

Automatic Light Control and Home Security using PIR Sensor, GSM and Arduino System

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Abstract- Nowadays without electricity, we cannot imagine our daily life as electricity has become a necessity for all, without which day-to-day life chores become stand still. People do not focus on the wastage of electricity around them. Sometimes we notice various electrical appliances keep on working even in the absence of people. This negligence can be seen in most of the public places, offices etc. However, there is a solution to control energy wastage at home by using automatic light control. In this project, we will focus on the Automatic light control using Arduino and Passive Infrared (PIR) Sensor, where the lights in the room will automatically turn ON when human presence is detected and turn off when no one is present. Apart from automation, the home security system is also needed for convenience and safety. The system is needed to keep the home safe from an intruder. For this work, we present the GSM based home security system. This motion-based security system detects any trespassing of objects that occur in the range of the motion sensor. Depending upon the movement of the object alert message will be sent to the user when the intrusion is detected. This GSM based home security system has the capability of sending SMS alert once PIR motion sensor detects the movement. This SMS sending facility gives the user a great safety feature.

Index terms: - Arduino, PIR, GSM, Relay, Microcontroller

I. INTRODUCTION

Humans face various problems in their life, House intrusion and wastage of power are two of the major problems faced by human beings all over the world. People have a tendency to leave lights and fans on even when they are not utilising them, they repeatedly forget to switch the appliances off which leads to wastage of electricity. In such a manner a lot of electricity is wasted. Simultaneously there is a constant risk of someone breaking into the house when no one is present in the house, so the people have to constantly remain alert every time they leave the house empty and worry if their house is secure or not. Repeatedly, they are wasting so much energy by not turning off the appliances and losing their focus over the security of the house. To overcome this problem, we have worked on a device that can be implemented anywhere in the house to resolve both the problems at a reasonable cost.

This project is aimed at designing a combination of automatic light control and home security system. Passive Infrared (PIR) Sensor is used to detect human movement and then it will send the signal to the Arduino and accordingly, it will activate the relay to switch on the load. Similarly, theft detection is turned on when the people of the house are not present in the house. First, it will sense the human movement presence through PIR then with the help of Global System for Mobile (GSM) communication it will send the message to the owner of the house on detecting motion.

Gopal Chandra Nepal et al [1] proposed a system that provides security with the help of PIR sensor. Here the PIR sensor is connected to relay and security camera. The recording only takes place when motion is detected in PIR sensing area. The PIR sensor will trigger the relay and camera is connected to output of relay. Here the storage required to save the security footage has been reduced as recording take place only when an intruder is detected. This type of security system lacks the provision of providing alert to user when the intrusion is detected. This system can be connected with a GSM module so that a message can be sent at the time when the intrusion is detected.

Maslekar et al [2] proposed a system with the aim of reducing power wastage by using PIR sensor and Raspberry pi. Here the Raspberry pi is used as a monitoring device to control the switching of load on the detection of motion. The system also lacks the provision of providing security system and also the cost of system is unnecessarily increased by using Raspberry pi which could be replaced by using arduino system to make a cost efficient system.

In [3] and [4], two type of system have been proposed to automate the load in public places. A system to automate the load in classroom using PIR sensor and Bluetooth module is proposed in the first model. Here the Bluetooth module is used to remotely select the load which needs to be triggered by the PIR output. In the second system the automation is done on the principle of visitor counter where a PIR sensor is placed on the entry of room. The sensor is utilised to count the number of people that have entered the room and number of people exited. The load remains active as long as the counter count is greater than zero. If the counter count drops to zero the load will turn off as no one will be present in the room. The first system has the drawback of unnecessary increase in cost due to increase in cost by Bluetooth module as PIR sensor is alone sufficient for the automation. The second system has the limitation that only one person can enter the room at a time otherwise the system would lead to improper counting and the device fails to fulfil its purpose in such conditions.

In this paper, there are two modes of operation at which this system works. First, when the user or family is at home it only acts as an automation load switching system. PIR sensor detects human movement in a particular area and if the motion is detected it sends a signal to switch on the load in a particular area. This system helps in reducing the wastage of electricity by human mistakes and thus reduces load consumption. Secondly, it acts as a security system, when the user or family is not

at home they have to activate this security system while leaving home. When this system is activated the PIR sensor which was being used as an automatic load switching device now helps to maintain security. As the motion is detected in an area this time the sensor sends the signal to a GSM module connected to the system. The system is programmed such that when it is in security mode and motion is detected it sends an alert message to the user that your house has been breached so that user can take desired action to keep their house safe. This project helps to maintain the house security which is important in current times as the number of robberies and housebreaking cases especially when the people are not at home. This system helps the user to remain ensured that his house is safe.

II. TECHNOLOGY

For establishing communication with the remote devices, different medium like radio waves, acoustic waves and optical radiations are used. These medium differ from each other on the basis of operating frequency. These type of communication may operate on wide variation of frequencies such as HF, LF, VHF, UHF bands, and so on. Optical radiations use the infrared and visible section of the spectrum. PIR sensor works on the infrared part of visible radiation. PIR alone is not sufficient it has to be incorporated with a circuit of motion detecting device. Actually PIR is a key component of a passive infrared detector (PID). PIR is incorporated with some other circuitry integrated together to develop the PID. Basically, a PID contains four main structures: A Fresnel lens, a PIR sensor, amplifier circuit, and a time delay circuit. A PIR sensor is used to detect the variation of infrared radiation in the field of view. This variation of infrared radiation is caused by movement of objects which have infrared radiation along the field of view of PIR sensor. They are commonly used in security system and automatic light control systems. They are commonly called PIR, or sometimes referred to as PID.

The PIR sensor detects if there is any change in infrared radiation, which varies depending on the temperature and surface characteristics of the objects in front of the sensor. When an object moves in front of the sensor, the pyroelectric material senses this variation in infrared radiation and a voltage pulse is generated, this voltage pulse is passed through the amplifier circuit and this will trigger the sensor. Objects having a similar temperature but different surface properties may also have a different infrared emission pattern, and thus moving them with respect to the sensor may trigger the detector as well [8].

PIR basically come in several different type of configuring depending on the purpose or the place of utilization. The field of view is directly dependent on the construction of the sensor hardware. The field of view can vary from 120 to 360 degree. The normal range of the PIR sensor motion detection is 6 to 10 meter. Some larger PIR are made with single segment mirrors and can sense changes in infrared radiation over thirty meters.

GSM is an abbreviation for Global System for Mobile Communication. It is a cellular technology which is used to communicate remotely with other devices using network connection at different frequency. It is the source of transmitting information through the mobile network. The GSM MODEM uses AT commands, for communicating with processor or controller, which are interfaced through the serial communication port. Figure 1 shows the GSM Module.



Fig. 1: The GSM Module

Arduino is basically a development board of a microcontroller. Arduino can be divided into two major parts: the Arduino board, which is the piece of hardware which is used to build objects; and the Arduino Integrated Development Environment (IDE), the piece of software run on the computer to assign functioning to Arduino. The IDE is used to create a virtual sketch (a little computer program) that is uploaded to the Arduino board through an interfacing cable. The Arduino board is a small microcontroller-based board. Arduino is a small circuit that contains a whole computer on a small chip (ATmega328 microcontroller if 8 bit). There are 14 Digital pins, 6 Analog input/output pins and 6 pins to provide supply and ground. The Arduino IDE is special software that supports many languages. It is used to write and test the code according to the need. An IDE brings many development tools like a text editor, code libraries, compilers etc. into a single application. The Arduino IDE is very useful as it provides a platform to develop code and test the code for errors directly in the software. The IDE is also helpful to directly feed the code in the Arduino board so no other application is required separately for burning the code. Arduino is different from other platforms because it has a multi-platform environment, uses an integrated development environment, programming via USB cable is also possible. Figure 2 shows the Arduino system.



Fig. 2: The Arduino System

The Microcontroller AT89S52 is an 8051 Microcontroller belonging to the family of Atmel Microcontrollers. It is an 8-bit CMOS microcontroller with flash memory of 8Kb and 256 bytes RAM. It has 32 I/O pins. It comprises of three 16-bit timers, external interrupts, full-duplex serial port, on-chip oscillator, and clock circuitry.

III. SYSTEM ARCHITECTURE AND WORKING

The aim of this project is to implement a simple and affordable, but efficient home security and automation light control system. The project is designed for detecting the movement and informing the owner by sending a message.

For automatic light control, a PIR sensor is used to sense the motion and Arduino UNO [9] is used to control the system. PIR on detecting motion gives a high signal to Arduino UNO, the Arduino sends the digital high signal to relay, and then the load is switched ON using a relay. The Arduino is programmed such that it checks for the motion constantly and when the motion stops the load is turned OFF after a delay of 20 seconds of completely stopping of motion. A PIR sensor is used here to detect the movement of the human body. Initially, when there is no movement, the PIR sensor doesn't detect any motion and the output pin stays LOW. As the person enters the room, there is a change in infrared radiation which is detected by the PIR sensor. As a result, the PIR sensor output becomes HIGH. Since the output pin of the PIR sensor is connected to the digital pin of Arduino, so whenever it becomes HIGH, it will activate the relay by making the relay pin HIGH (the relay module is an active HIGH). This will turn on the lights. The light stays turned on as long as there is a movement of the object in front of the sensor.

If the person leaves the room, there is a no change of infrared radiation (that is it become stable) and hence, the output of the PIR sensor will become LOW. This, in turn, will make the Arduino turn OFF the relay (by making the relay pin LOW) and the room light will be automatically turned OFF. Figure 3 shows the block diagram of the automatic light control and security system.

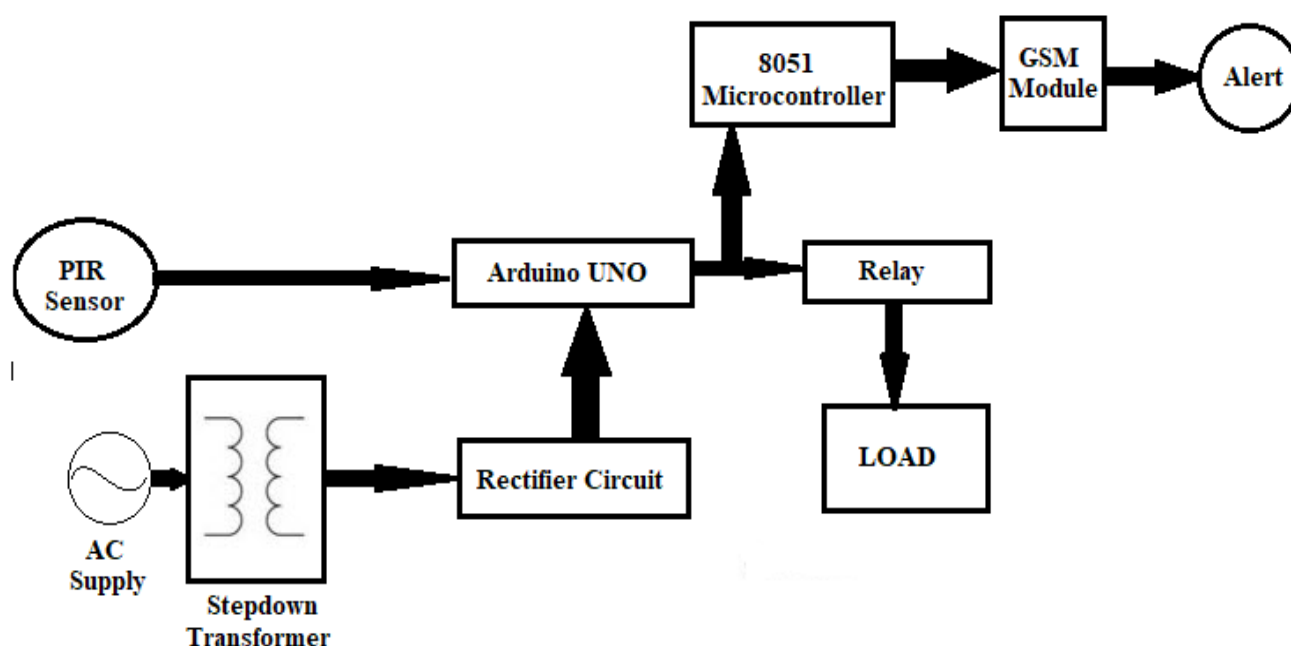


Fig. 3: Block Diagram of Automatic Light Control and Security System

Likewise, home security is also very important, for this part a microcontroller is connected with the output of PIR. During the presence of the user at home the system is isolated from the automation system through a switch, but when the people of the house leave it completely empty the security system is activated. The system then receives the input through PIR, the input is sent to the microcontroller, on detection of intruder, an alert message is sent to the submitted mobile

number. With this advancement, a house owner doesn't have to worry about home security while getting off his/her home. When the PIR sensor detects any movement, the output of the PIR sensor is high. This is detected by the Arduino UNO board. Arduino will then communicate with an 8051 microcontroller which has been interfaced to GSM module via serial communication to make a call or send a message to the pre-programmed mobile number. The output of the PIR sensor goes low from time to time, even when there is motion which may mislead the microcontroller into considering that there is no movement. This issue is dealt with in the programming of Arduino by ignoring the low output signals and also simultaneously setting PIR to H mode. Thus proper security application of the system is achieved.

The different condition of operation of the system has been depicted in table 1. In the table1 sw1 refers to switch which is for the operation of the automation system and sw2 refers to switch used for the security system.

Table 1: - Operation of Automation and Security System

S. No.	Condition	sw1	sw2	Output
1	No Motion Detected	NIL	NIL	Load is turned OFF No alert message sent
2	Motion Detected	open	open	Load is turned OFF No alert message sent
3		closed	open	Load is turned ON No alert message sent
4		open	closed	Load is turned OFF Alert message sent
5		closed	closed	Load is turned ON Alert message sent

IV. CONCLUSION

In this project, we have designed automatic house lighting and house security system with the help of the PIR sensor. This system provides a solution to counter the increasing number of house robberies by alerting the user about the breach in the house. The system is also helping in reducing wastage of electricity by switching on the load only when a human entity is present. So the system is helping to automatically correct mistakes like unnecessarily active loads due to the human tendency of laziness and tendency of forgetting to switch the loads off while exiting the room or a particular area. This problem is expected to be overcome by using the PIR sensor as automatic load controller which switches the load on detection of human presence. This type of automation is very useful for old aged people as it is very stressful for them to switch the supply on and off repeatedly while moving around in the house. This system helps to reduce such stress on old people by removing the repeated use of switches to turn on or off the loads. So the people can move around different areas of the house freely without worrying about switching the loads. So the system is able to provide a solution to some of our day to day problems.

The fact of having chosen home automation and security as a subject to work on has been fulfilling because it is an issue which is currently in full expansion and has a promising future. This technology is constantly expanding and its scope is growing to cover more important areas. This project helps to provide a boost to the idea of developing smart homes by providing both automation and security at reasonable rates. This project not only helps in automation but also in reducing the wastage of electricity. Fig 4 shows the proposed automatic light control and security system. The image shows the way in which all the component need to be connected to develop the proposed system.

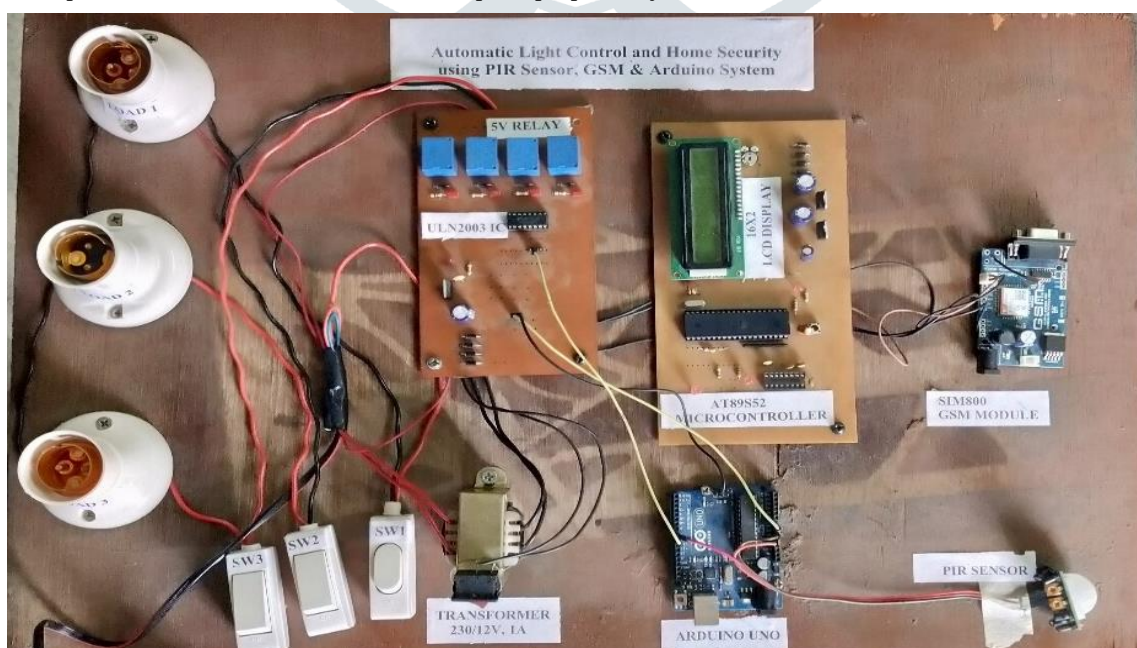


Fig 4:- Automatic Light Control and Security System

V. FUTURE SCOPE

The project has a great scope of future enhancement and implementation with incorporating different enhancements. With some modifications, it could be used for several purposes in the future. The system is a great development because of PIR technology being cost efficient it could be used in low-income houses because it is difficult for them to afford and install an automation or security system due to the system available are generally very costly.

Applications of our device are listed below:

1. The project could be enhanced with incorporating a camera interface to capture the image of the person who breaks into the house with sending a message and storing the photo of the intruder.
2. An extension can be added to differentiate between human and animals to reduce false triggering of alarm thus leading to more efficient and reliable operation.
3. The system could be further modified for use as a fire detector. It can be done by adding the feature to differentiate fire by its flickering nature.
4. It could further be modified for uses in places like banks or safes for providing great security enhancement.

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