

1 Introduction

Home automation system in simple terms refers to automation of day to day appliances that is used in homes. Automation of homes can be divided into two broad categories:

1. Controlling
2. Monitoring

Home automation is achieved through either monitoring or controlling. In our project we try to cover both monitoring and controlling and a combination of both.

Home automation satisfies the resident's needs and desires by making it more convenient to adjust or control attributes such as lighting, temperature, entertainment systems, and other electrical as well as non-electrical appliances. In addition to that, home automation may also including safety and security of residents.

Home automation can be really advanced and might allow the residents to control certain parameters in numerous different ways such as gesture recognition, or sensors or voice commands and so on. Nonetheless, all these technologies favor in comfort of the residents.

We aim to perform microcontroller based home automation with the help of wired sensor technology. In our home automation system, devices will get triggered automatically based on certain conditions so that the resident won't have to manually control them.

2 Objectives

The fundamental objective of this project is to gain a more comprehensible knowledge about real-time applications of several electronic components along with a few sensing devices and also to acquire proper idea about interfacing a micro-controller with various electronic components.

Specific objectives of our project are as follows:

1. Automatic Light Switching based on Visitor Count

To switch the lights of a room off by counting the number of people in the room. If the visitors in a room are 0, the system will switch off the lights after a minimum time period has elapsed.

2. Home Security System

This includes detection and hopefully prevention of possible fire accidents. Detect leakage of LPG gas and notify the user in his/her cell via. mobile networking.

3. Touchless Automated Trash Can

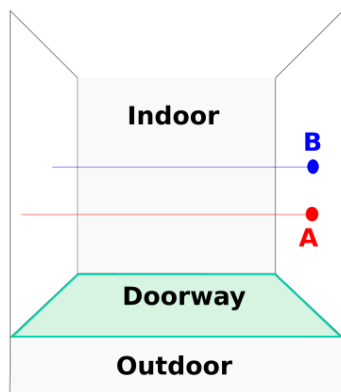
Design a system such that whenever a motion is detected within the range of the sensor it opens the lid of the trash can automatically and the lid remains open as long as the sensor detects motion.

3 Method and Materials

3.1 Automatic Light Switching based on Visitor Count

The main component used for automatic light switching is Ultrasonic Sensor. The ultrasonic sensor is used to reckon the number of person entering and exiting a room and determine the number of visitors.

The fundamental principle behind people counter is that two separate US sensors are placed at the front and rear of the doorway such that one sensor is proximal to the indoor and the other is proximal to the outdoor as show in the following diagram:



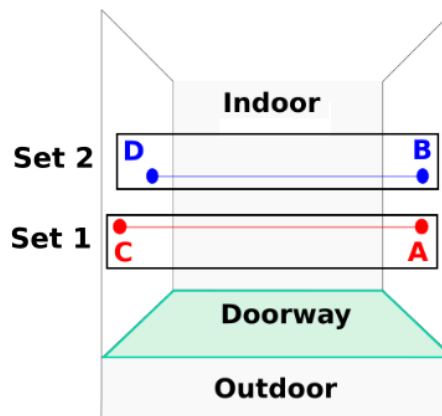
Suppose a sensor A, is placed at the front and another sensor B is placed at the rear of the door so that when a person enters the room, sensor A gets triggered first and then sensor B get triggered sensor. As a result, the time at which the transmitted signal reflects back will be less for sensor and it implies that a person just entered the room. Conversely, when a person leaves the room, sensor B gets triggered first, and sensor A gets triggered second which implies that a person just left the room.

One major flaw of this system is that even if more than one people enter a room simultaneously the sensors are only able to interpret them as a single person. So in order to overcome this limitation, we use four ultrasonic sensors in sets of 2 instead of just 2 sensors.

This four sensor arrangement will also have contribution in improving the accuracy of the system. Since width of most doorways are not that large, sensors from either set may get trig-

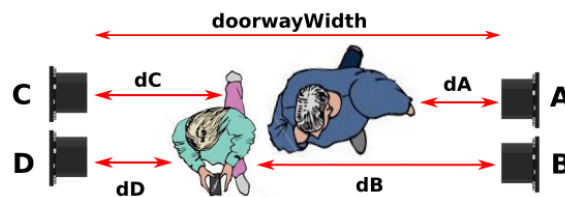
gered at the exact same time. In such cases, having an extra sensor will help to reduce or completely eliminate errors in counting.

Here is a schematic representation of arrangement with four sensors:



As illustrated earlier, set 1 will be placed at front of the doorway and set 2 will be placed at the rear end of the doorway to determine whether a person is exiting or entering.

The logic behind using 4 sensors for estimating the number of people walking past the doorway is fairly simple. First we calculate an approximate width of the obstacle in the doorway as follows:



The width of the obstacle can now be calculated as

$$\text{obstacleWidth} = \text{doorwayWidth} - (\min(dA, dC) + \min(dB, dD));$$

This “obstacleWidth” can be compared with a standard value to predict the possible number of people walking past the doorway.

3.1.1 Algorithm

Step 1: Collect data from the sensor

- Time values t_A , t_C , t_B and t_D are the time at which the respective sensors detects the transmitted sound wave after it reflects back.
- Distance d_A , d_C , d_B , d_D are more or less the length of the pulse transmitted from the respective sensors and are proportional to t_A , t_C , t_B and t_D .

Step 2: Count the number of visitors inside the room based on data obtained from the sensors

```
obstacleWidth = doorwayWidth - (min(dA,dC) + min(dB,dD));  
  
if (tA < tB || tA < tD || tC < tB || tC < tD)  
    if (obstacleWidth > certainStandardValue)  
        visitorCount = visitorCount + estimatedPeopleEntering;  
    else  
        visitorCount++; // at least one person entered  
  
else if (tB < tA || tB < tC || tD < tA || tD < tC)  
    if (obstacleWidth > certainStandardValue)  
        visitorCount = visitorCount - estimatedPeopleExiting;  
    else  
        visitorCount--;
```

Step 3: Turn the lights off if there is no one inside the room.

```
if visitorCount == 0 && lightON {  
    delay();  
    turnOffLights();  
}
```

3.2 Home Security System

Under home security system, our primary goal is to notify the home about possible leakage of flammable LPG gas via. mobile networking. This security system serves the sole purpose of notifying the user about possible fire accidents so that the owner can take necessary actions to prevent them. In a way, this makes our just a bit more secure.

For the sake of this first we need to determine whether there is a gas leakage. An LPG gas sensor is used for determining whether there is a gas leakage or not. The sensor is designed in such a fashion that whenever it detects presence of flammable gas in the air, it gets triggered. The concentration of LPG gas won't matter as much because the concentration of combustible gas in normal air is 0. Once the sensor has been triggered, it sends a signal to the microcontroller unit.

The second part of this design, is notifying the user about the leakage that has just been detected. This is done via. mobile networking. A GSM module is interfaced with the microcontroller such that it broadcasts a predefined message to user in the form of an SMS as an alert signal about the leakage on his/her cell phone.

3.2.1 Algorithm

Step 1: Acquire a signal from the sensor.

Step 2: If the leakage is detected notify the user via SMS.

```
if (leakageSensorSignalHigh)
    broadcastSMSThroughGsmModule();
else
    NOP; // no operation
```

3.3 Touchless Automatic Trash Can

The concept of touchless automatic trash can is also pretty much straightforward. The first thing that we require is a trash can with a LID whose lid opens when a foot is placed at the bottom of the trash can. Now, a PIR sensor is placed at face of this trash can to detect movement. A servo-motor is placed at the bottom of the trash can just beside the part where placing a foot would open the trash can.

The PIR sensor detects motion by evaluating fluctuations in the amount of infrared radiation within a certain range of its proximity. The infrared radiation impinging upon the PIR sensor varies with respect to temperature and surface characteristics of the objects right in front of it.

Living creatures emit certain heat energy in the form of infrared radiation when they move. Therefore, when someone appears in front of the sensing element or when ever someone comes within the sensor's range, the sensor will detect a motion by sensing fluctuations in temperature or the amount of IR radiation in that region. The sensor converts the resulting change in infrared radiation into a change in the output voltage, and transmits it to the controlling unit. When the microcontroller receives such signal from the PIR sensor, it will deploy a output signal of certain magnitude, which sets the servo motor interfaced with in into motion, allowing the trash can's lid to open automatically.

Finally, if the person in front of the sensor moves away, the parameters around the environment will get restored and the sensor will stop transmitting a signal to the controller.

3.3.1 Algorithm

Step 1: Acquire a signal form the sensor.

Step 2: Send a pulse to the external circuit to turn the server motor if the signal from the sensor is high.

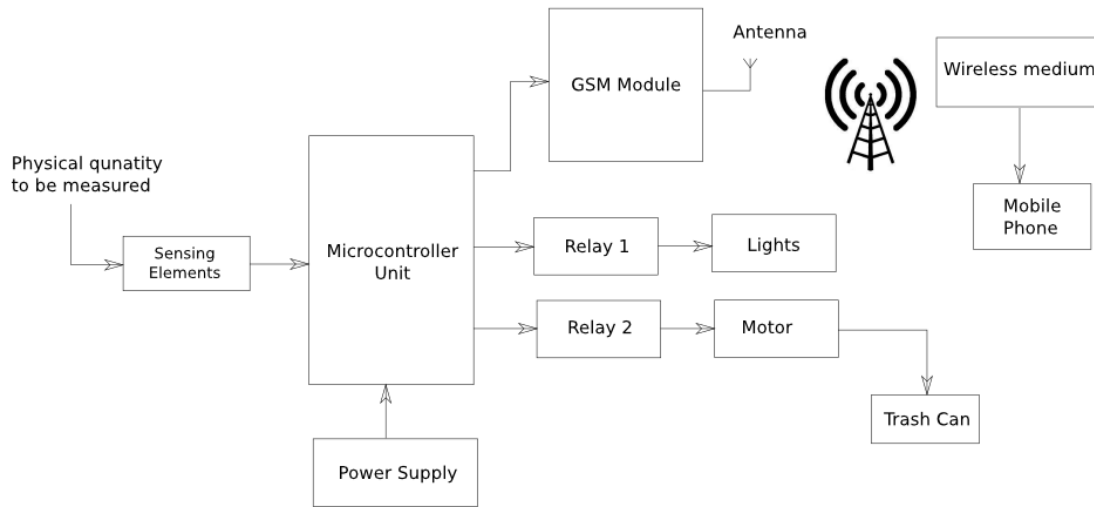
```
if (motionSensorSignalHigh)
    transmitSignalToPowerMotor();
```

Step 3: The trash can has an auto closing mechanism so there is no need to perform anything to close the lid. If the sensor signal is low simply halt the signal from the controller so that the servo motor turns off.

```
if (motionSensorSignalLow)
    stopSignalPoweringMotor();
```

4 Block-diagram and Overall Circuitry

Block-diagram of the proposed system:



As seen in the block diagram the micro-controller will be the heart of the system.

5 Expected Outcome

6 Conclusion Of the Synopsis