GSM based Home Security System using Arduino

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Abstract— This paper discusses the design and implementation process of a security system that is microcontroller-based, and that is applicable in residential homes or small commercial buildings such as offices. The system is GSM-based, a wireless technology that consumes very little power. A microcontroller has been used to save the instructions (the program code) that would be sent to the homeowner in case there is a security breach at the premises where the system is installed. Other peripherals in conjunction with the microcontroller are a power supply unit, a PIR motion detection sensor, and a Global System for Mobile Communication (GSM) Module. The microcontroller is placed on an Arduino board connected to the other peripherals. The PIR sensor detects motion, and its output becomes high, detectable by the microcontroller, which sends a signal to the GSM module. The module then calls the premise owner to alert them about a possible intrusion. This report details the design procedure and implementation of the system by analysing similar systems under literature review. The system is first fabricated, and the results are discussed. The design and implementation of the hardware and software have then been discussed.

Keywords— Security Systems, Arduino UNO, GSM Module, PIR Sensor

I. INTRODUCTION

Since security has become a worldwide concern, the number of security firms has increased. These firms have come up with innovative ways of securing homes and offices. The system designed here is an innovative way of detecting an intrusion and alerting the concerned parties, the owner or the security firm, about the intrusion. The system is microcontroller based and is a wireless, GSM-based communication approach with meagre power consumption. The system does not deter the intruder but alerts the concerned persons about the intrusion, and they would take action based on the information sent to them.

The project is divided into two main parts. The first part detects when motion is detected at the point of entry into the premise where the system has been installed. The second part revolves around the GSM Module. This part is used to relay information to the homeowner or the security firm to a handheld communication device, a mobile phone, or a tablet. The receiver of the call is then supposed to initiate the next course of action, such as deploying security personnel to the location.

The trending culture in modern home designs is home automation. This is done to facilitate a flexible and comfortable living experience for the new homeowners. Part of home automation is an improved home security system. This forms the backdrop of this project, aiming to develop a means of securing the home through the various points of entry; that is, it can be at the doors or the windows. Conventional key and lock padlocks are being phased out with intelligent systems. These systems can detect unauthorised entry and alert the property owner in real-time. This is a much more significant and preferred improvement over the traditional big padlocks that cannot deter intruders.

The main aim of this paper is to develop a home security system that can alert the homeowner in real-time in case there is an intrusion into the house. For this main objective to be achieved, specific objectives were developed and contributed to the overall achievement of the main objective. These specific objectives include:

1. To analyse and evaluate existing home security systems in terms of their cost and efficiency and come up with an accurate, low-cost alternative

2. To evaluate how a mobile-based system, GSM, can be integrated into a security system to create a real-time awareness of a homeowner

3. To design, build, and test a prototype of the solution proposed in the first subjective.

While similar systems may exist in the market at the moment, they are costly and not simplified to be user-friendly. This research aims to redesign such a system using locally available materials and simplified programming, making it low-cost and user-friendly. The merits can be summed up as follows:

● **_Easy to Use:_** The use of LED to display the door status (either locked or unlocked) is a straightforward and low-cost means of checking the door status. The use of GSM, thanks to technological advancement, is a simple yet reliable means of relaying information and covers all parts of the globe; thus, the homeowner is not limited to access alerts by location away from the house.

● **_Portable:_** The design developed is a small, lightweight prototype. This makes it easy to carry about and install anywhere the homeowner may feel it is necessary to secure.

● **_Affordable:_** The prototype comprises simple electronic components readily available, and the microcontroller used is low cost. The impact is that the project cost is reduced and made.

II. LITERATURE REVIEW

[1] A global mobile communication-based domestic safety alarm gadget is designed using Arduino, PIR sensors, and a GSM module. When the device is activated, it continuously examines for speed, and if it is detected, it will name the owner. Only the intruder's alert on this system can be upgraded to other safety indicators such as fire, smoke, etc. [2] This paper has described how a microcontroller, PIR sensor, and GSM module can be used to alert a homeowner of an intrusion into their property. The materials are cheap, and the design is relatively simple, making the project easy to implement. The project only alerts the owner. The system can be improved by introducing a buzzer or siren to alert the neighbours, and a magnetic lock can be triggered to reinforce the door lock. A relay can be used to start a magnetic lock mechanism that can be used to bolster the door lock if an intrusion is detected. [3] The Project is an implementation of the IOT based home security system, which is able to secure homes and make people feel safe and can be bought by almost everyone.The Major aim of the Project was to be cost efficient and simultaneously it should be secure, and this was accomplished with the use of internet of things and other electronics component. [4] The paper deals with the plan and execution of a LASER based smart security system for discovering burglars. The principal edge of using the Laser system is that the burglar is unmindful of the fact that a security system is fix in the entry points like doors and windows since laser rays can travel long distances and are almost imperceptible.When someone go through the laser ray the circuit senses the cutoff and stumble the alarm. The alarming sound does not stop until someone turns it off manually after scrutinising.It is one of the most economical security apparatus that can be used indoors as well as outdoors. [5] Study suggests a quick-response method to assist women in times of need. When someone is going to harass a woman, she can press the button and her current location information is transmitted as an SMS alert to the predefined numbers based on latitude and longitude.In the future, the system might be connected to a camera to capture images and record live video. Our project concept expands on the idea of designing a system that will make every place and hour safer for women. [6] Safety plays a foremost part in our today's world and an automatic safety system must be employed in environments like institutions, hospitals, homes, industries, and workplaces.One of the precautionary measures one has to take to avoid the danger associated with the gas leakage is to install a gas leakage system detector at susceptible places.The research aims to detect the leakage of gas when the gas is above the certain requirement needed in the environment.

III. METHODOLOGY

1. Components Used

Arduino UNO Board: Arduino is an open-source platform for prototyping used by students for reasonably low-level programming because of its ease to use and simplicity. The Arduino Uno board is programmed through the Arduino IDE. This offers a flexible means of writing and uploading codes to the board through a PC. A microcontroller, ATMEGA 328, is mounted on the board, where the codes are uploaded. The controller is the logic unit of the system. It monitors the PIR input and instructs the GSM module to place the call to the predefined mobile number.
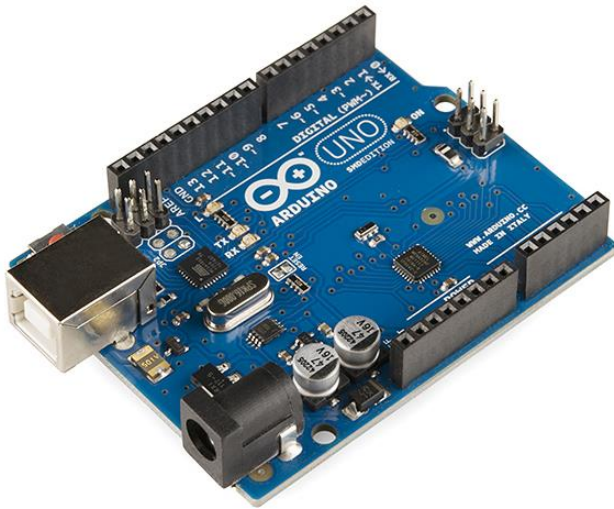
Fig. 1 Arduino UNO Board

PIR Sensor: PIR is an acronym for passive infrared. The sensor is used to detect any motion in front of it. The working principle is based on the fact that all living beings with a favourable body temperature emit radiation. These are the radiations that the PIR sensor picks up. The sensor has a high digital output in the presence of an intruder. This digital output is connected to one of the digital inputs of the microcontroller.

Fig. 2 Passive Infrared (PIR) Sensor

GSM Module - SIM900A: This project uses the SIM 900A as the GSM Module. The Sim900A is a second-generation (2G), two-band device operating on a frequency range of 900 to 1800MHz. This module has 2 built-in RS232 serial ports. One port is used for standard communications, mainly between a PC and the module itself. The other port is also an RS232 serial port and is considered a" service port, " meaning it is primarily used to debug the module and upgrade the firmware. The purpose of this module is to achieve communication with the preset handset. The user defines a mobile number to which intrusion messages are sent. AT commands are applied here to achieve this link once the controller instructs the GSM module.
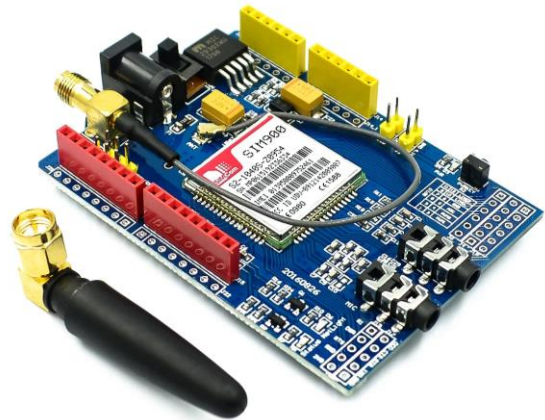
Fig. 3 GSM Module

2. Implementation

The microcontroller on the Arduino board is the brain of the system and is what links all the other components. It is powered by a 9V dry cell alkaline battery, the power supply for the entire system. The components are low-energy consumers; thus, the battery is sufficient to power it. This ensures continuous operation of the system even during power interruption since the power source is independent of the main power. The Arduino board regulates the power supply to 5V for operation; thus, the low battery below should be replaced. The PIR motion detection sensor is the critical trigger in the entire setup. When it detects motion for a long time, it sends a signal to the microcontroller. The GSM module is fitted with a SIM card to communicate with the homeowner.
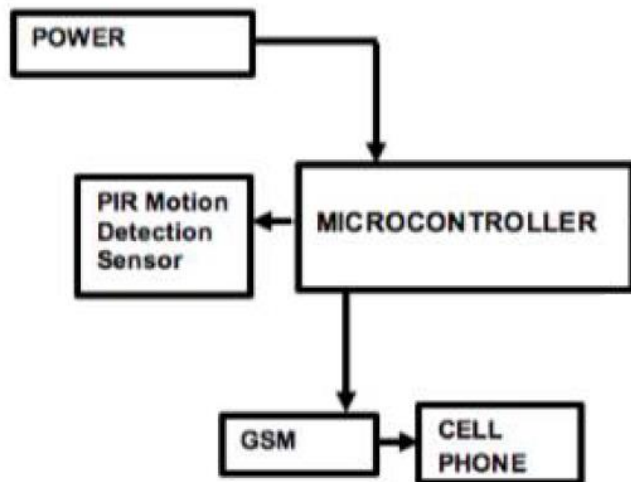
Fig. 4 System Block Diagram

IV. RESULT

Once the power supply is connected, the design is good to go. The PIR sensor is the critical trigger for all the subsequent events. It senses the difference in radiant heat levels emitted by surrounding objects, also called infrared radiation. It is accurate up to 6 metres. When there is nobody in the line of sight of the sensor, the output pin would be LOW. When a heat radiating body is placed at the line of sight, the sensor would need about 20 seconds to warm up; a process called settling. This settling time is used to calibrate the sensor according to the environment before stabilising the infrared detector. During the settling time, there should be no change in the radiation detected.
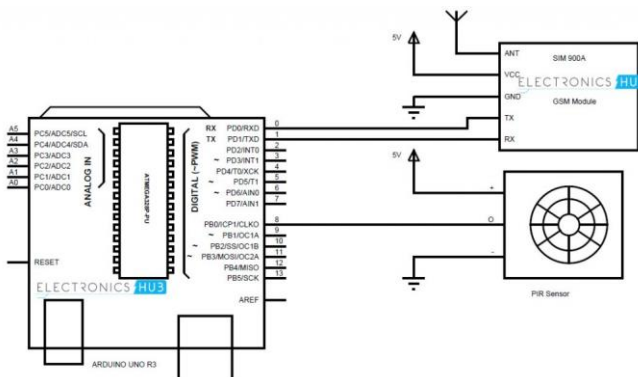

Fig. 5 System Circuit Diagram

The sensor cannot calibrate if there is motion, which triggers the output pin to a HIGH. The sensor's output pin is connected to a microcontroller pin configured as an input. A change from LOW to HIGH at the microcontroller input pin triggers a HIGH at the output

pin connected to the serial communication port through which the GSM module is connected. The microcontroller then activates a call to the homeowner through the GSM module. The module has a SIM card registered with the local telecom service provider. The home owner's number is programmed into the microcontroller.
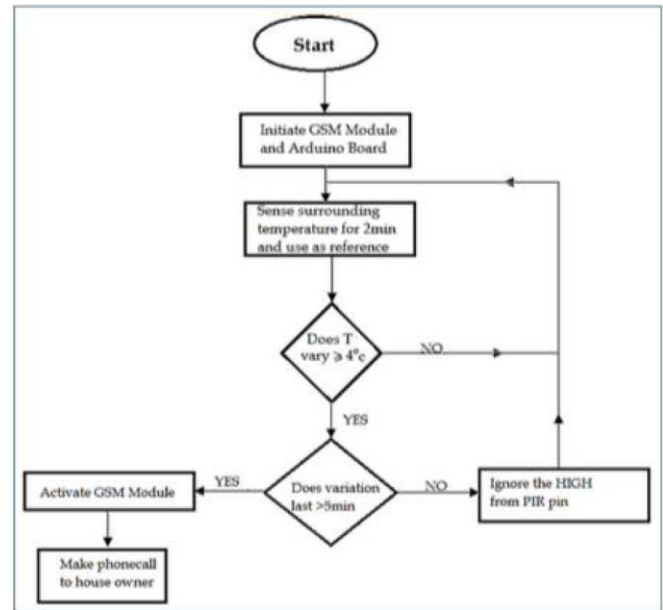

Fig. 6 System Flow Chart

It was observed that the response time increased with an increase in the atmosphere's temperature. The possible explanation for this is that when the atmospheric temperature is low, the PIR sensor can easily detect the body temperature and send the signal for the call faster. Its performance is affected by some external factors, such as atmospheric temperature and wind. It would be recommended that the prototype, the PIR sensor itself, be installed in an enclosed area with no wind blowing.
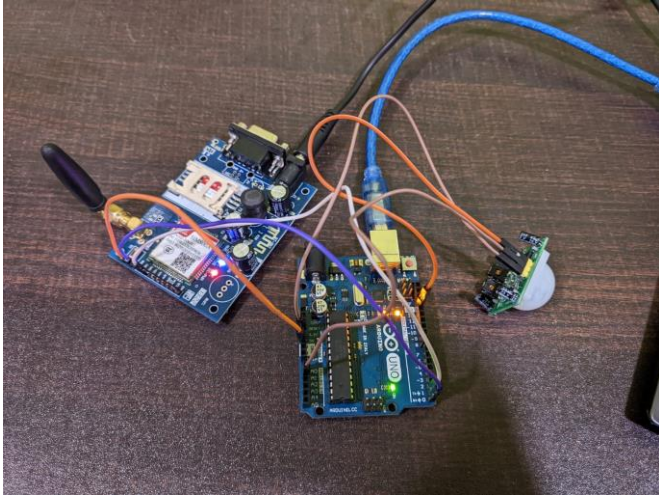
Fig. 7 Final Circuit Implementation

V. FUTURE SCOPE

A relay can be used to trigger a magnetic lock mechanism that can be used to reinforce the door lock if an intrusion is detected. The system can be improved further by introducing a buzzer or siren to alert the neighbours. A siren can alert the neighbours if the owner is not near the house at the time, and a magnetic lock can be triggered to reinforce the existing lock.

VI. CONCLUSION

This paper has described how a microcontroller, PIR sensor and GSM module can be used to alert the homeowner of an intrusion into their property. The materials used and the design are relatively simple, making the project easy to implement and low cost to obtain. The objectives set out in this paper have been achieved. The design, as it is, does not secure the owner's premise. It only serves to alert the owner. The recommendations on possible ways the system performance can be improved to make it more robust and practical.

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