this project homeowners can protect their houses from criminal activities like burglary and theft can also be prevented by using a motion detector. Control the house temperature using the temperature sensor. Detect the massive sound using the sound sensor. This system is better than other systems that are described in the literature review chapter. Those systems use only one, two, or three sensors to detect the problem but this system uses a generalized system containing five sensors to detect abnormal incidents and a GSM GPRS module for sending messages and calls to the house owner.

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