"Course: Microprocessor Design II and Embedded Systems"

"Course # EECE.5520"

"Title - Multithreaded Programming"

"Instructor - Yan Luo"

"Group number - 12"

"Student Name: Aravind Dhulipalla"

"Hand in Date – 12/21/2017"

"Lab Due Date – 12/21/2017"

Section 2 : Contributions */1 points*

1. Group Member 1 – Aravind Dhulipalla

    - Worked on configuring an i²C communication between the intel Galileo and Gesture sensor APDS-9960, HTTP protocol, and multithreaded programming.

    - Worked on chip hardware circuit i.e, making connections between the Galileo board, pic micro controller, gesture sensor, temperature sensor.

2. Group Member 2 – Zubair Nadaph

    - Worked on configuring the camera to capture picture on Galileo using OpenCV. Debugging the codes, HTTP protocol and multithreaded programming.

    - Worked on chip hardware circuit i.e, making connections between the Galileo board, pic micro controller, gesture sensor, temperature sensor.

3. Group Member 3 – Dushyanth Kadari

    - Worked on configuring the I2C communication between the intel Galileo Gen2 and Temperature sensor TMP102. Debugging the codes

    - Worked on chip hardware circuit i.e, making connections between the Galileo board, pic micro controller, gesture sensor, temperature sensor.

Section 3: Purpose */0.5 points*

The main purpose of this lab is to understand the multithreading programing using Pthreads. Synchronization of those threads using Mutex. Understanding usage of curl library, HTTP protocol using a client and server application. Understanding of image processing using OpenCV library.

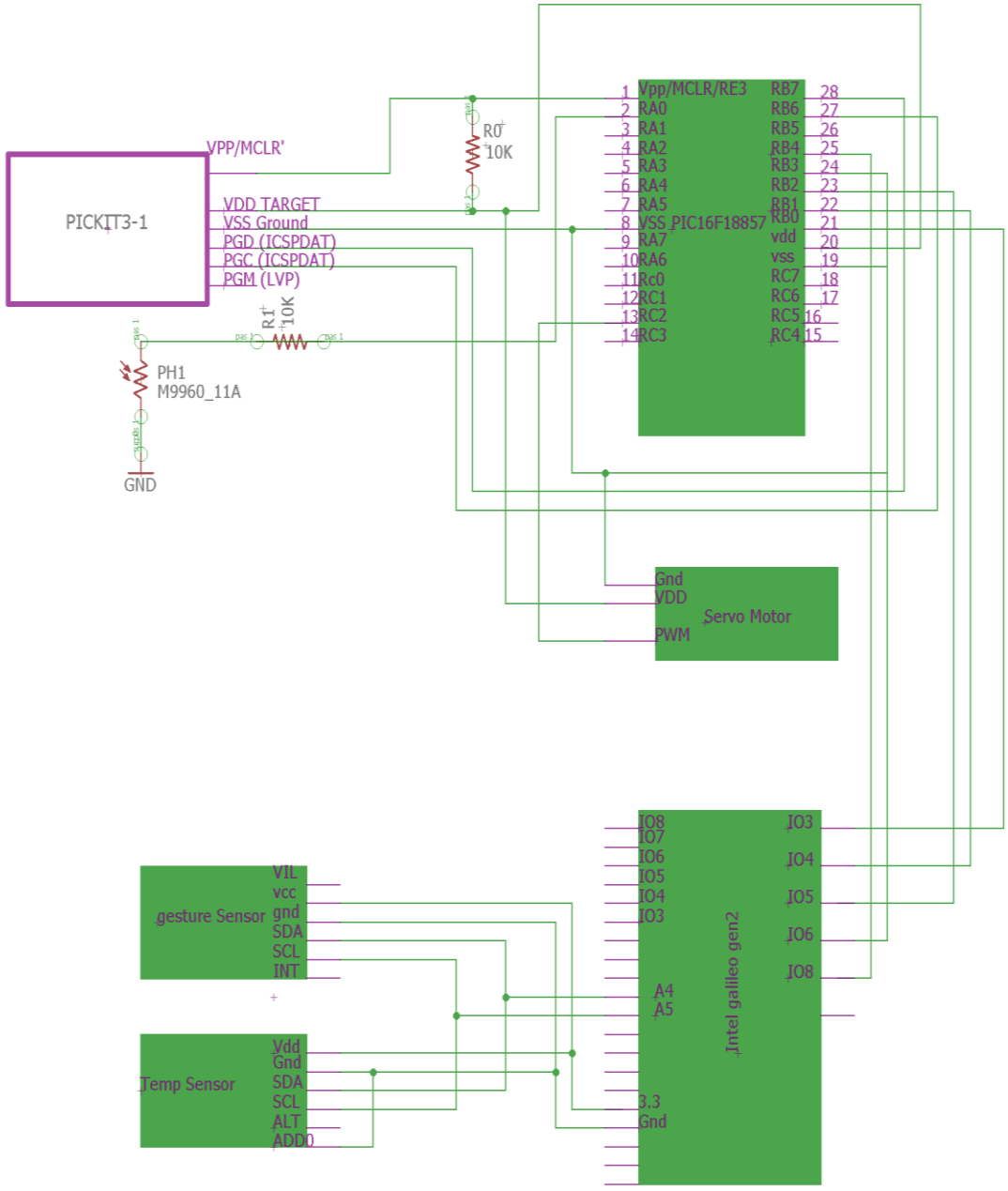
Section 4: Introduction /0.5 points

The main objective of this lab is to read the sensor data from a I2C devices Gesture sensor(APDS-9960) and Temperature sensor (TMP102). To read the sensor data (Photo resistor ADC value) from microcontroller PIC16F18857 through strobe communication. Trigger the camera to capture a picture when the required threshold value of the sensor data is reached. Processes the captured image for facial recognition using OpenCV library. And then transfer those images and sensor data to server through HTTP protocol using curl library. Make all these actions concurrent using threads using POSIX thread library.

Section 5: Materials, Devices and Instruments /0.5 points

- Bread board
- Wires to connect
- Temperature sensor TMP102
- Gesture sensor APDS-9960
- Serial to USB connector
- Multi-meter
- Voltage supply (3.3V) from Galileo and 5V for servo motor through FTDI
- Intel Galileo Gen 2 Board
- Yocto Linux
- Putty Software
- PIC16F18857 microcontroller
- Resistors 2 (10K ohms)
- Servo Motor
- LDR
- Oscilloscope
- WinSCP to get the image

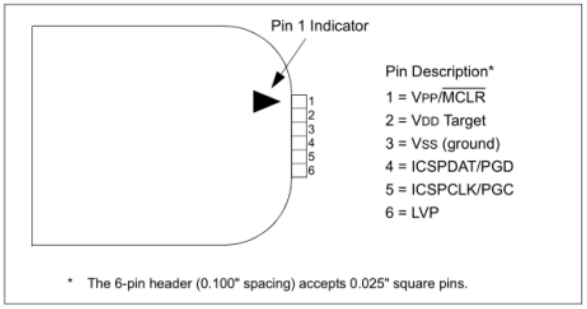
Section 6: Schematics /0.5 points



Hardware design:

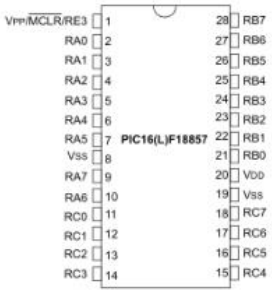
- PIC Microcontroller: Initially Pickit3 is connected to the microcontroller. If you observe the pin diagram of both Pickit 3 on top and PIC. Both MCLR, Vdd, Vss, ICSPDAT/PGD, ICSPCLK/PGC are connected to each other. ICSPDAT is pin 27 and ICSPCLK is pin 28 for the PIC. The MCLR is connected to Vdd through 10K ohm resistor. The sensor is connected through ADC Channel 2(Pin 4). And LED is connected to the pin PB0 (Pin21). A 220-ohm resistor is connected in series to the LED, for protection. Pin RB2 is connected to strobe(GPIO8) of Galileo. RC0, RC1, RC2 & RC3 pins are connected to the GPIO3,4,5,6 pins of Intel Galileo.

FIGURE 1-2: PICKIT™ 3 PROGRAMMER CONNECTOR PINOUT



PIN DIAGRAMS

28-pin SPDIP, SOIC, SSOP



Note 1: See Table 2 for location of all peripheral functions.
2: All VDD and all VSS pins must be connected at the circuit board level. Allowing one or more VSS or VDD pins to float may result in degraded electrical performance or non-functionality.

- **I2C devices and camera:** Galileo is connected to a laptop using serial to USB connector. It is powered from the adaptor cable. I2C bus is designed on the bread board by connecting SCL, SDA pins from the Galileo board and the sensors as shown in the schematic. Those lines are made active high by connected to VCC through 5k Ohm resistors. On Galileo SCL is A5 and SDA is A4. The VCC (3.3) and ground to two sensors is supplied from the Galileo. In this I2C protocol communication Galileo is the master and the two sensors are slaves. The slave address of Gesture sensor APDS-9960 is 0x39 and Temperature sensor TMP102 is 0x48 (by connecting ADD0 to ground selects default address). After the connection, by typing "i2cdetect -r 0" shows all the I2C devices connected to the Galileo as shown in the below picture. Camera is connected to the Galileo board through the USB cable.

```
root@galileo:~#
root@galileo:~#
root@galileo:~# i2cdetect -r 0
WARNING! This program can confuse your I2C bus, cause data loss and worse!
I will probe file /dev/i2c-0 using read byte commands.
I will probe address range 0x03-0x77.
Continue? [Y/n] y
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:          -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- UU UU UU -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- 39 -- -- -- -- -- --
40: -- -- -- -- -- -- -- UU 48 -- -- -- -- -- -- --
50: -- -- -- -- UU UU UU UU -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: 70 -- -- -- -- -- -- --
root@galileo:~#
```

Wi-Fi connectivity: It is configured using connmanctl software, after plugging-in the Wi-Fi card to intel Galileo. Use commands from Yacto linux *connmanctl scan wifi* to scan the Wi-Fi networks, *connmanctl servies* to view the Wi-Fi networks and *connmanctl connect* $Wi-Fi-id to connect to the selected Wi-Fi network.

Software design:

Modules used in PIC:
ADC, PWM, Timer 2 configured accordingly with reference to the data sheet.

Galileo GPIO's:
Gpio's are initialized by exporting and unexport them when we are done using them.

Thread1:
It performs the following tasks:

1. A set of options to configure the sensors are created for user, it takes the value from user.
2. Performs the actions mentioned in the options
3. Sets flags like update and capture if user selects the option for gesture.

Thread2:
It performs the following tasks:

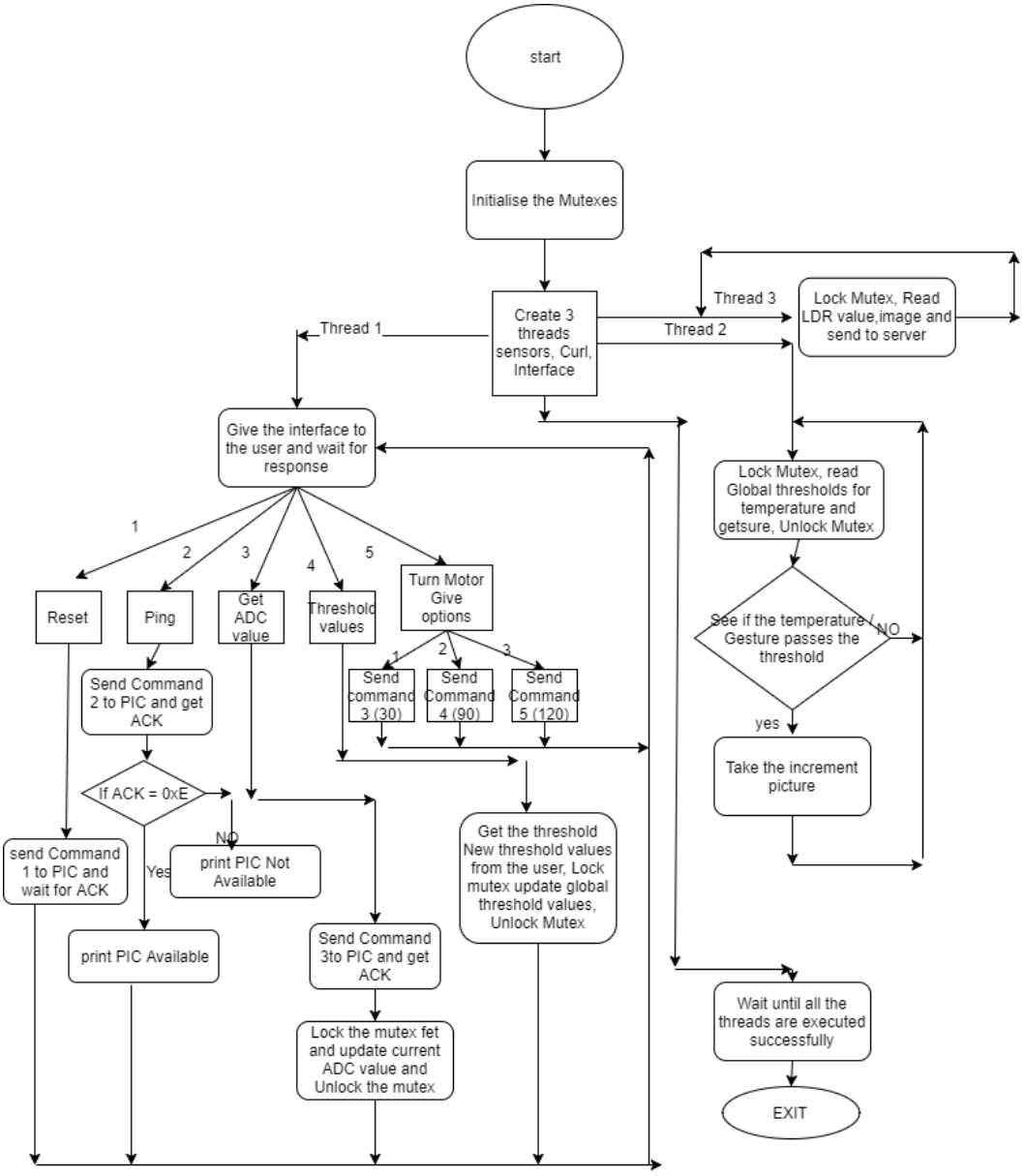
1. Sets up the apds 9960 geture sensor and programs the bits of enable register.
2. Reading the registers form sensor to get relevant data
3. Checks for gesture and takes picture if beyond threshold.

Thread3:
It performs the following tasks:

1. If the capture flag is set high then enters into it
2. Takes the username/id, ip address, status, adc values, time-date and image and uploads on server.

Mutexes are used whenever we are sharing a data between two threads. The global variables are protected so that no two threads are accessing this variable at the same time. By this the other threads will be able to see if there is any update that is done by any of the threads.

Flow Chart :



Section 8 : Trouble Shooting */1 points*

In the first, the response from both the sensors will be responsible for the taking of pictures so, it would be difficult to decide which is responsible. To solve this temperature sensor threshold values are set to high value and can meet it only at certain special conditions and it can also be changed if necessary.

Second Issue was limited availability of the Server most of the time the server was not available almost all the time when we are working. We used that python script which you gave us, and it took us almost 2 hours to figure and run that script.

Third Issue was the HTTP post used by CURL library. We had to figure out that we have to use HTTP Get request instead of Post. It would be good if you had given us the HTTP Get request in the sample code for CURL Library.

Section 9 : Results */1 points*

As you can see below the PIC data and no image is sent. Our group is 12. PIC value is 512.

Group ID	Student Name	PIC ADC Value	PIC Status	Last Update	Image File Name
11	Ehsan_Qiyassi	257	ALIVE	2017-12-13_18:22:57	no_picture_taken_yet
10	Kyle	734	Online	2017-12-17_19:11:49	No face detected
12	Zuber_arvind	512	Alive	2017/12/21_16:30:51	imag8.jpg
15	Matt	0	Offline	2017-12-20_10:15:39	pic0.jpg
3	group3	10	ONLINE	2017/12/18_23:53:25	no_image
2	Aman_and_Gian	595	ONLINE	2017/12/13_23:00:17	
4	Advait_Chetan_Shubham	410	Alive	2017/12/21_03:32:14	image1.jpg

The Image is only taken when there is a UP gesture or the temperature is more than 25^0 C.

Section 10: Appendix

Code:

```
/*By

Aravind Dhulipalla, Zubair Nadaph,
Dushyanth Kadari
for Lab assignment 4,EECE.
Microprocessors Systems II and
Embedded Systems
UMASS LOWELL
*/
#include <pthread.h>
#include <stdio.h>
#include <stdlib.h>
#include <stdbool.h>
#include <curl/curl.h>
#include <sys/stat.h>
#include <time.h>
#include "opencv2/opencv.hpp"
#include <iostream>
#include <cstdio>
#include <fcntl.h>
#include <unistd.h>
#include <sys/ioctl.h>
#include <linux/i2c-dev.h>

        #define UP 1
        #define DOWN 2
        #define LEFT 3
        #define RIGHT 4
        #define ACK 0xF
        using namespace cv;
        using namespace std;

        pthread_mutex_t mutex,mutex2;

        int ldrvalue;
        int update;
        static int capture=0;
        char buffer[100];

useconds_t delay = 2000;
                char *dev = "/dev/i2c-0";
                int  fd = open(dev, O_RDWR );

/*-----------------------------------------------
----------------------
APDS9960_write()
writes the commands to i2-c devices
-----------------------------------------------
--------------------*/

bool APDS9960_write(unsigned char
address,unsigned char command)
        {
                unsigned char
command1[2] = {address,command};
                int r =
write(fd,&command1,2);
                if(r<0)
                {
                        printf("error
wrinting to address: %d",address);
                        return false;
                }
                else
                return true;
        }

void Imagecapture()
        {
        VideoCapture cap(0); // open
the video camera no. 0

                if (!cap.isOpened())  // if
not success, exit program
                {
                        cout << "ERROR:
Cannot open the video file" << endl;

                }
```

```
        double dWidth =
cap.get(CV_CAP_PROP_FRAME_WID
TH); //get the width of frames of the
video
        double dHeight =
cap.get(CV_CAP_PROP_FRAME_HEI
GHT); //get the height of frames of the
video
        cout << "Frame Size = " <<
dWidth << "x" << dHeight << endl;
        vector<int>
compression_params; //vector that
stores the compression parameters of
the image

compression_params.push_back(CV_I
MWRITE_JPEG_QUALITY);
//specify the compression technique

compression_params.push_back(95);
//specify the jpeg quality
        Mat img(dWidth, dHeight,
CV_8UC1);
        cap.read(img);
        static int i =0;

snprintf(buffer,100,"Img%d.jpg",i);
       i++;
        bool bSuccess =
imwrite(buffer, img,
compression_params); //write the
image to file
        if ( !bSuccess )
        {
                cout << "ERROR :
Failed to save the image" << endl;
        }
      }
/*-----------------------------------------------
----------------------
Read_gesture()
reads the gesture value from the
APDS9960 and sense the gesture value
and returns
the gesture value.
-----------------------------------------------
----------------------*/
unsigned char read_gesture()
      {
            unsigned char GF4 =
0xAB;
            unsigned char  STATUS
= 0x93;
            unsigned char GFLVL =
0xAE;
            unsigned char GSTATUS
= 0xAF;
        unsigned char GUP = 0xFC;
            unsigned char GDOWN =
0xFD;
            unsigned char  GLEFT =
0xFE;
        unsigned char GRIGHT =
0xFF;
            unsigned char
GF4_V,STATUS_V,GFLVL_V,GSTAT
US_V;
            unsigned char
GUP_V[32] , GDOWN_V[32],
GLEFT_V[32] ,GRIGHT_V[32] ;
            unsigned char
valid_up[1],valid_down[1],valid_left[1]
,valid_right[1];
            while(1)
            {
                  write(fd,&GF4,1);
                  usleep(delay);

      read(fd,&GF4_V,1);
                  //printf("Status :
%d\n",GF4_V);

      write(fd,&STATUS,1);
                  usleep(delay);

      read(fd,&STATUS_V,1);
                  //printf("Status :
%d\n",STATUS_V);
```

```
write(fd,&GSTATUS,1);
                usleep(delay);

read(fd,&GSTATUS_V,1);
                //printf("GSTATUS:
%d\n",GSTATUS_V);
                unsigned char x =
GSTATUS_V & 0x01;
                //printf("x =
%d",x);
                unsigned char y =
STATUS_V & 0x02;
                //printf("y =
%d",y);
                if(((GSTATUS_V &
0x01) ==1) && ((STATUS_V & 0x04)
== 4 ))
                {

        if(!APDS9960_write(0xAB,0x03)
)
                        {
                                return
false;
                        }
                        sleep(1);

        //printf("valid\n");

        write(fd,&GFLVL,1);

        usleep(delay);

        read(fd,&GFLVL_V,1);

        //printf("GFLVL:
%d\n",GFLVL_V);
                        for(int
i=0;i<=GFLVL_V-1;i++) // for reading
the 32 datasets
                        {

        sleep(0.7);

        write(fd,&GUP,1);

        usleep(delay);

        read(fd,&GUP_V[i],1);

        //printf("GUP:
%d\n",GUP_V[i]);

        write(fd,&GDOWN,1);

        usleep(delay);

        read(fd,&GDOWN_V[i],1);

        //printf("GDOWN:
%d\n",GDOWN_V[i]);

        write(fd,&GLEFT,1);

        usleep(delay);

        read(fd,&GLEFT_V[i],1);

        //printf("GLEFT:
%d\n",GLEFT_V[i]);

        write(fd,&GRIGHT,1);

        usleep(delay);

        read(fd,&GRIGHT_V[i],1);

        //printf("GRIGHT:
%d\n",GRIGHT_V[i]);
                        }

        if(!APDS9960_write(0xAB,0x00)
)
                        {
                                return
false;
                        }
```

```
        valid_up[1]={0};

        valid_down[1] = {0};
                                valid_left[1]
= {0};

        valid_right[1] = {0};
                                for(int
j=0;j<GFLVL_V-1;j++)
                                {

        if(GUP_V[j] >50){valid_up[0] =
GUP_V[j];}

        if(GDOWN_V[j]
>50){valid_down[0] = GDOWN_V[j];}

        if(GLEFT_V[j] >50){valid_left[0]
= GLEFT_V[j];}

        if(GRIGHT_V[j]
>50){valid_right[0] = GRIGHT_V[j];}

                                }


        if((valid_up[0] ==
valid_down[0]) && (valid_left[0] ==
valid_right[0]) && (valid_down[0] ==
valid_left[0]))
                                {cout <<
"Give a Gesture please"<<endl;}

        if((valid_down[0] < valid_up[0])
&& (valid_left[0] > valid_right[0]))
                                {
                                        cout
<< "UP GESTURE DETECTED" <<
endl;
                                        return
UP;
                                }

        if((valid_down[0] > valid_up[0])
&& (valid_left[0] > valid_right[0]))
                                {
                                        cout
<< "Down GESTURE DETECTED" <<
endl;
                                        return
DOWN;
                                }

        if((valid_down[0] > valid_up[0])
&& (valid_left[0] < valid_right[0]))
                                {
                                        cout
<< "Left GESTURE DETECTED" <<
endl;
                                        return
LEFT;
                                }

        if((valid_down[0] < valid_up[0])
&& (valid_left[0] < valid_right[0]))
                                {
                                        cout
<< "Right GESTURE DETECTED" <<
endl;
                                        return
RIGHT;
                                }
                                else
                                {
                                        cout
<< "Wrong GESTURE DETECTED
Please Try again" << endl;
                                        break;
                                }
                        }
                        else
                        {
                                / / printf("not
valid");

write(fd,&GFLVL,1);
```

```
                        usleep(delay);

read(fd,&GFLVL_V,1);
                        printf("GFLVL:
%d\n",GFLVL_V);
                        for(int
i=1;i<=GFLVL_V;i++)
                        {

        write(fd,&GUP,1);

        usleep(delay);

        read(fd,&GUP_V[i],1);

        write(fd,&GDOWN,1);

        usleep(delay);

        read(fd,&GDOWN_V[i],1);

        write(fd,&GLEFT,1);

        usleep(delay);

        read(fd,&GLEFT_V[i],1);

        write(fd,&GRIGHT,1);

        usleep(delay);

        read(fd,&GRIGHT_V[i],1);
                        }

        if(!APDS9960_write(0xAB,0x00)
)
                        {
                                return false;
                        }
                }
                }
                return 0;
        }
/*-----------------------------------------
Gesture Enable function
Enables the Gesture sensor required
register values
-----------------------------------------*/
bool gesture_enable()
        {

        if(!APDS9960_write(0xA1,0x00))
                {
                        return false;
                }
                //Config1

        if(!APDS9960_write(0xA2,0x00))
                {
                        return false;
                }
                //Config2

        if(!APDS9960_write(0xA3,0x41))
                {
                        return false;
                }
                //Up Offstet Register

        if(!APDS9960_write(0xA4,0x00))
                {
                        return false;
                }
                //Down offset register

        if(!APDS9960_write(0xA5,0x00))
                {
                        return false;
                }
                //Left offset register

        if(!APDS9960_write(0xA7,0x00))
                {
                        return false;
                }
                //right offset register

        if(!APDS9960_write(0xA9,0x00))
```

```
                {
                        return false;
                }
                //Pulse count length

        if(!APDS9960_write(0xA6,0x47))
                {
                        return false;
                }
                //cofig3

        if(!APDS9960_write(0xAA,0x03)
)
                {
                        return false;
                }
                //config 4

        if(!APDS9960_write(0xAB,0x03)
)
                {
                        return false;
                }
                //clear interrupts

        if(!APDS9960_write(0xE7,0x00)
)
                {
                        return false;
                }
                        return true;

        }
/*-----------------------------------------------
-------------
Temperature()
Reads the temperature value from the
sensor and returns the value.
-----------------------------------------------
------------*/
unsigned char Temperature()
        {
                int i;
                int r;
                int fd2;
                float result = 0.0;
                char value[2] ={0} ;
                char addr = 0x48;
                //const char *dev =
"/dev/i2c-0";

        pthread_mutex_lock(&mutex);
                fd = open(dev, O_RDWR
);
                if(fd < 0)
                {
                        perror("Opening
i2c device node\n");
                        return 1;
                }
                r = ioctl(fd, I2C_SLAVE,
addr);
                if(r < 0)
                {
                        perror("Selecting
i2c device\n");
                }
                for(i=0;i<2;i++)
                {
          r = read(fd, &value[i], 1);
          if(r != 1)
          {
             perror("reading i2c
device\n");
          }
          usleep(delay);
                }
                float  tlow =0;
                tlow = (float)(((value[0]
<< 8) | value[1]) >> 4);
                result = 0.0625*(tlow);
       printf("Temperature:
%f\n",result);
       close(fd);

          pthread_mutex_unlock(&mutex)
;
                return result;
```

```
}



void Export()
{
        //export the pin 8 GPIO 40
                system("echo 40 >
/sys/class/gpio/export");
                //export the pin 7 GPIO
38
      system("echo 38 >
/sys/class/gpio/export");
                //export pin 6 GPIO 1
and SHIFTER GPIO 20
                system("echo 1 >
/sys/class/gpio/export");
                system("echo 20 >
/sys/class/gpio/export");
                //export pin 5 GPIO 0
and SHIFTER GPIO 18
                system("echo 0 >
/sys/class/gpio/export");
                system("echo 18 >
/sys/class/gpio/export");
                //export pin 4 GPIO 6
and SHIFTER GPIO 36
                system("echo 6 >
/sys/class/gpio/export");
                system("echo 36 >
/sys/class/gpio/export");
}
void UnExport()
{
        //export the pin 8 GPIO 40
                system("echo 40 >
/sys/class/gpio/unexport");
                //export the pin 7 GPIO
38
      system("echo 38 >
/sys/class/gpio/unexport");
                //export pin 6 GPIO 1
and SHIFTER GPIO 20
                system("echo 1 >
/sys/class/gpio/unexport");
                system("echo 20 >
/sys/class/gpio/unexport");
                //export pin 5 GPIO 0
and SHIFTER GPIO 18
                system("echo 0 >
/sys/class/gpio/unexport");
                system("echo 18 >
/sys/class/gpio/unexport");
                //export pin 4 GPIO 6
and SHIFTER GPIO 36
                system("echo 6 >
/sys/class/gpio/unexport");
                system("echo 36 >
/sys/class/gpio/unexport");
}
void SetGPIO_output()
{
    //setting pin8 as an output
        system("echo out >
/sys/class/gpio/gpio40/direction");
        //Setting pin7 as an output
        system("echo out >
/sys/class/gpio/gpio38/direction");
        //setting pin6 as an output
        system("echo out >
/sys/class/gpio/gpio1/direction");
        system("echo out >
/sys/class/gpio/gpio20/direction");
        //setting pin5 as an output
        system("echo out >
/sys/class/gpio/gpio0/direction");
        system("echo out >
/sys/class/gpio/gpio18/direction");
        //setting pin4 as output
        system("echo out >
/sys/class/gpio/gpio6/direction");
        system("echo out >
/sys/class/gpio/gpio36/direction");
}

void SetGPIO_Input()
{
```

```
        //Setting pin7 as an input
        system("echo in >
/sys/class/gpio/gpio38/direction");
        //setting pin6 as an input
        system("echo in >
/sys/class/gpio/gpio1/direction");
        system("echo in >
/sys/class/gpio/gpio20/direction");
        //setting pin5 as an input
        system("echo in >
/sys/class/gpio/gpio0/direction");
        system("echo in >
/sys/class/gpio/gpio18/direction");
        //setting pin4 as input
        system("echo in >
/sys/class/gpio/gpio6/direction");
        system("echo in >
/sys/class/gpio/gpio36/direction");
}

int StrtoInt(char data)
{
        int value;
        if(data == '0')
                value =0;
        if(data == '1')
                value = 1;

        return value;
}

int read_gpio()
{
        int a;
                FILE *fp;
                system("./gpio_in.sh 6");
      fp = fopen("out.txt","r");
      a = StrtoInt(fgetc(fp));
      fclose(fp);
                system("./gpio_in.sh 0");
                fp = fopen("out.txt","r");
      a = a | (StrtoInt(fgetc(fp)) << 1);
      fclose(fp);
                system("./gpio_in.sh 1");
      fp = fopen("out.txt","r");
      a = a | (StrtoInt(fgetc(fp))<< 2);
      fclose(fp);
                system("./gpio_in.sh 38");
                fp = fopen("out.txt","r");
      a = a | (StrtoInt(fgetc(fp))<<3);
      fclose(fp);

                return a;
}

void *Interface(void *Interfaceid)
{
  int cmd,a,adc,data;

  while(1)
  {
        char a = getchar();
        if(a=='\n')
        {
             printf("Enter pressed");
        pthread_mutex_lock(&mutex);
        update = 1;

pthread_mutex_unlock(&mutex);
        printf("Give any one of the
command \n 1.Reset 2.Ping 3.PIC
LDR VALUE 4.TURN 30 5.TURN 90
6.TURN 120 7.Temperature\n");
     scanf("%d",&cmd);
        //make the strobe high
  switch(cmd)
  {
    case 1:
         Export();
         SetGPIO_output();
          system("echo 1 >
/sys/class/gpio/gpio40/value");
                system("echo 0 >
/sys/class/gpio/gpio6/value");
                system("echo 0 >
/sys/class/gpio/gpio0/value");
                system("echo 0 >
/sys/class/gpio/gpio1/value");
```

```
                system("echo 0 >
/sys/class/gpio/gpio38/value");
                usleep(10000);
                system("echo 0 >
/sys/class/gpio/gpio0/value");
            UnExport();
                Export();
            SetGPIO_Input();
                system("echo 1 >
/sys/class/gpio/gpio40/value");
                a = read_gpio();
                usleep(10000);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
            UnExport();
                if(a!=ACK)
                {
                        printf("pic not
available");
                }
                break;
                case 2:
                Export();
            SetGPIO_output();
                system("echo 1 >
/sys/class/gpio/gpio40/value");
                system("echo 1 >
/sys/class/gpio/gpio6/value");
                system("echo 0 >
/sys/class/gpio/gpio0/value");
                system("echo 0 >
/sys/class/gpio/gpio1/value");
                system("echo 0 >
/sys/class/gpio/gpio38/value");
                usleep(10000);
            system("echo 0 >
/sys/class/gpio/gpio40/value");
                UnExport();
                Export();
            SetGPIO_Input();
                system("echo 1 >
/sys/class/gpio/gpio40/value");
                a=read_gpio();
                usleep(10000);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
            UnExport();
                if(a!=ACK)
                {
                        printf("pic not
available");
                }
                break;
                case 3:
                Export();
            SetGPIO_output();
                system("echo 1 >
/sys/class/gpio/gpio40/value");
                system("echo 0 >
/sys/class/gpio/gpio6/value");
                system("echo 1 >
/sys/class/gpio/gpio0/value");
                system("echo 0 >
/sys/class/gpio/gpio1/value");
                system("echo 0 >
/sys/class/gpio/gpio38/value");
                usleep(10000);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
                UnExport();
                Export();
            SetGPIO_Input();
                system("echo 1 >
/sys/class/gpio/gpio40/value");
                a = read_gpio();
                usleep(10000);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
                if(a==ACK)
                {
                system("echo 1 >
/sys/class/gpio/gpio40/value");
                int data = read_gpio();
                sleep(0.01);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
                system("echo 1 >
/sys/class/gpio/gpio40/value");
```

```
                data = data |
(read_gpio()<<4);
                sleep(0.01);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
                system("echo 1 >
/sys/class/gpio/gpio40/value");
                data = data |
(read_gpio() << 8);
                sleep(0.01);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
                UnExport();

        pthread_mutex_lock(&mutex);
                ldrvalue = data;
                printf("%d\n",data);

        pthread_mutex_unlock(&mutex)
;
                }
                else
                {
                        printf("pic not
found");
                        update = 0;
                }
                break;
                case 4:
                                Export();
            SetGPIO_output();
                system("echo 1 >
/sys/class/gpio/gpio40/value");
                system("echo 1 >
/sys/class/gpio/gpio6/value");
                system("echo 1 >
/sys/class/gpio/gpio0/value");
                system("echo 0 >
/sys/class/gpio/gpio1/value");
                system("echo 0 >
/sys/class/gpio/gpio38/value");
                usleep(10000);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
                UnExport();
                Export();
            SetGPIO_Input();
                system("echo 1 >
/sys/class/gpio/gpio40/value");
                a = read_gpio();
                sleep(0.01);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
            UnExport();
                break;
                case 5:
                                Export();
            SetGPIO_output();
                system("echo 1 >
/sys/class/gpio/gpio40/value");
                system("echo 0 >
/sys/class/gpio/gpio6/value");
                system("echo 0 >
/sys/class/gpio/gpio0/value");
                system("echo 1 >
/sys/class/gpio/gpio1/value");
                system("echo 0 >
/sys/class/gpio/gpio38/value");
                usleep(10000);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
                UnExport();
                Export();
            SetGPIO_Input();
            system("echo 1 >
/sys/class/gpio/gpio40/value");
                a = read_gpio();
                usleep(10000);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
            UnExport();
            if(a!=ACK)
                {
                        printf("pic not
ready");
                }
                break;
                case 6:
```

```
                        Export();
            SetGPIO_output();
                system("echo 1 >
/sys/class/gpio/gpio40/value");
                system("echo 1 >
/sys/class/gpio/gpio6/value");
                system("echo 0 >
/sys/class/gpio/gpio0/value");
                system("echo 1 >
/sys/class/gpio/gpio1/value");
                system("echo 0 >
/sys/class/gpio/gpio38/value");
                usleep(10000);
            system("echo 0 >
/sys/class/gpio/gpio40/value");
                UnExport();
                Export();
            SetGPIO_Input();
            system("echo 1 >
/sys/class/gpio/gpio40/value");
            a = read_gpio();
                usleep(10000);
                system("echo 0 >
/sys/class/gpio/gpio40/value");
            UnExport();
                if(a!=ACK)
                {
                        printf("pic not
ready");
                }
                break;

                case 7:

                unsigned char  Temp =
Temperature();
                break;


    }
        sleep(2);
         }

        //create thread 1 & 2
 }
```

```
}

void *Sensors(void *Sensorsid)
{
        while(1)
        {

        pthread_mutex_lock(&mutex);
                int cmd = update;

pthread_mutex_unlock(&mutex);
                                if(update ==
0)
                        {
                unsigned char Temp_value
= Temperature();
                        //char *dev =
"/dev/i2c-0";

        pthread_mutex_lock(&mutex);
             fd = open(dev, O_RDWR );
         int i,r;
                        int addr = 0x39;
                        if(fd < 0)
                        {

        perror("\nOpening i2c device
node\n");
                        }
                        r = ioctl(fd,
I2C_SLAVE, addr);
                        if(r < 0)
                        {

        perror("\nSelecting i2c
device\n");
                        }
                        gesture_enable();
                        r =
APDS9960_write(0x80,0x4D);
                        if(r<0)
                        {
```

```
        perror("\ngesture engine not
started\n");
                        }
                        printf("\ngesture
engine started\n");
                        usleep(delay);
                        unsigned char
value = read_gesture();

        if(!APDS9960_write(0xAB,0x00)
)
                        {
                                printf("Error
during write to sensor");
                        }

        if(!APDS9960_write(0xE7,0x00)
)
                        {
                                printf("Error
during write to sensor");
                        }

        if(!APDS9960_write(0x80,0x00))
                        {
                                printf("Error
during write to sensor");
                        }
                        if((Temp_value>20)
||(value == UP))
                        {

        Imagecapture();

        cout<<"Gesture Recognised and
Picture taken" << endl;

        pthread_mutex_lock(&mutex2);
                                capture = 1;

        pthread_mutex_unlock(&mutex2
);
                        }
                                else
                                {
                                        cout
<<"Gesture Not Correct or Recognised"
<< endl;
                                }
                                close(fd);

pthread_mutex_unlock(&mutex);
                                }
        }

}

void HTTP_POST(const char* url,
const char* image, int size){
        CURL *curl;
        CURLcode res;

        curl = curl_easy_init();
        if(curl){
                curl_easy_setopt(curl,
CURLOPT_URL, url);
                curl_easy_setopt(curl,
CURLOPT_POST, 1);
                curl_easy_setopt(curl,
CURLOPT_POSTFIELDSIZE,(long)
size);
                curl_easy_setopt(curl,
CURLOPT_POSTFIELDS, image);
                res =
curl_easy_perform(curl);
                if(res != CURLE_OK)
                        fprintf(stderr,
"curl_easy_perform() failed: %s\n",

        curl_easy_strerror(res));
                curl_easy_cleanup(curl);
        }
}

char *time_stamp(){
```

```
char *timestamp = (char
*)malloc(sizeof(char) * 16);
time_t ltime;
ltime=time(NULL);
struct tm *tm;
tm=localtime(&ltime);

sprintf(timestamp,"%04d%02d%02d%
02d%02d%02d", tm->tm_year+1900,
tm->tm_mon+1,
   tm->tm_mday, tm->tm_hour-5, tm-
>tm_min, tm->tm_sec);
return timestamp;
}

void *Client(void *clientid)
{
        while(1)
        {
        if(capture ==1)
        {
        printf("sending pic value\n");
        const char* hostname="ec2-54-
202-113-131.us-west-
2.compute.amazonaws.com"; // Server
Hostname or IP address
        const int   port=8000;
// Server Service Port Number
        const int   id=12;
        const char*
password="password";
        const char* name="Zubair";
        const int   adcval=ldrvalue;
        const char* status="HelloAll";
        const char*
timestamp=time_stamp();
        char* filename="img.jpg";  //
captured picture name + incremented
file number
        //fgets(buffer,100,stdin);
        //filename = (char
*)malloc(strlen(buffer)+1);
        //strcpy(filename,buffer);
        char buf[1024];


sprintf(buf,"http://%s:%d/update?id=
%d&password=%s&name=%s&data=
%d&status=%s&timestamp=%s&filen
ame=%s",
        hostname,
        port,
        id,
        password,
        name,
        adcval,
        status,
        timestamp,
        filename);
    //.....
    // use sprintf() call here to fill out
the data "buf":
        // use the provided URL
Protocol in the lab description: replace
the "server_hostname", "portnumber",
"var_xxxx" with the related format
specifiers "%d" or "%s"
    //.....


        // ========== Don't bother
the lines below
        FILE *fp;
        struct stat num;
        stat(filename, &num);
        int size = num.st_size;
        char *buffer =
(char*)malloc(size);
        //fp = fopen(filename,"rb");
        //int n = fread(buffer, 1, size,
fp);
   // ========== Don't bother the
above lines
        HTTP_POST(buf, buffer, size);
        fclose(fp);
        pthread_mutex_lock(&mutex2);
```

```
        capture = 0;
        pthread_mutex_unlock(&mutex2
);
        }
        }
}



int main(void)
{
        pthread_mutex_init(&mutex,NU
LL);
        pthread_mutex_init(&mutex2,N
ULL);
        pthread_t
thread_client,thread_Interface,thread_
Sensors;
        pthread_create(&thread_Interfa
ce,NULL,Interface,NULL);
        pthread_create(&thread_Sensor
s,NULL,Sensors,NULL);
        sleep(0.01);
        pthread_create(&thread_client,
NULL,Client,NULL);
        pthread_join(thread_Interface,N
ULL);
        pthread_join(thread_Sensors,N
ULL);
        pthread_join(thread_client,NUL
L);
        pthread_mutex_destroy(&mutex
);
        pthread_mutex_destroy(&mutex
2);
        return 0;

}
```