Universitat de Lleida

Data log and Screen representation (Sprint 4)

MINF UDL 20-21

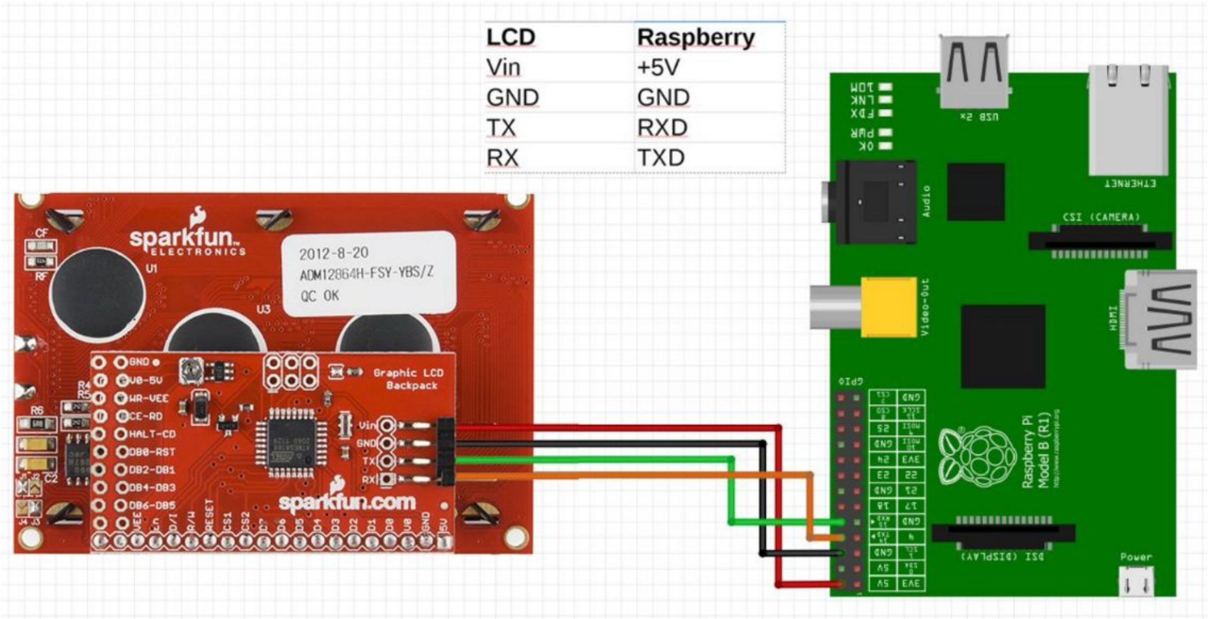
Ubiquitous and embedded systems

Team 1

1. Objective

a. The objective is to make a graphical representation of the obtained temperature and humidity on the LCD Screen, being a relation of value x time (24h), the code will be present in the chibiOS.

2. Wiring

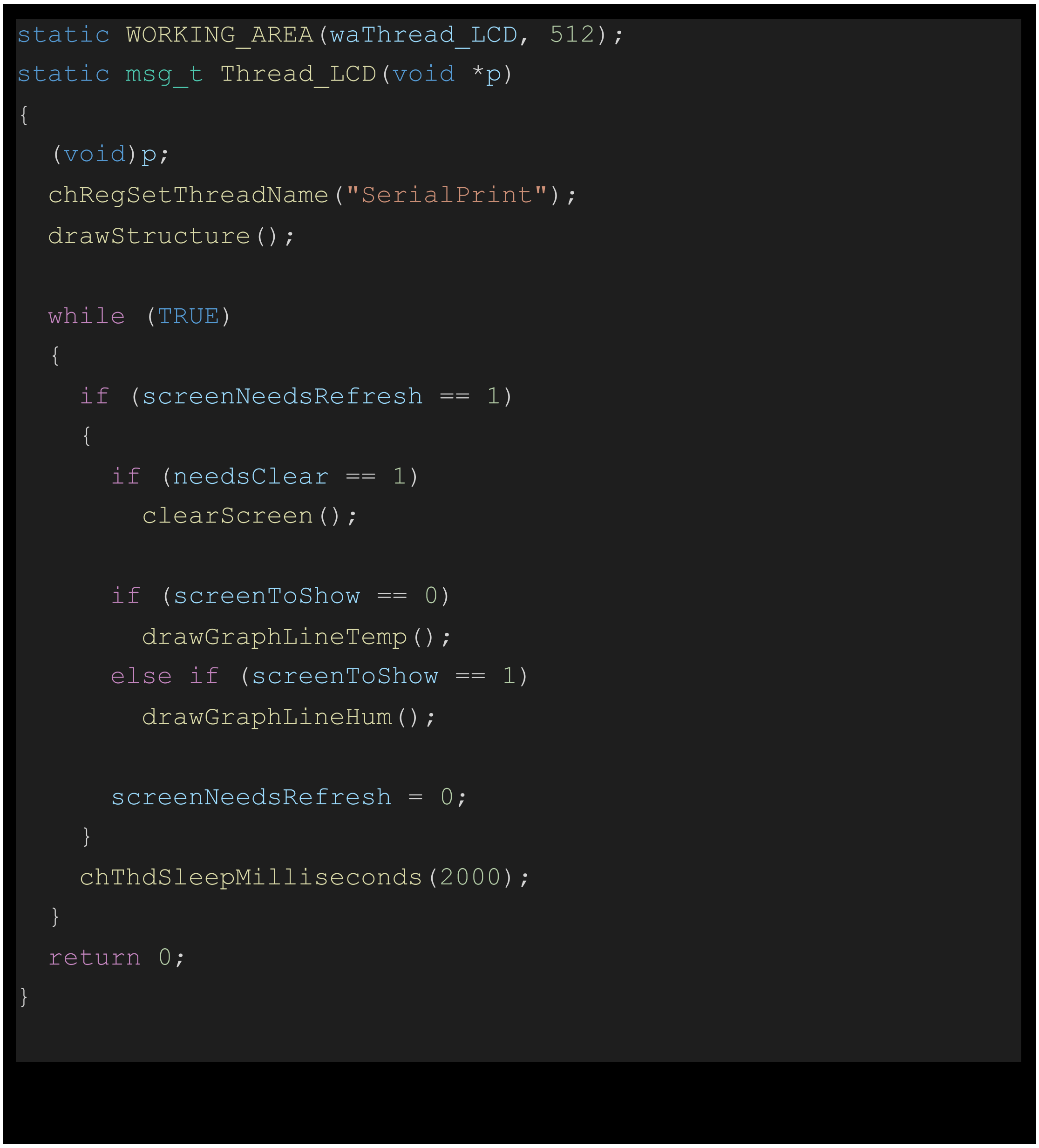


LCD	Raspberry
Vin	+5V
GND	GND
TX	RXD
RX	TXD

Note: in this case the RXD -> TX cable is not necessary, onyl the TXD <> RX since the LCD is not sending anything to the Raspberry.

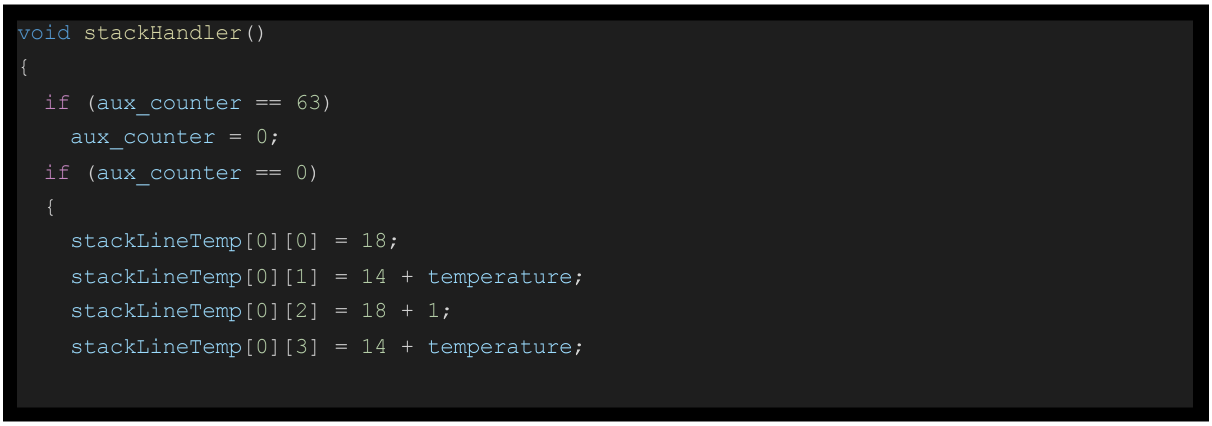
3. Code (ChibiOS)

a. Thread

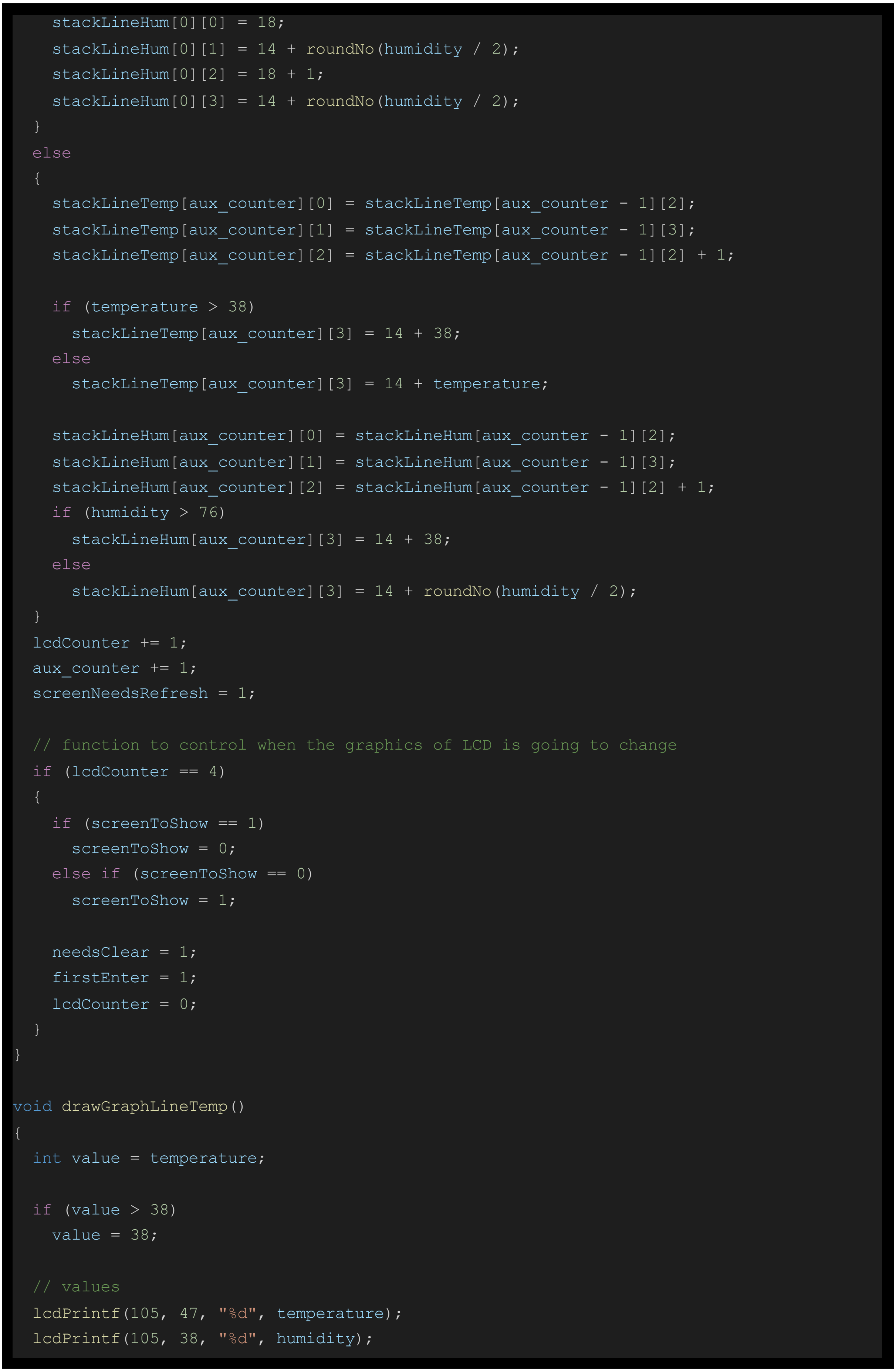


```
static WORKING_AREA(waThread_LCD, 512);
static msg_t Thread_LCD(void *p)
{
  (void)p;
  chRegSetThreadName("SerialPrint");
  drawStructure();

  while (TRUE)
  {
    if (screenNeedsRefresh == 1)
    {
      if (needsClear == 1)
        clearScreen();

      if (screenToShow == 0)
        drawGraphLineTemp();
      else if (screenToShow == 1)
        drawGraphLineHum();

      screenNeedsRefresh = 0;
    }
    chThdSleepMilliseconds(2000);
  }
  return 0;
}
```

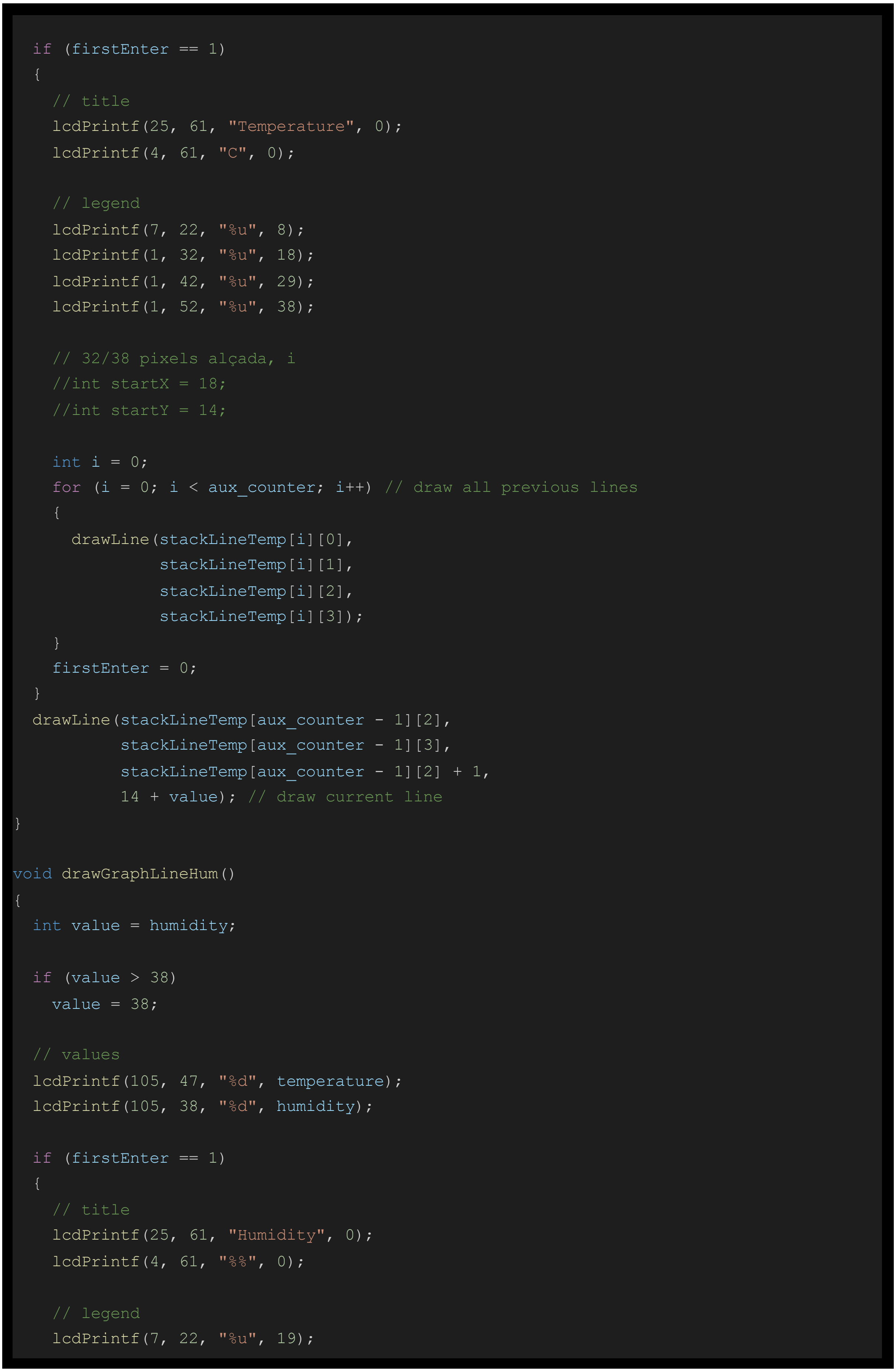
b. Auxiliar functions



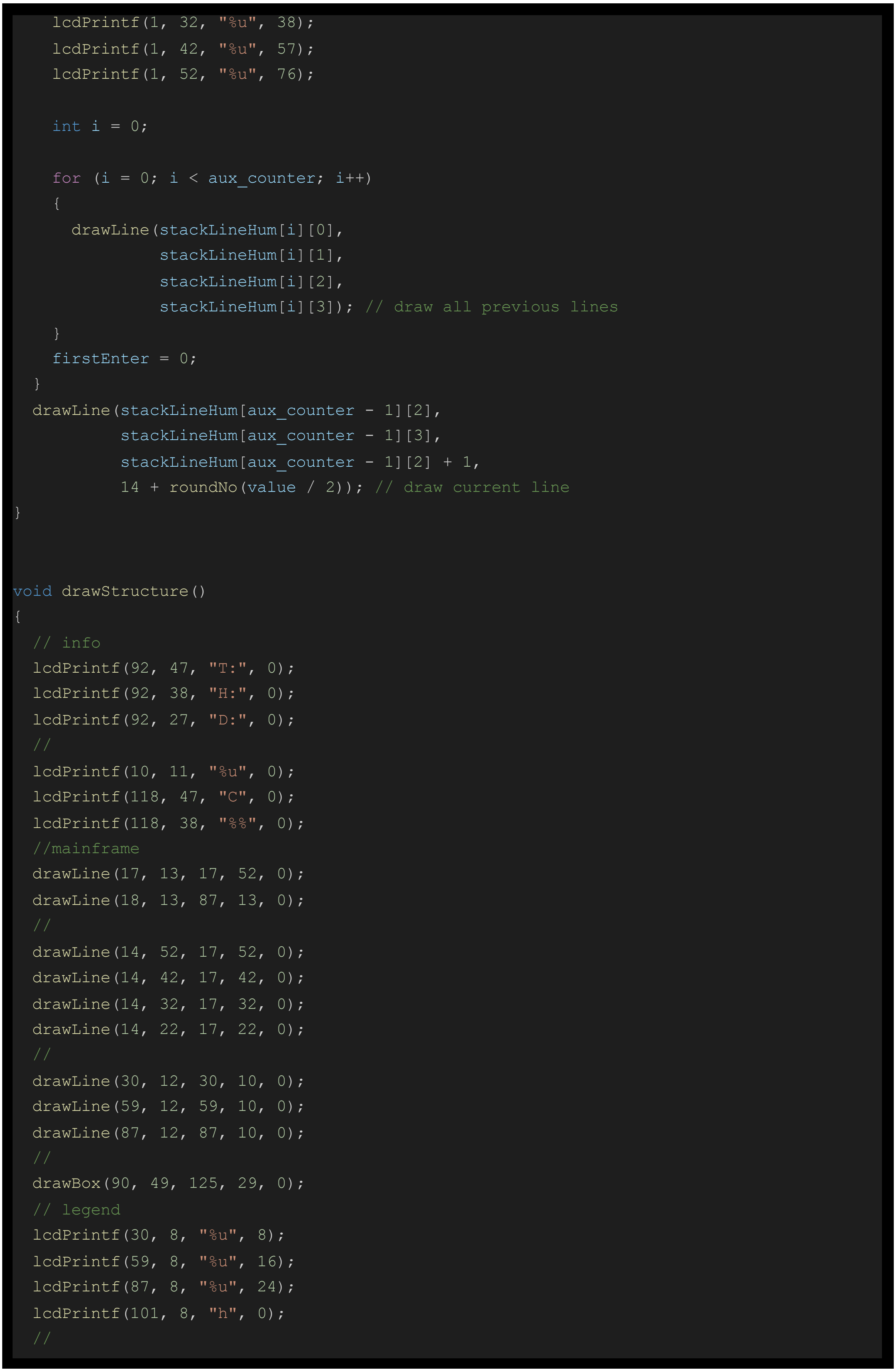
```
void stackHandler()
{
  if (aux_counter == 63)
    aux_counter = 0;
  if (aux_counter == 0)
  {
    stackLineTemp[0][0] = 18;
    stackLineTemp[0][1] = 14 + temperature;
    stackLineTemp[0][2] = 18 + 1;
    stackLineTemp[0][3] = 14 + temperature;
```



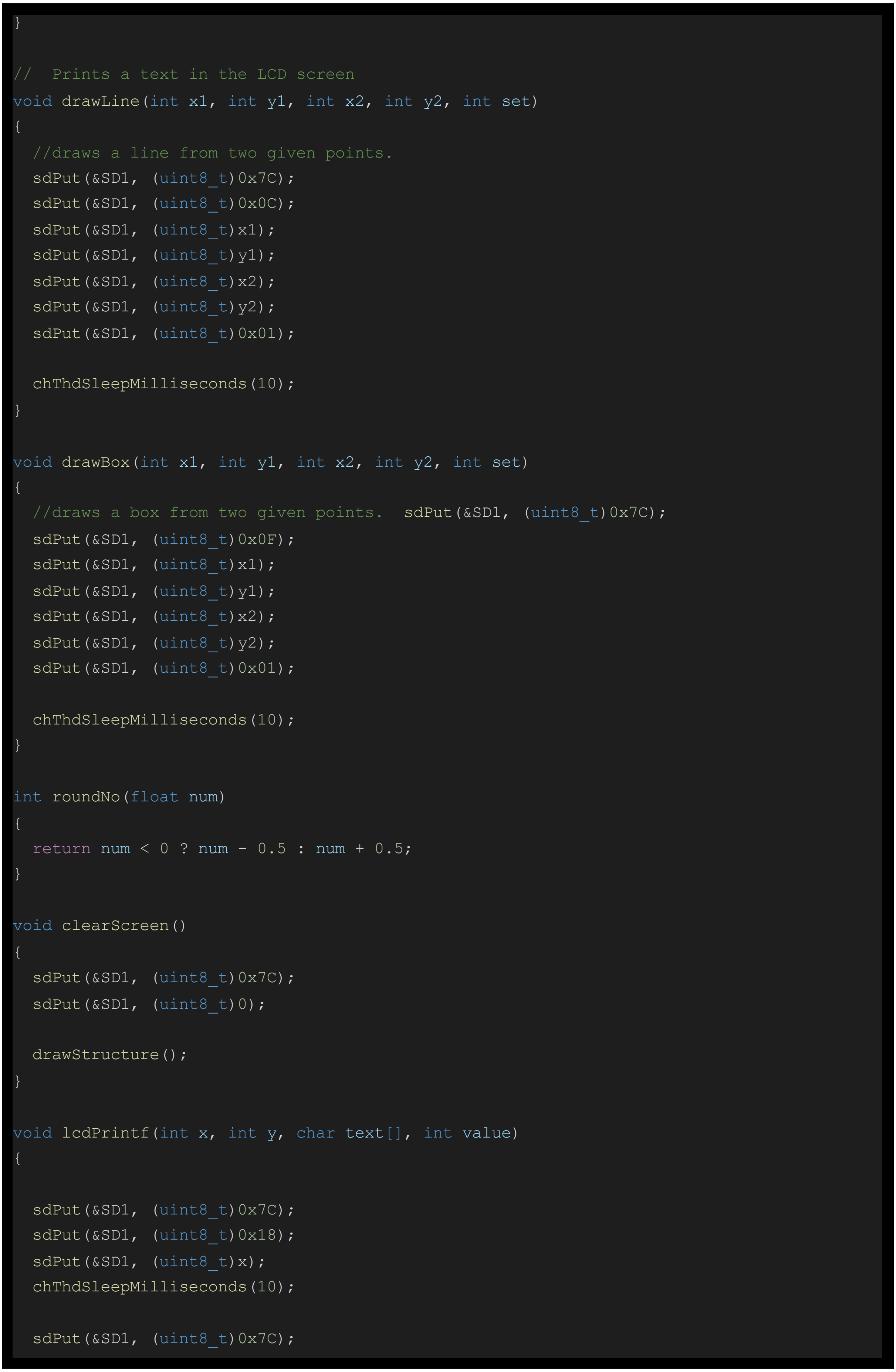
```
    stackLineHum[0][0] = 18;
    stackLineHum[0][1] = 14 + roundNo(humidity / 2);
    stackLineHum[0][2] = 18 + 1;
    stackLineHum[0][3] = 14 + roundNo(humidity / 2);
  }
  else
  {
    stackLineTemp[aux_counter][0] = stackLineTemp[aux_counter - 1][2];
    stackLineTemp[aux_counter][1] = stackLineTemp[aux_counter - 1][3];
    stackLineTemp[aux_counter][2] = stackLineTemp[aux_counter - 1][2] + 1;

    if (temperature > 38)
      stackLineTemp[aux_counter][3] = 14 + 38;
    else
      stackLineTemp[aux_counter][3] = 14 + temperature;

    stackLineHum[aux_counter][0] = stackLineHum[aux_counter - 1][2];
    stackLineHum[aux_counter][1] = stackLineHum[aux_counter - 1][3];
    stackLineHum[aux_counter][2] = stackLineHum[aux_counter - 1][2] + 1;
    if (humidity > 76)
      stackLineHum[aux_counter][3] = 14 + 38;
    else
      stackLineHum[aux_counter][3] = 14 + roundNo(humidity / 2);
  }
  lcdCounter += 1;
  aux_counter += 1;
  screenNeedsRefresh = 1;

  // function to control when the graphics of LCD is going to change
  if (lcdCounter == 4)
  {
    if (screenToShow == 1)
      screenToShow = 0;
    else if (screenToShow == 0)
      screenToShow = 1;

    needsClear = 1;
    firstEnter = 1;
    lcdCounter = 0;
  }
}

void drawGraphLineTemp()
{
  int value = temperature;

  if (value > 38)
    value = 38;

  // values
  lcdPrintf(105, 47, "%d", temperature);
  lcdPrintf(105, 38, "%d", humidity);
```



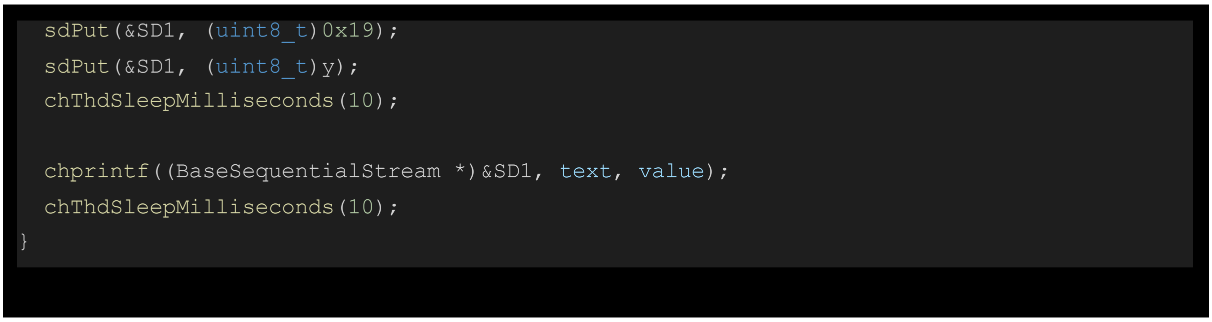
```c
  if (firstEnter == 1)
  {
    // title
    lcdPrintf(25, 61, "Temperature", 0);
    lcdPrintf(4, 61, "C", 0);

    // legend
    lcdPrintf(7, 22, "%u", 8);
    lcdPrintf(1, 32, "%u", 18);
    lcdPrintf(1, 42, "%u", 29);
    lcdPrintf(1, 52, "%u", 38);

    // 32/38 pixels alçada, i
    //int startX = 18;
    //int startY = 14;

    int i = 0;
    for (i = 0; i < aux_counter; i++) // draw all previous lines
    {
      drawLine(stackLineTemp[i][0],
               stackLineTemp[i][1],
               stackLineTemp[i][2],
               stackLineTemp[i][3]);
    }
    firstEnter = 0;
  }
  drawLine(stackLineTemp[aux_counter - 1][2],
           stackLineTemp[aux_counter - 1][3],
           stackLineTemp[aux_counter - 1][2] + 1,
           14 + value); // draw current line
}

void drawGraphLineHum()
{
  int value = humidity;

  if (value > 38)
    value = 38;

  // values
  lcdPrintf(105, 47, "%d", temperature);
  lcdPrintf(105, 38, "%d", humidity);

  if (firstEnter == 1)
  {
    // title
    lcdPrintf(25, 61, "Humidity", 0);
    lcdPrintf(4, 61, "%%", 0);

    // legend
    lcdPrintf(7, 22, "%u", 19);
```



```
    lcdPrintf(1, 32, "%u", 38);
    lcdPrintf(1, 42, "%u", 57);
    lcdPrintf(1, 52, "%u", 76);

    int i = 0;

    for (i = 0; i < aux_counter; i++)
    {
      drawLine(stackLineHum[i][0],
               stackLineHum[i][1],
               stackLineHum[i][2],
               stackLineHum[i][3]); // draw all previous lines
    }
    firstEnter = 0;
  }
  drawLine(stackLineHum[aux_counter - 1][2],
           stackLineHum[aux_counter - 1][3],
           stackLineHum[aux_counter - 1][2] + 1,
           14 + roundNo(value / 2)); // draw current line
}


void drawStructure()
{
  // info
  lcdPrintf(92, 47, "T:", 0);
  lcdPrintf(92, 38, "H:", 0);
  lcdPrintf(92, 27, "D:", 0);
  //
  lcdPrintf(10, 11, "%u", 0);
  lcdPrintf(118, 47, "C", 0);
  lcdPrintf(118, 38, "%%", 0);
  //mainframe
  drawLine(17, 13, 17, 52, 0);
  drawLine(18, 13, 87, 13, 0);
  //
  drawLine(14, 52, 17, 52, 0);
  drawLine(14, 42, 17, 42, 0);
  drawLine(14, 32, 17, 32, 0);
  drawLine(14, 22, 17, 22, 0);
  //
  drawLine(30, 12, 30, 10, 0);
  drawLine(59, 12, 59, 10, 0);
  drawLine(87, 12, 87, 10, 0);
  //
  drawBox(90, 49, 125, 29, 0);
  // legend
  lcdPrintf(30, 8, "%u", 8);
  lcdPrintf(59, 8, "%u", 16);
  lcdPrintf(87, 8, "%u", 24);
  lcdPrintf(101, 8, "h", 0);
  //
```

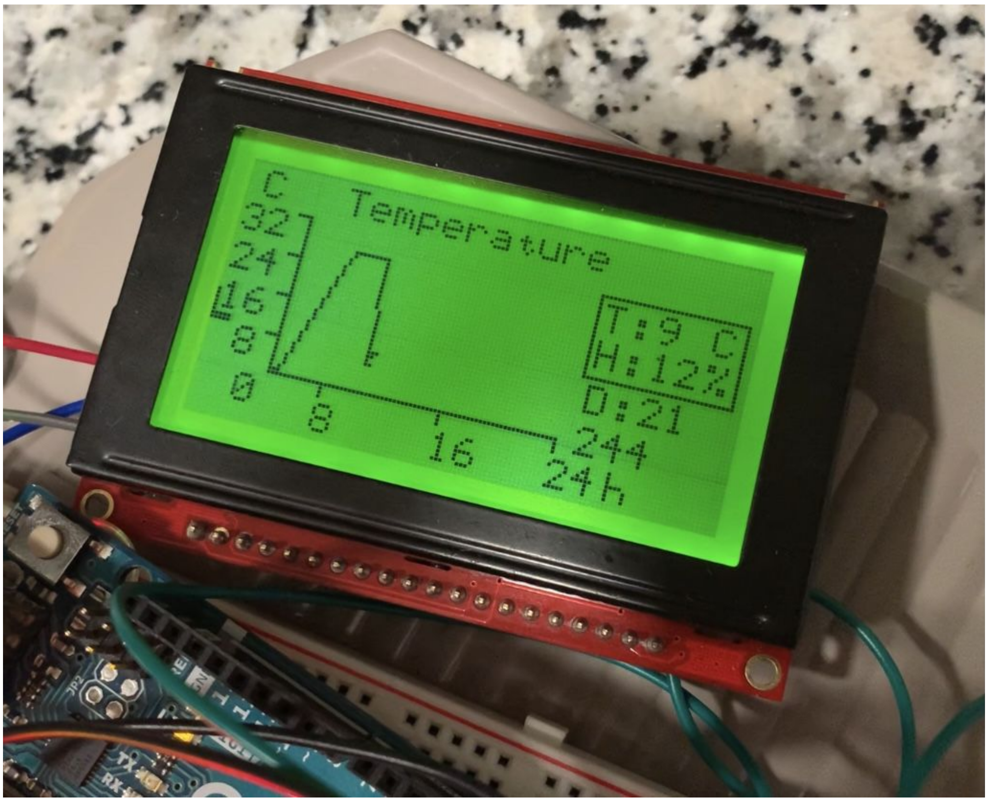


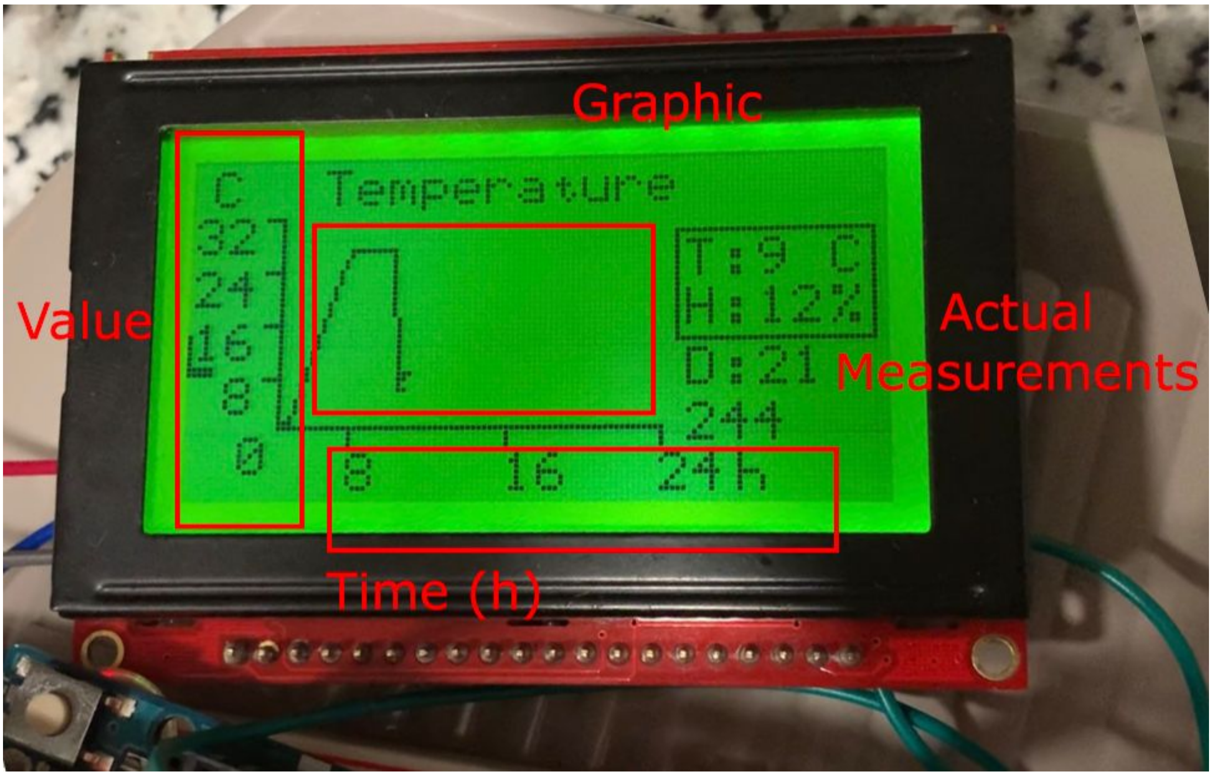
```
}

//  Prints a text in the LCD screen
void drawLine(int x1, int y1, int x2, int y2, int set)
{
  //draws a line from two given points.
  sdPut(&SD1, (uint8_t)0x7C);
  sdPut(&SD1, (uint8_t)0x0C);
  sdPut(&SD1, (uint8_t)x1);
  sdPut(&SD1, (uint8_t)y1);
  sdPut(&SD1, (uint8_t)x2);
  sdPut(&SD1, (uint8_t)y2);
  sdPut(&SD1, (uint8_t)0x01);

  chThdSleepMilliseconds(10);
}

void drawBox(int x1, int y1, int x2, int y2, int set)
{
  //draws a box from two given points.  sdPut(&SD1, (uint8_t)0x7C);
  sdPut(&SD1, (uint8_t)0x0F);
  sdPut(&SD1, (uint8_t)x1);
  sdPut(&SD1, (uint8_t)y1);
  sdPut(&SD1, (uint8_t)x2);
  sdPut(&SD1, (uint8_t)y2);
  sdPut(&SD1, (uint8_t)0x01);

  chThdSleepMilliseconds(10);
}

int roundNo(float num)
{
  return num < 0 ? num - 0.5 : num + 0.5;
}

void clearScreen()
{
  sdPut(&SD1, (uint8_t)0x7C);
  sdPut(&SD1, (uint8_t)0);

  drawStructure();
}

void lcdPrintf(int x, int y, char text[], int value)
{

  sdPut(&SD1, (uint8_t)0x7C);
  sdPut(&SD1, (uint8_t)0x18);
  sdPut(&SD1, (uint8_t)x);
  chThdSleepMilliseconds(10);

  sdPut(&SD1, (uint8_t)0x7C);
```



```
  sdPut(&SD1, (uint8_t)0x19);
  sdPut(&SD1, (uint8_t)y);
  chThdSleepMilliseconds(10);

  chprintf((BaseSequentialStream *)&SD1, text, value);
  chThdSleepMilliseconds(10);
}
```

4. **Final result**
    a. Every 5 iterations, the screen switch between showing the Temperature and the Humidity
    b. All values for the lines are saved on an array of coordinates, so we can keep showing the graphics for 24h.

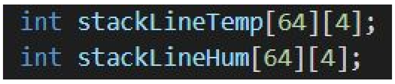




Reference video: https://www.youtube.com/watch?v=WJ3wlqHZit0

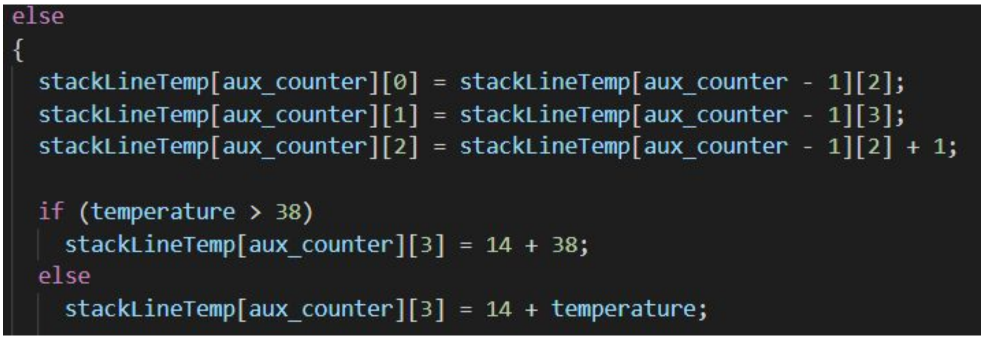
Data Storage structure:

The selected structure for the data log is a 2-dimensional array, this way we can easily simulate the coordinates for the lines to print in the LCD.



```
int stackLineTemp[64][4];
int stackLineHum[64][4];
```

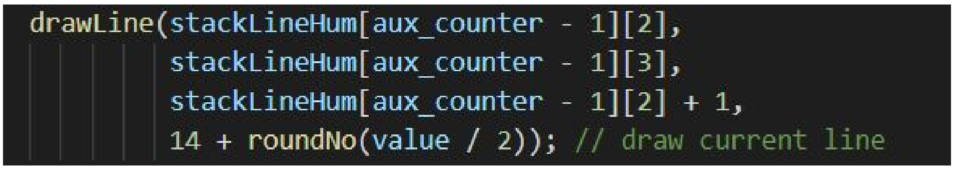
With this data which is treated in the stackHandler function (as seen before), we can easily plot the graphics with the acquired data in the LCD Thread (as seen previously)



```
else
{
  stackLineTemp[aux_counter][0] = stackLineTemp[aux_counter - 1][2];
  stackLineTemp[aux_counter][1] = stackLineTemp[aux_counter - 1][3];
  stackLineTemp[aux_counter][2] = stackLineTemp[aux_counter - 1][2] + 1;

  if (temperature > 38)
    stackLineTemp[aux_counter][3] = 14 + 38;
  else
    stackLineTemp[aux_counter][3] = 14 + temperature;
```

The aux_counter is a auxiliar counter created and incremented in the stackHandler() function, this variable controls mostly of the LCD Data representation frequency.

Example of drawing a line the graphic:



```
drawLine(stackLineHum[aux_counter - 1][2],
         stackLineHum[aux_counter - 1][3],
         stackLineHum[aux_counter - 1][2] + 1,
         14 + roundNo(value / 2)); // draw current line
```