

ECE 483 Project 1: Security System Project

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For this project, we were instructed to design a security system with specifics given to us in the assignment prompt. These specifications would together in order to act as one security system. This security system would use a basic residence as the foundation for the layout and the student would implement the several aspects of their own design with this foundation. Together these two would work to form as home security system. As well as designing a security system, we had to write the design in C/C++ or Python in order to configure it with the STM32L476G Board. This board utilizes LEDs, switches, buzzers, sirens, etc. for programmable hardware. In my project, I decided to use C++ code using the Codeblocks application to write my initial code and use the other software [.....] to program the code to the hardware.

In my project I used my own home as the basis of the design. This design consisted of four rooms, three exterior doors, and eight windows...two for each room. For each room, window, and door there were to be separate sensors that would work for each kind of disturbance that is most frequently encountered when it comes to them. For each room, we were instructed to include a Carbon Monoxide Detector. After doing some research, I found that there are many kinds of Carbon Monoxide Detectors that are available to the public. These include: biomimetic sensors, metal oxide semiconductors, and electrochemical sensors. For my project, I decided to go with metal oxide semiconductors. A CO Detector that uses a metal oxide semiconductor works by alerting the system once the resistance level of the detector decreases when it is exposed to Carbon monoxide. This decreasing level of resistance that triggered the alarm is caused by the chemical properties of the CO actually altering the electrical properties of the detector by oxidation & others.

To implement this in my project I decided to compare use a random number generator, a for loop, and several conditional if statements. To be more concise, the for loop is built to run four times. This number represents the amount of rooms (ie. sensors) to be generated. In the for loop, a random number generator is programmed first. This is meant to generate random values between 0 and 71. I chose 71 to be the limit because the random number generator will generate values 0-70 if the upper limit is 71...(200 if the upper limit is 20, 201 if the upper limit is 202, etc.). It uses the modulo function to do this. After the numbers are generated, these values are seen as the new resistance levels. The initial resistance value is set to be 70. Next, the program will compare each new resistance level (value) and compare it to the initial resistance value. This is meant to represent the act of the carbon monoxide being detected by the sensor and lowering the resistance level through the various chemical process (ie. oxidation). If the new level is less than the initial level, the program will send a message saying:

"Carbon Monoxide detected. Please exit Room. Thank you."

A signal is suppose to be sent to the board if this alert goes off, but I was not able to program the board successfully. If the new level is equal to the initial level then no CO emissions have been detected and no signal will be sent.

For the second part of this project I used a similar method of random value generation. In this case, however, the values would be changed to reflect decibel values & the amount of windows used. I started off by setting the values of the output files that the data would be written to. I then set the sound int variable to be 140 decibels. I chose 140 decibels because it is about 10 decibels short of the amount that would destroy someones eardrums. The for loop is built to run between 1 and 9. This will create 8 different values. After the for loop is built, a random number generator is implemented to generate random sound decibel values from 0 to 140. These sound decibel values represent high noise directly near each sensor of the window. The following conditional statements are used to represent different parameters. These parameters are written as high level, mid level, and low level. The only level that will produce an actual alarm is the high level. The mid level will let off a warning beep and the low level one will only detect that there is noise but nothing threatening to the window.

To pick each decibel value, I did some research. Like I mentioned before 141 is about 10 decibels short of the sound that will actually cause hearing loss. 100 decibels is the sound level that is needed to break glass. So the “high level” alert will be implemented when any decibel value over or equal to 100 is generated by the random number generator. The alarm will then be set on. For the second conditional statement, I decided to use the following parameter:

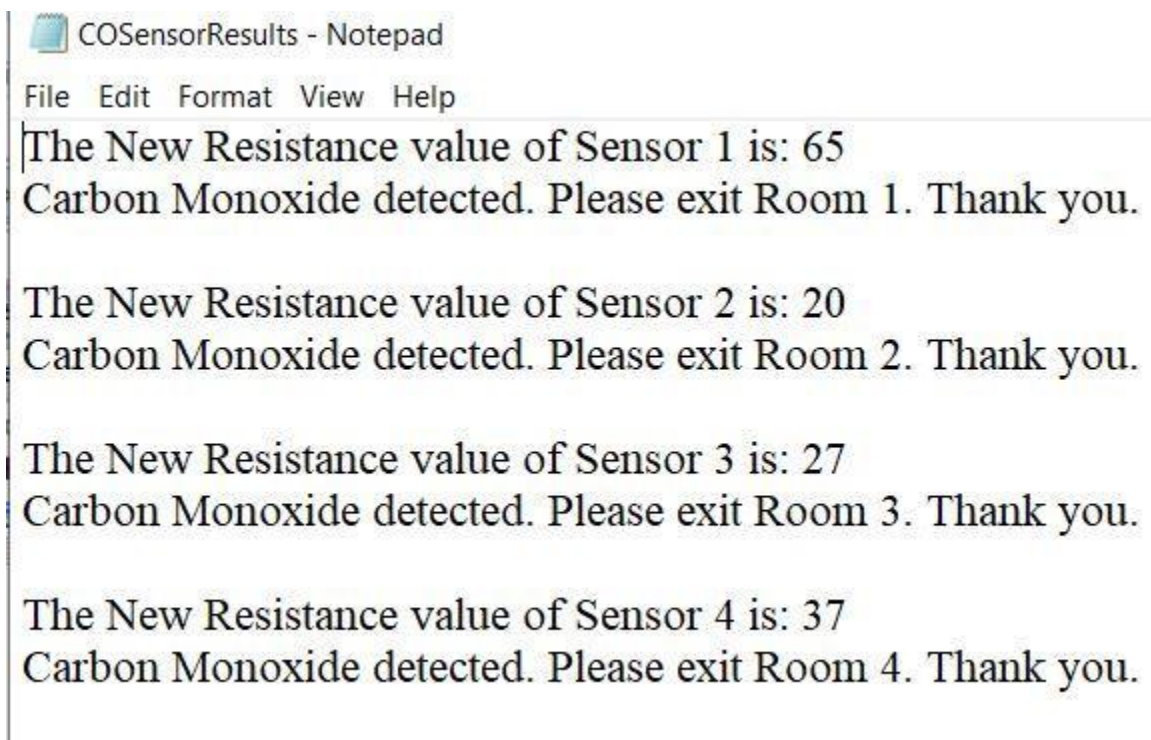
$50 < \text{Disturbance} < 100$. These are chosen because 100 is the level that is needed to break glass and 50 is the average conversation decibel value. So, if there is any noise level within the average conversation level to the window breaking level then a beep will generate and a signal sent to represent a “warning”. The last conditional statement is when the newly generated disturbance level is less than or equal to 50 decibels. These values are considered “low level alerts” and will not trigger the alarm.

The last set of coding that I built for this project is surrounded by the act of one of the three external doors being impacted and that sound setting off an alarm. The only difference between the window sound sensors and these sensors are the decibel values being used to represent the various noises that I am using to represent the “break ins”. Once again, the random number generator is used once again. Mainly because I feel like, in this case, it works great at comparing the “break in” sound decibels to non-threatening decibel values and using different parameters to represent these actions. According to one article, “85 - 100 decibels: For example, a hair dryer, blender, power lawn mower, forklift, or subway train” and “100 - 120 decibels: For example, a bull dozer, impact wrench, or motorcycle”. With these given values I set my upper parameter to 121 decibel values. This was used to generate random values between 0 and 120 decibels which will provide non-threatening decibel values and threatening decibel values. The for loop will run three times so that three random decibel values are generated for the conditional statements.

The first if statement is set to activate if values greater than or equal to 85 and also less than or equal to 120. If this if statement is activated the alarm will be set to on and an output will be written to an output file. A signal to the board will be triggered in this case. The other statement is meant to trigger if the generated disturbance level is less than or equal to 85 and less than/equal to 40. This is meant to represent noises that are non threatening when it comes to the door, but still require notification of the authorities just in case a break in was attempted. The third case is a representation of disturbances less than or equal to 35 decibels. This will produce a low level type of detection and will produce a warning. It will not however, notify the police.

This program runs all these cases at the same time and outputs each sensor value and the responses associated with them in three different output .txt files. These three files are for the window sensor, the door sensor, and the carbon monoxide sensor. Below are the text files that resulted from the running of the program.

1. COSensorResults



```
COSensorResults - Notepad
File Edit Format View Help
The New Resistance value of Sensor 1 is: 65
Carbon Monoxide detected. Please exit Room 1. Thank you.

The New Resistance value of Sensor 2 is: 20
Carbon Monoxide detected. Please exit Room 2. Thank you.

The New Resistance value of Sensor 3 is: 27
Carbon Monoxide detected. Please exit Room 3. Thank you.

The New Resistance value of Sensor 4 is: 37
Carbon Monoxide detected. Please exit Room 4. Thank you.
```

2. DoorSensorResults

ExternalDoorSensor - Notepad

File Edit Format View Help

Disturbance has been detected at door 1. Decibal Value : 99
Type: high level
Alarm on. Get to Safety. Police are on their way.

Disturbance has been detected at door 2. Decibal Value : 17
Type: low level
Warning. Non-threatning. Please Check door 2

Disturbance has been detected at door 3. Decibal Value : 73
Type: Mid level
Alarm on. Notifying Police

3. Window Sensor Results

WindowDisturbance - Notepad

File Edit Format View Help

A disturbance has been detected at window 1. Decibal value : 130
Type: High level
Alarm armed. Please get to safety, the police are on their way

A disturbance has been detected at window 2. Decibal value : 79
Type: Mid level
Alarm armed. Please get to safety, the police are on their way

A disturbance has been detected at window 3. Decibal value : 28
Type: Low level
Alarm not set.

A disturbance has been detected at window 4. Decibal value : 7
Type: Low level
Alarm not set.

A disturbance has been detected at window 5. Decibal value : 19
Type: Low level
Alarm not set.

A disturbance has been detected at window 6. Decibal value : 132
Type: High level
Alarm armed. Please get to safety, the police are on their way

A disturbance has been detected at window 7. Decibal value : 80
Type: Mid level
Alarm armed. Please get to safety, the police are on their way

A disturbance has been detected at window 8. Decibal value : 28
Type: Low level
Alarm not set.

```

#include <iostream>
#include <cstdlib>
#include <ctime>
#include <fstream>
#include <cstdio>
using namespace std;

int main()
{
    //-----//
    //Carbon Monoxide Sensor//

    ofstream COSensor;
    COSensor.open("COSensorResults.txt");
    srand(time(0));
    int R = 71;
    int IR = 70;

    for (int Room = 1; Room < 5; Room++)
    {
        int NR = rand()%R;
        COSensor <<"The New Resistance value of Sensor "<< Room << " is: "<< NR <<endl;
        if(NR < IR)
        {
            COSensor << "Carbon Monoxide detected. Please exit Room "<< Room << ". Thank you."<<endl;
            COSensor<<endl;
        }
        else if (NR = IR)
        {
            COSensor <<"No Carbon Monoxide detected in Room "<<Room<< ". Thank you.";
            COSensor<<endl;
        }
    }

    //-----//
    //Window Disturbance Alarm//

    ofstream WindowDisturbance;
    WindowDisturbance.open("WindowDisturbance.txt");
    srand(time(0));
    int Sound = 141;

    for (int Window =1; Window <9; Window++)
    {
        int Disturbance = rand()%Sound;
        WindowDisturbance<<"A disturbance has been detected at window "<< Window<< ". Decibal value : "<< Disturbance <<endl;

        if(Disturbance >= 100)
        {
            WindowDisturbance<<"Type: High level"<<endl;
            WindowDisturbance<<"Alarm armed. Please get to safety, the police are on their way"<<endl;
            WindowDisturbance<<endl;
        }
        else if((Disturbance > 50) && (Disturbance <100))
        {
            WindowDisturbance<<"Type: Mid level"<<endl;
            WindowDisturbance<<"Alarm armed. Please get to safety, the police are on their way"<<endl;
            WindowDisturbance<<endl;
        }
        else if(Disturbance <= 50)
        {
            WindowDisturbance<<"Type: Low level"<<endl;
            WindowDisturbance<<"Alarm not set."<<endl;
            WindowDisturbance<<endl;
        }
    }
}

```

```

//External Door Alarm//

ofstream ExternalDoorSensor;
ExternalDoorSensor.open("ExternalDoorSensor.txt");
srand(time(0));
int Sound2 = 121;

for (int Door =1; Door<4; Door++)
{
    int Disturbance2 = rand()%Sound2;
    ExternalDoorSensor<<"Disturbance has been detected at door "<<Door<<" . Decibal Value : "<<Disturbance2<<endl;

    if((Disturbance2 >= 85) && (Disturbance2 <=120))
    {
        ExternalDoorSensor<<"Type: high level "<<endl;
        ExternalDoorSensor<<"Alarm on. Get to Safety. Police are on their way."<<endl;
        ExternalDoorSensor<<endl;
    }
    else if ((Disturbance2 <= 85) && (Disturbance2 >= 40))
    {
        ExternalDoorSensor<<"Type: Mid level "<<endl;
        ExternalDoorSensor<<"Alarm on. Notifying Police"<<endl;
        ExternalDoorSensor<<endl;
    }
    else if (Disturbance2 <= 35)
    {
        ExternalDoorSensor<<"Type: low level "<<endl;
        ExternalDoorSensor<<"Warning. Non-threatening. Please Check door "<<Door<<endl;
        ExternalDoorSensor<<endl;
    }
}
//-----//

```