1 Intro

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. Automated Trash bin

   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

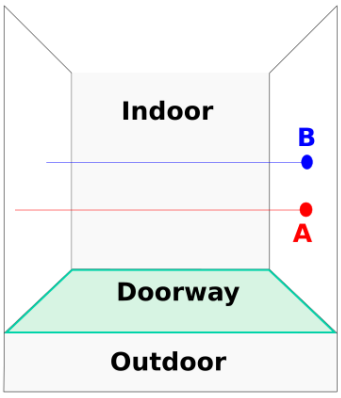
Block-diagram of the proposed system:

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

3.1 Automatic Light Switching

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.

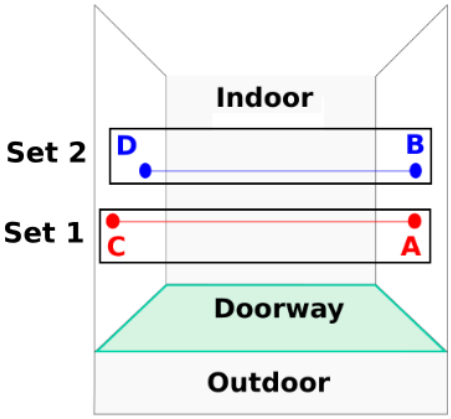
The fundamental principle behind people counter is that two separate US sensors are placed at the front and rear of the doorway such that one sensor is proximal to the indoor and the other is proximal to the outdoor as show in the following diagram:



Suppose a sensor A, is placed at the front and another sensor B is placed at the rear of the door the entry door and sensor B, is inside the entry door. So, 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.

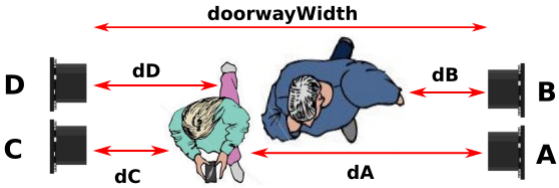
One major flaw of this system is that even if more than one people enter a room simultaneously the sensors are only able to interpret them as a single person. So in order to overcome this limitation, we use four ultrasonic sensors in sets of 2 instead of just 2 sensors.

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

```
obstacleWidth = 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.

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

3.1.1 Algorithm

Step 1: Collect data from the sensor

- Time values tA, tC, tB and tD are the time at which the respective sensors detects the transmitted sound wave after it reflects back.
- Distance dA, dC, dB, dD are more or less the length of the pulse transmitted from the respective sensors and are proportional to tA, tC, tB and tD.

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

3.3 Automatic Trash Can