Microprocessors II and Embedded System Design

EECE.4800

Lab 4: Multithreaded programming

Professor Yan Luo

Group number 12

Dushyanth Kadari

December 21, 2017

December 21, 2017

Section 2 : Contributions */1 points*

1. Group Member 1 – Aravind Dhulipalla

    - Worked on configuring an i^2C 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 the lab is to interface the Galileo Board to the light sensor, temperature sensor, proximity/Gesture sensor and camera, and the data from these sensors is sent to the web server and the pictures are taken based on these values. All these processes should be done by using a Multithreaded C programming that handles user inputs, gesture sensors data, triggers Camera and sends data to remote server.

Section 4 : Introduction /0.5 points

In this lab, the Galileo is the Master and the gesture sensor(APDS-9960), light sensor

(LDR), and the temperature sensor (TMP102) are the Slaves and the connections are made

using a communication protocol called i^2C. These i^2C devices are configured in such a way

that when they meet the specified threshold values the pictures are taken using the camera

connected. OpenCV is used to capture the images using the camera. The data collected

from the sensors are sent to the remote web server that is done using a HTTP protocol. The

data from all the sensors are gathered and send to the server, this can be achieved by

client5 application using threads. The camera is attached to the servo motor and it takes

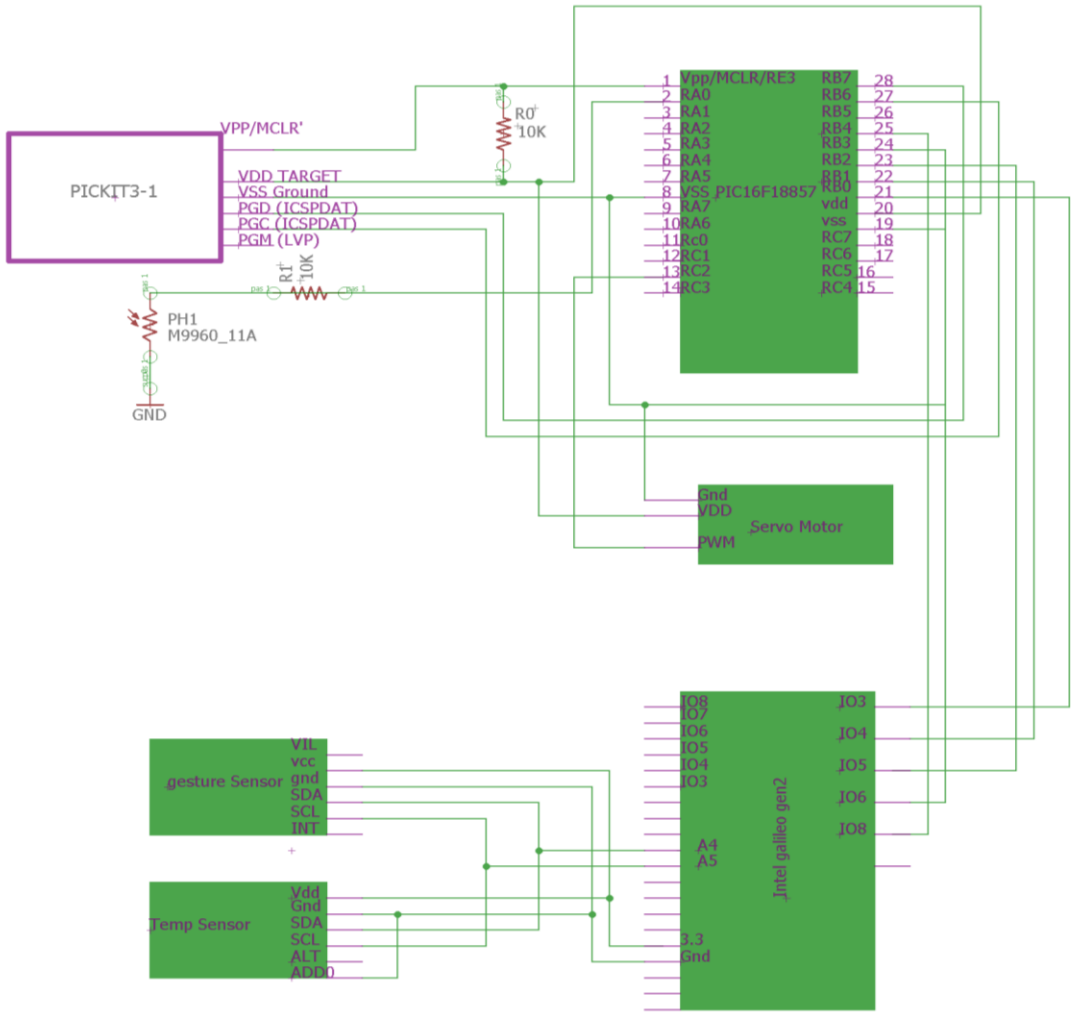
the pictures when it need to be done based on the data received form the sensors and the

designed program.

Section 5 : Materials, Devices and Instruments /0.5 points

- Intel Galileo Gen 2
- Temperature Sensor – TMP102
- Gesture Sensor – APDS – 9960
- Serial to USB connector (FTDI cable)
- Yoctohm Linux
- two 5k Ohm resistors to connect SCL, SDA to VCC
- Light sensor
- Servo motor
- Pic Micro Controller 16F18857
- Putty Software
- WinSCP Software
- Camera
- Jumper Cables
- Breadboard.

Section 6 : Schematics /0.5 points



picture_1: Hardware schematic

Section 7 : Lab Methods and Procedure /2 points

Hardware design:

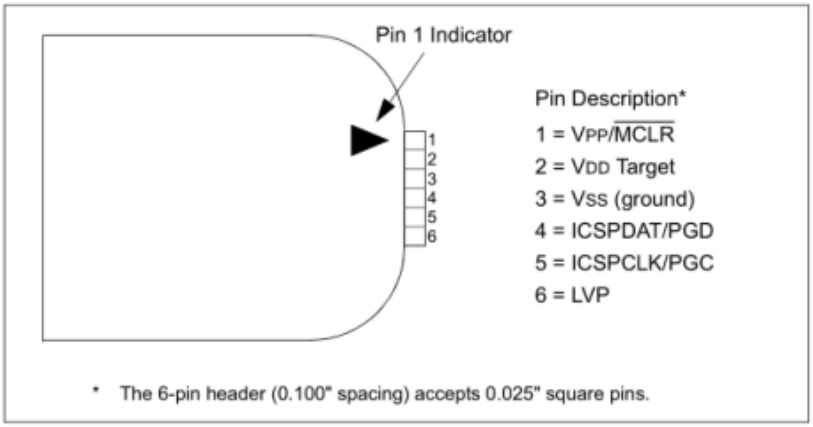
Pic microcontroller and PICKit3 are connected as follows:

Pin 9 and 5 were grounded, pin 1 is connected to the positive voltage through a 10KΩ resistor and the operating voltage is 3.3V. Pin 2 of pickit3 and the pin19 of micro controller is connected to Vcc. Pin 4 and pin 5 of pickit3 are connected to the pin 28 and pin 27 respectively to program the chip.

The hardware design of the project is done as shown in the figure. The Serial Clock Line(SCL) and the Serial Data Line(SDA) of both the temperature sensor and the gesture sensor is connected to the pins A5 and A4 of the intel Galileo Board respectively. The Vdd to the temperature sensor is given through the Galileo board and has a voltage value of 3.3Volts. in the same way the gesture input voltage is given from the same pin of the Galileo to which the temperature sensor Vdd is connected. The camera is connected to the intel Galileo Board. The supply to the intel Galileo is given through the power chord.

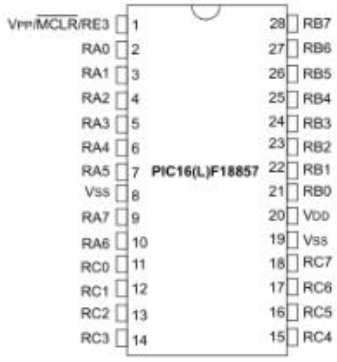
I2c bus protocol is designed to connect sensors temperature sensor, gesture sensor, LDR are connected as slaves to master Galileo board.

FIGURE 1-2: PICKIT™ 3 PROGRAMMER CONNECTOR PINOUT



PIN DIAGRAMS

28-pin SPDIP, SOIC, SSOP

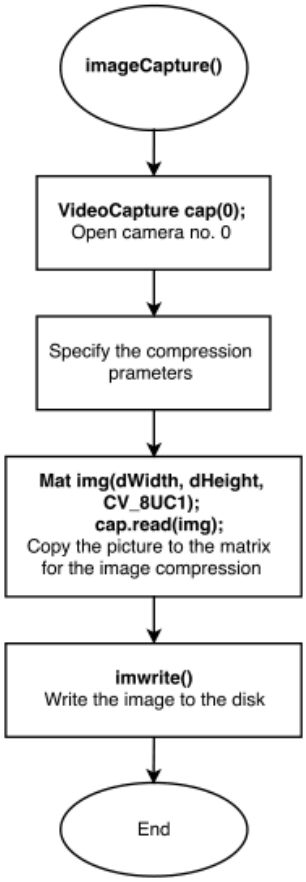


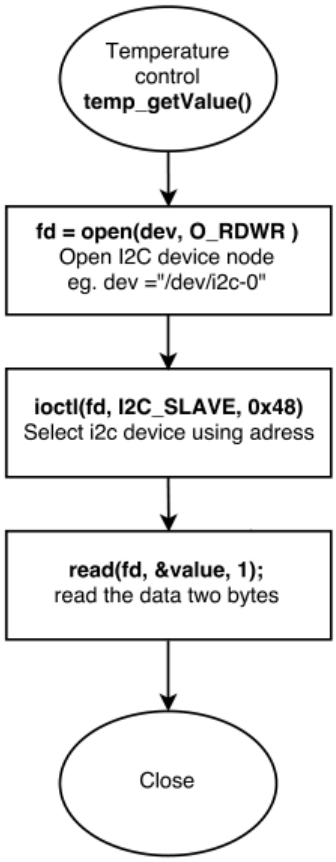
Note 1: See Table 2 for location of all peripheral functions.

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.

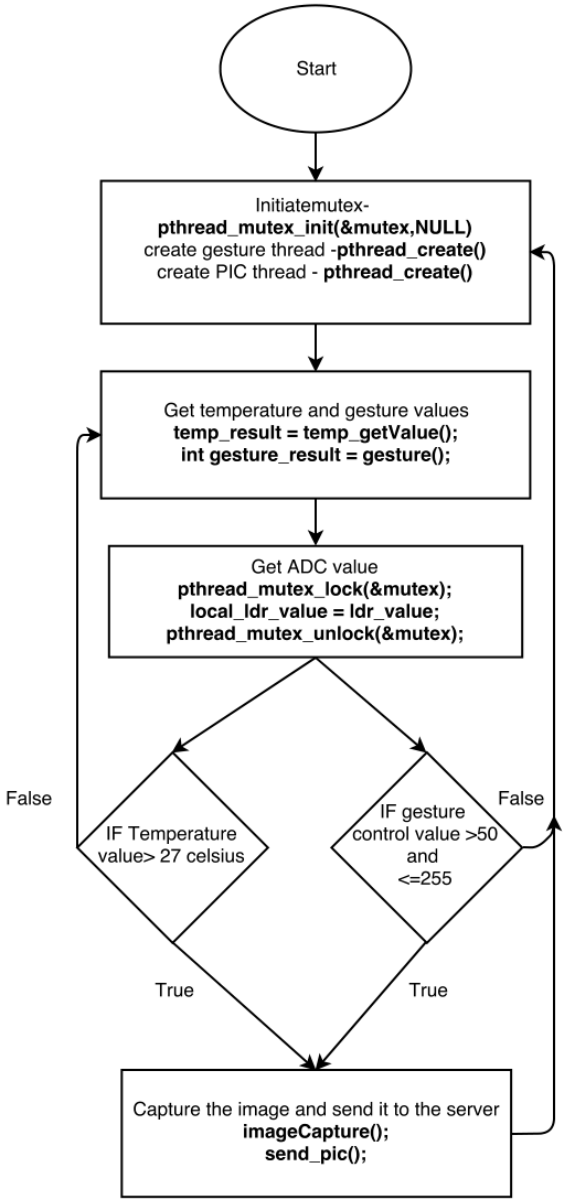
```
root@galileo:~#
root@galileo:~#
root@galileo:~# i2cdetect -r 0
WARNING! This program can confuse your I2C bus, cause data loss and worse!
I will probe file /dev/i2c-0 using read byte commands.
I will probe address range 0x03-0x77.
Continue? [Y/n] y
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e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

Software design:





Main program



```
/*----------Imagecapture----------
        Uses open cv to take the image and saves it in the media card/img
        ----------*/
        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;

/*----------
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;
        }
/*----------
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,GSTATUS_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;
        }

/*-------------------------------------------------------
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;
}
```

HTTP protocol:

```
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&statu
s=%s&timestamp=%s&filename=%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"
        //.....
            HTTP_POST(buf, buffer, size);
            fclose(fp);
            pthread_mutex_lock(&mutex2);
            capture = 0;
            pthread_mutex_unlock(&mutex2);
            }
            }
}
```

Section 8 : Trouble Shooting /1 points

Issue 1:

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.

Issue 2:

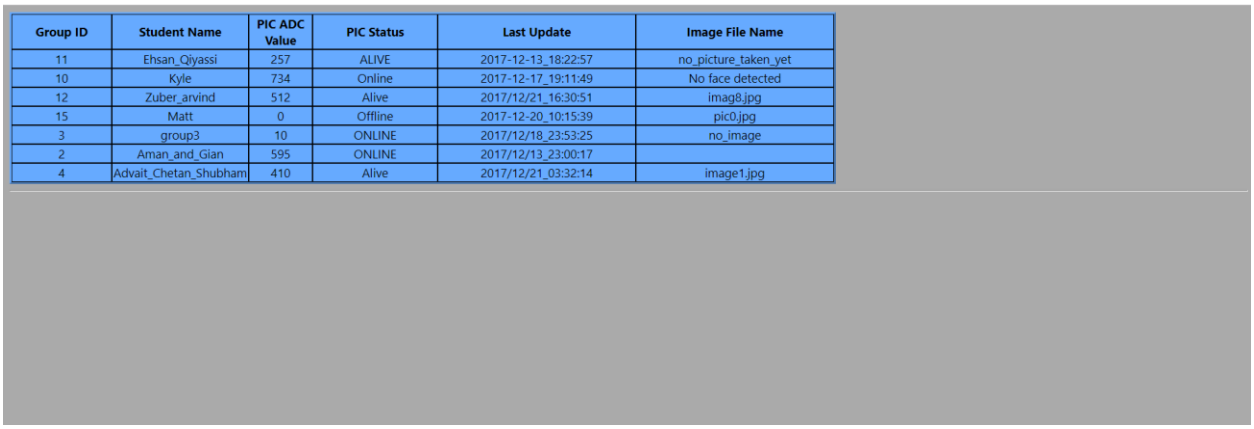
We could be able to send the data from the sensors to web server, but we were not able to

get the servo motor interface with Galileo board, it is necessary to interface it and place

camera on it but we could not do it.

Section 9 : Results /0.5 points

Results:



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

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_WIDTH); //get the width of frames of the video
	 double dHeight = cap.get(CV_CAP_PROP_FRAME_HEIGHT); //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_IMWRITE_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,GSTATUS_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&statu
s=%s&timestamp=%s&filename=%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,NULL);
        pthread_mutex_init(&mutex2,NULL);
        pthread_t thread_client,thread_Interface,thread_Sensors;
        pthread_create(&thread_Interface,NULL,Interface,NULL);
        pthread_create(&thread_Sensors,NULL,Sensors,NULL);
```

```
        sleep(0.01);
        pthread_create(&thread_client,NULL,Client,NULL);
        pthread_join(thread_Interface,NULL);
        pthread_join(thread_Sensors,NULL);
        pthread_join(thread_client,NULL);
        pthread_mutex_destroy(&mutex);
        pthread_mutex_destroy(&mutex2);
        return 0;

}
```