IoT Enabled Occupancy Based Lab Automation Controller
EDL-Final Report

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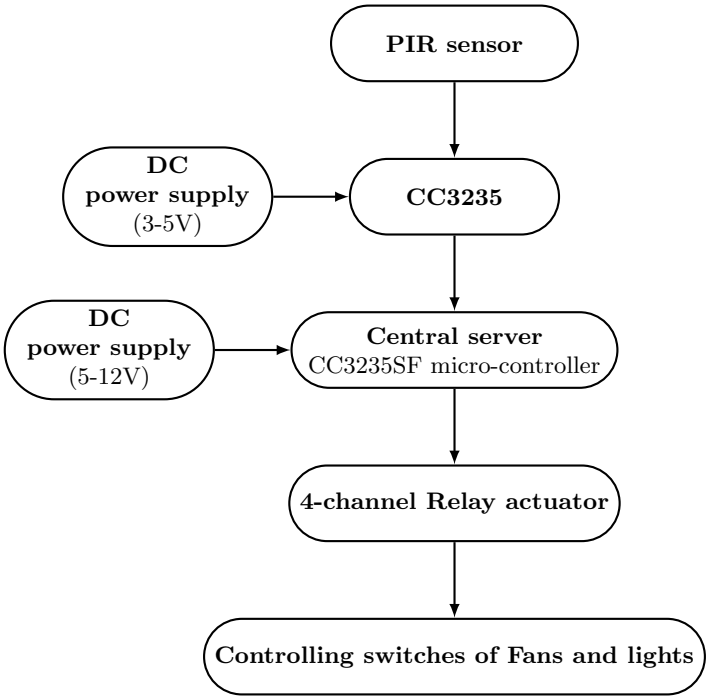
1 Block Diagram



2 Schematic

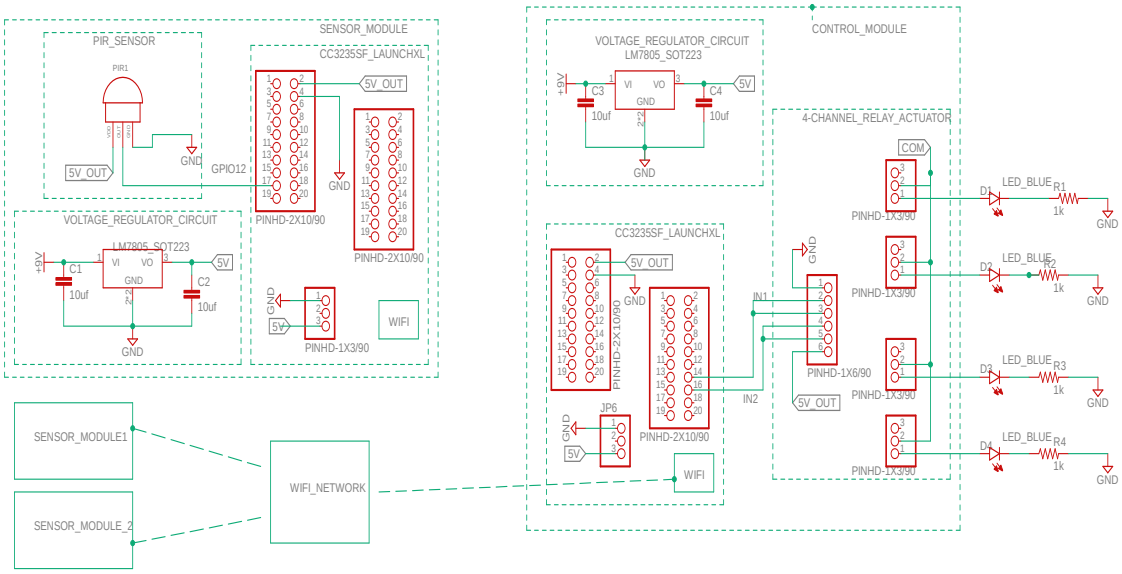


Figure 1: Circuit Schematic

3 Bill Of Materials

S.No	Component	Quantity	Unit price
1.	PIR Sensor	1	Rs.1600
2.	CC3235SF board	2	Rs.5000
3.	4-channel Relay Actuator	1	Rs.320
4.	9V battery	2	Rs.50
5.	LM7805 IC	2	Rs.70

Every component is issued from lab which are already available. We have ordered 4-channel Relay actuator.
https://amzn.eu/d/hzH4Zyq

4 Work Done till now

4.1 Sensor Module

We are done with the working of the sensor module. We designed a circuit that controls LED using the output of the PIR sensor which is digital that is interfaced with the CC3235SF LaunchPad as shown in the above schematic. Below is the code snippet followed to read sensor output values from an analog pin and control the GPIO interrupt using threshold value.

CODE:

```
    void *threadFxn1(void *arg0)
{
    uint16_t     i;
    ADC_Handle   adc;
    ADC_Params   params;
    int_fast16_t res;
    ADC_Params_init(&params);
    adc = ADC_open(CONFIG_ADC_1, &params);
```

```
if (adc == NULL) {
    Display_printf(display, 0, 0, "Error initializing CONFIG_ADC_1\n");
    while (1);}
while(1){

for (i = 0; i < ADC_SAMPLE_COUNT; i++) {
    res = ADC_convert(adc, &adcValue1[i]);

    if (res == ADC_STATUS_SUCCESS) {

        Display_printf(display, 0, 0, "CONFIG_ADC_1 raw result (%d): %d\n", i,
                       adcValue1[i]);

        if (adcValue1[i] > 1500) {
                                        GPIO_write(LED_PIN, 1); // Turn the LED on
                                    } else {
                                        GPIO_write(LED_PIN, 0); // Turn the LED off
                                    }
    }
    else {
        Display_printf(display, 0, 0, "CONFIG_ADC_1 convert failed (%d)\n", i);
    }
    Task_sleep(3000);}
}

ADC_close(adc);

return (NULL);}
```

4.2 Control Module

The idea was to use a main control board as the access point for a small low power IOT network and connect the second node board to this network that is established by the control board. We then wanted to transfer the data from the sensor to the control board using this setup.
There are several ways we can establish a connection between the nodes and the main server (MQTT, CoAP, etc.) but we have chosen HTTP because it is easier to set up and the CC3235S board does not support CoAP. We could have used MQTT protocol but that needs an extra board for setting up the MQTT broker which is not feasible for this project.
The following is the sample code for setting up the central server:

```
#include <ti/net/http/httpserver.h>

/* Define HTTP server port */
#define HTTP_PORT 80

void main(void) {
    /* Initialize the network stack */
    SlNetIf_init(0);

    /* Create the HTTP server */
    int server_handle = httpServerStart(HTTP_PORT);

    /* Listen for incoming requests */
    while (1) {
        /* Accept incoming connections */
        int client_handle = httpServerAccept(server_handle);

        /* Handle the incoming request */
        httpServerProcessRequest(client_handle);

        /* Close the connection */
        httpServerResponse(client_handle, "", 0);
        httpServerDisconnect(client_handle);
    }
}
```

5 Results

Demo link : `https://drive.google.com/file/d/1fsqRsvz6beMYZnehVjeVd7WlCRmUw7ak/view?usp=drivesdk`

5.1 Sensor Output values

We are giving a output to led from the GPIO pin (PIN 05). As we can see there is human presence continuously the LED will be glown as the GPIO has only high logic value. The output value of sensor is 4.65 volts when it is detecting motion of human and approxinately 450-900mV when there is no human presence. PIR sensor is too sensitive so we are unable to record when the LED is off in hardware setup. But we noted values in the terminal and we observed it's giving an output of around 1V. The result in the terminal is in milli Volts.

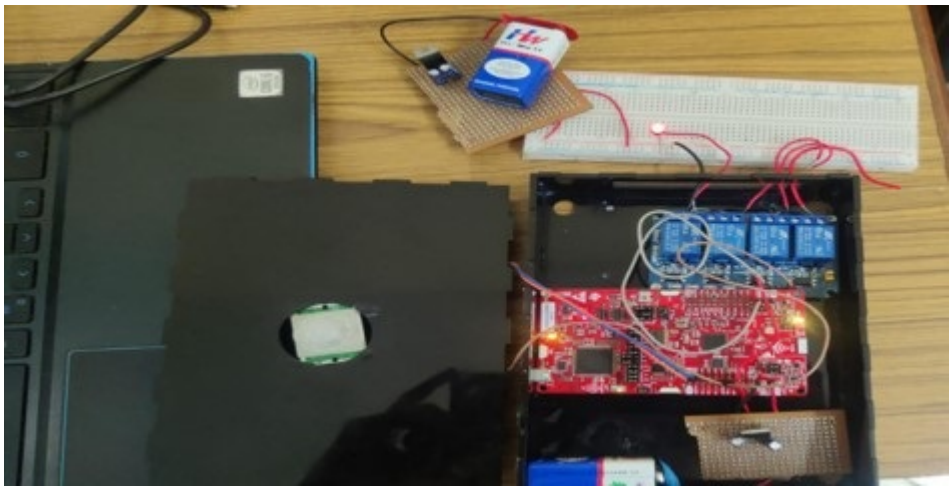


Figure 2: Hardware Sensor LED Output

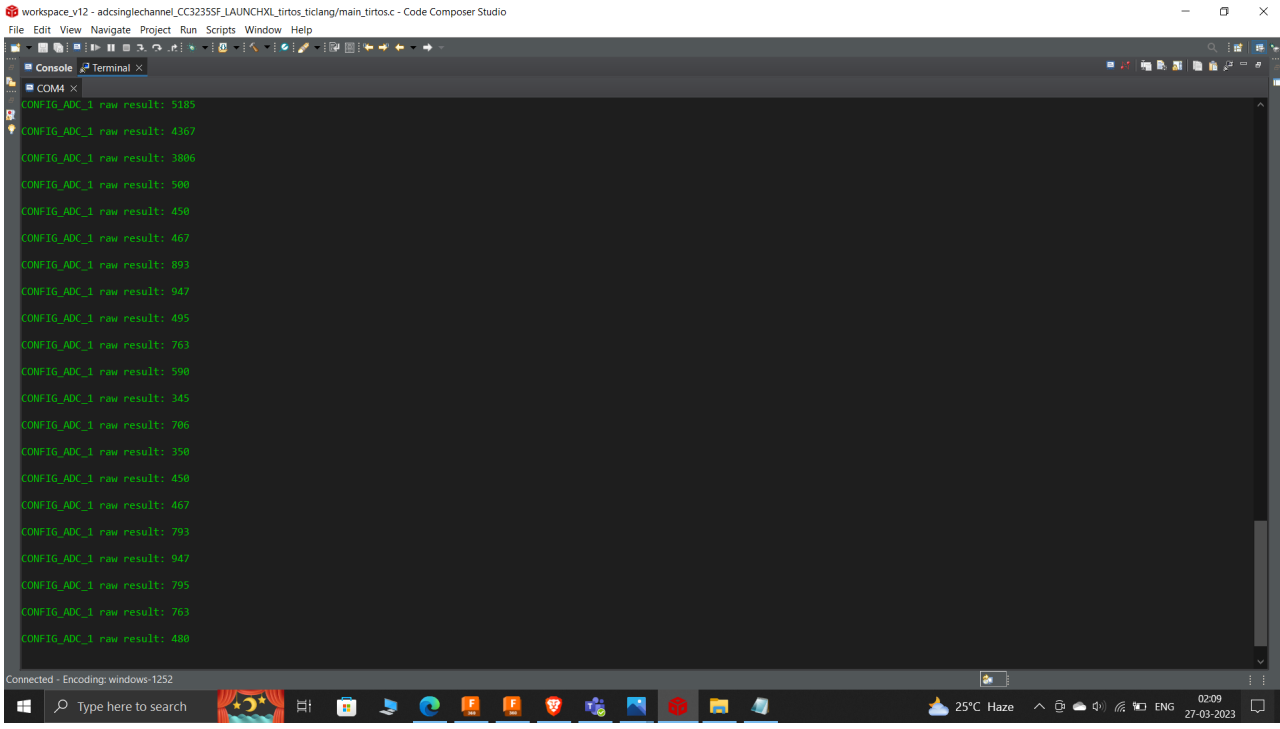


Figure 3: Sensor Readings: No person detected

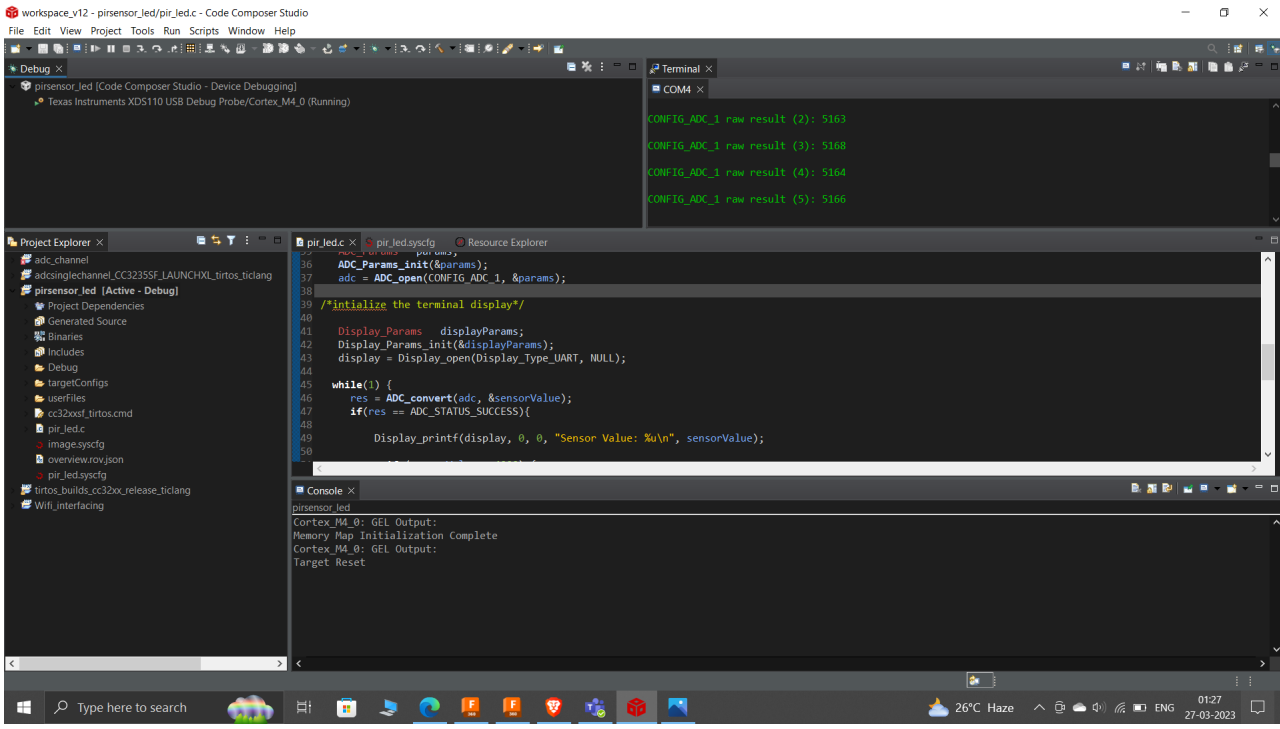


Figure 4: Sensor Readings: person detected

6 Observations

- The output value of the PIR sensor varies from 500mV to 5200mV. There is some offset while reading values from the analog pin of the CC3235SF microcontroller board
- Sensor Readings:
  When no person is present in the detection range of the sensor: 450-900 mV
  When a person is present in the detection range of the sensor around 10ft: 4000-5200mV
- We were unable to achieve the between values even the distance is varied below 10ft as our PIR sensor is highly sensitive
- From the sensor readings obtained we decide the threshold value for the GPIO pin as 1500mV such that if the value is greater than 1500mV the GPIO interrupt will be high and the LED turns on (person is present in Room)

7 Conclusion

The successful completion of an IoT-based home automation project brings a plethora of benefits to homeowners. The project enables remote control and monitoring of devices and appliances, leading to increased convenience, improved energy efficiency, enhanced security, and a more comfortable living experience. Through the project, we have learned the importance of careful planning, selection of appropriate sensors and actuators, programming of the microcontrollers, and effective communication protocols between the devices. The implementation of the project has also honed our skills in designing and developing complex systems. Overall, the completion of the IoT-based home automation project is a significant milestone in our journey towards building smarter, more efficient, and more comfortable homes.

8 Future work

- We have successfully implemented the sensor module and calibrated the readings so as to accurately detect the presence of a person.
- Next, Our goal is to implement the wifi part of the project.
- A HTTP connection needs to be established between the node and the central servers.
- The central server has been coded up and it is able to act as a wifi access point.
- The node server needs to be configured so that it can interact with the central server and transmit the sensor information.