THE UNIVERSITY OF TEXAS AT ARLINGTON

COMPUTER SCIENCE AND ENGINEERING

MECHATRONICS LAB 8 REPORT

ELECTROMECHANICAL SYSTEMS & SENSORS

Submitted toward the partial completion of the requirements for CSE 5355-001

Submitted by,

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1. **Connect the A1M8 LIDAR assembly using 5 cables to the white board. Apply power to the 5V input (RED) from Vbus and ground (BLACK) from GND. Connect the PWM input (WHITE) to a GPO to enable the motor.**

2. **Power on the TM4C123GXL board and output a short pulse on PWM to turn the motor on and then off again.**
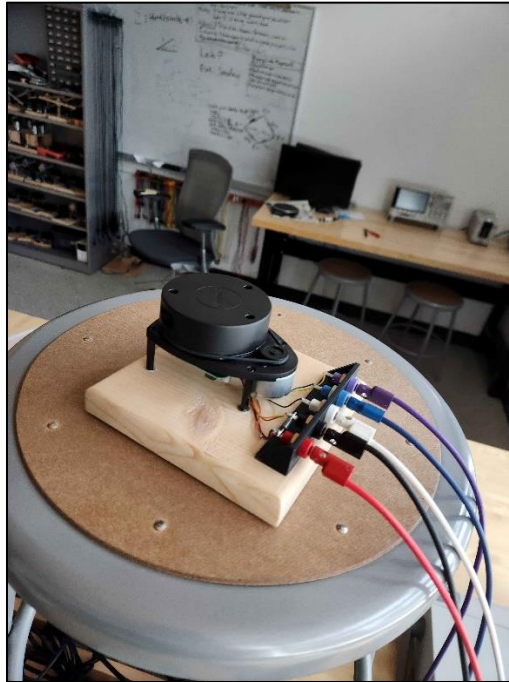
3. **Connect the TX output (BLUE) to U1RX and the RX input (VIOLET) to U1TX.**
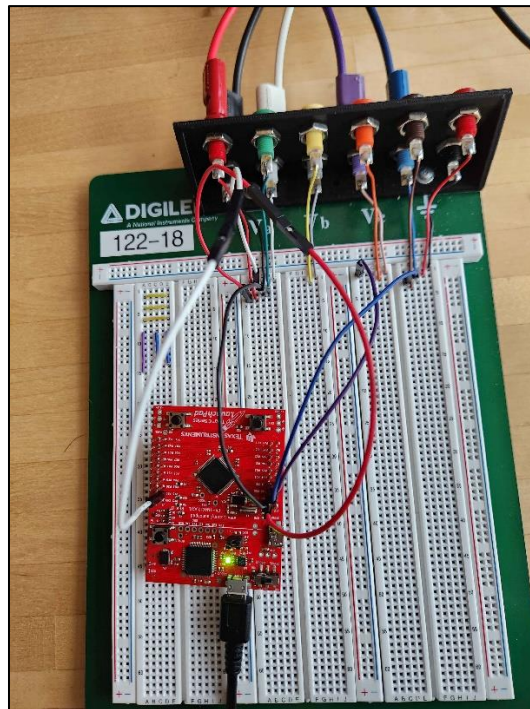
4. Write code to initialize UART1 to 115,200 baud, 8N1.

The code from UART0 was used as a based to initialize UART1

5. Send a STOP command to the LIDAR sensor.

A stop command is sent by sending the following bytes in order through UART:

<div align="center">0xA5 0x25</div>

6. Send an INFO comment to the LIDAR sensor and verify that the information in the response is as expected and display on UART0.

An info command is sent by sending the following bytes in order through UART:

<div align="center">0xA5 0x50</div>

Response Descriptor & Response Packet:

```
A5 5A 14 00 00 00 04
18 1D 01 07 E9 B6 ED F9 C7 E2 9B CE A7 E3 9E F2 79 65 43 04
```

7. Turn on the motor and wait until it reaches the correct speed.

8. Send a SCAN command (or an advanced version) to the LIDAR sensor.

A scan command is sent by sending the following bytes in order through UART:

<div align="center">0xA5 0x20</div>

9. Verify that the response is as expected.

Response Descriptor:

```
A5 5A 05 00 00 40 81
```

10. Enter an endless loop to read the bearing and distance data from the sensor until a full data set is created (one full rotation of data).

11. Send a STOP command to the LIDAR sensor and turn off the PWM signal to stop the motor.

12. Calculate the total room area on the TM4C123GXL board and display on UART 0.

In code, a scan command is sent and then subsequently in a while loop the response packers are processed. There are two conditions to verify that the data being received is the one we want. The first check is to validate the 'check' bit, if it is set then this data is valid. Then the second check waits for the 'start' flag in the response packet to be set, since this tells us that a new 360 scan has begun. Once this flag is set the angle and distance are extracted from each packet, converted appropriately, and stored in a global struct, until another 'start' flag is detected since this signal the end of the first scan and the beginning of another. Once we've stopped extracting angles and distance the data is processed to calculate area using triangulation and is also printed out to putty.
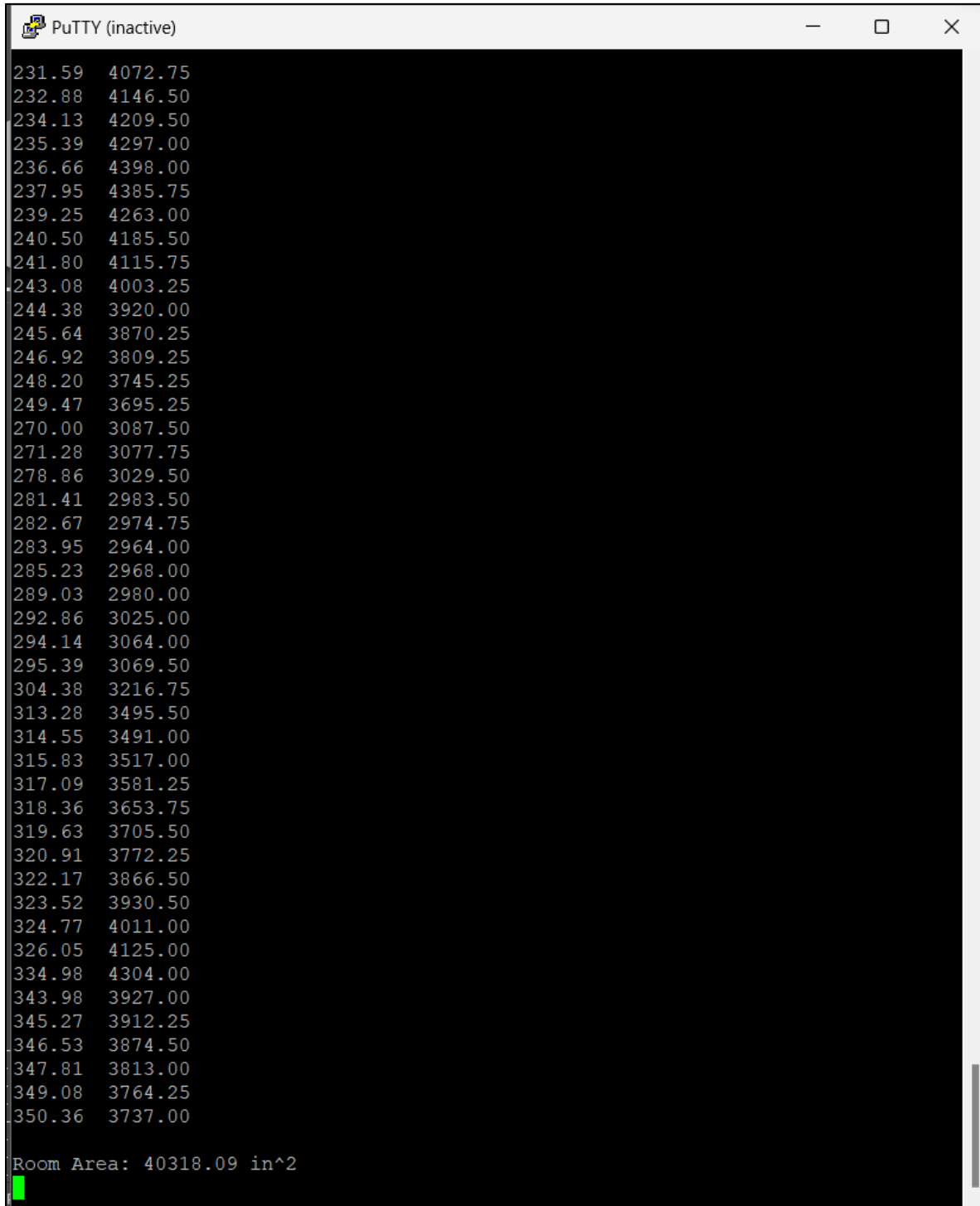
To calculate the area of the room using the gathered data, we iterate through the entire data and use the following formula:

Area += distance$_i$ * distance$_{i-1}$ * 0.5 * sin(Angle$_i$ * Angle$_{i-1}$)   (where i starts at 1)

This area is in units of m^2 so it is multiplied by 0.00150 to convert it into ft^2.

```
Room Area: 40318.09 in^2
```

13. Output the data set in a tabular format on UART 0. Take the terminal data and import into a spreadsheet and display as a polar plot. Verify the image as expected, noting that the window and open door may appear a bit unusual at first in the scans.

```
PuTTY (inactive)                                    —    □    ×
231.59   4072.75
232.88   4146.50
234.13   4209.50
235.39   4297.00
236.66   4398.00
237.95   4385.75
239.25   4263.00
240.50   4185.50
241.80   4115.75
243.08   4003.25
244.38   3920.00
245.64   3870.25
246.92   3809.25
248.20   3745.25
249.47   3695.25
270.00   3087.50
271.28   3077.75
278.86   3029.50
281.41   2983.50
282.67   2974.75
283.95   2964.00
285.23   2968.00
289.03   2980.00
292.86   3025.00
294.14   3064.00
295.39   3069.50
304.38   3216.75
313.28   3495.50
314.55   3491.00
315.83   3517.00
317.09   3581.25
318.36   3653.75
319.63   3705.50
320.91   3772.25
322.17   3866.50
323.52   3930.50
324.77   4011.00
326.05   4125.00
334.98   4304.00
343.98   3927.00
345.27   3912.25
346.53   3874.50
347.81   3813.00
349.08   3764.25
350.36   3737.00

Room Area: 40318.09 in^2
```

To map out the room, Putty is setup to log all the data onto a file. The angles and distances are then brought to excel to be processes and obtain the polar coordinates using the following equation:

$$x = distance * \cos{(anlgle)} \qquad \text{(where angle is in radiant)}$$

$$y = distance * \sin{(angle)} \qquad \text{(where angle is in radiant)}$$

Then, once the x and y values are computed, they are taken into Desmos's to then be graphed.