Team Ate

Deliverable F – Prototype I and Customer Feedback

GNG1103 C – Introduction to Engineering Design

Lab Section CO2 – Group 8

Group Members

Ryley Dunn (300405314)

Makia Bernard (300436325)

Coulton Wong (300426191)

Haneen Barghouti (300414387)

Mujibullah Naziri (300430492)

Abstract

In this deliverable a prototype will be created and be tested using a new testing plan created. This prototype will get feedback from the client which will be included in the deliverable.

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Introduction

The prototype that is being tested is the two laser sensors. The prototype works by pointing a laser at each photoresistor, when something (bat) blocks the path of both lasers, entry or exit increases depending on the order the sensors were triggered. This prototype utilizes Arduino IDE.

Flowchart for code for the prototype testing:

```
    |    Start     |
         |
    | Initialize     |
    | Variables      |
         |
    |    Loop      |
         |
    | Read LDR Values |
         |
  | Check Sensor 1 by reading ldr1   |
      | (ldr2 > 300)      | (ldr2 < 300)
 | Bats at Sensor |   | No Bats at Sensor |
         |
| Check Sensor 2 by reading ldr2   |
      | (ldr2 > 300)      | (ldr2 < 300)
 | Bats at Sensor |   | No Bats at Sensor  |
         |
    | Check Both Sensors|
          |yes
    | Set Counter = 1   |
         |
    | both sensors are
    Not triggered and counter is 1   |
         |
    | Reset Counter to 0|
```

|

| Check if sensor 1 is

| triggered |

Yes | No |

| Exit increases by 1| | Entry increase by 1 |

|

| Loop |

Arduino code:

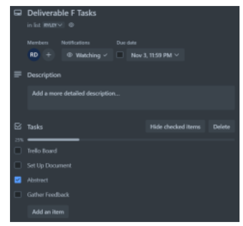
```
int ldr1 = 0;
int ldr_value1 = 0;
int ldr2 = 1;
int ldr_value2 = 0;
int counter=0;
int entry=0;
int exits=0;

void setup() {
  Serial.begin(9600);
}

void loop() {
  ldr_value1 = analogRead(ldr1);
  ldr_value2=analogRead(ldr2);
  Serial.println(ldr_value1);
  Serial.println(ldr_value2);

  if (ldr_value1 >300) {                          // ldr_value gets lower when
laser pointed at photoresistors
    Serial.println("bats at sensor 1");
  } else {
    Serial.println("no bats at sesnor 1");
  }
  if (ldr_value2 >300) {
    Serial.println("bats at sensor 2");
  } else {
    Serial.println("no bats at sesnor 2");
  }
```

```
  if (ldr_value1 >300 && ldr_value2>300) {
    counter=1;
    }
  else if (counter==1) {
    counter=0;
    if (ldr_value1<300 && ldr_value2>300) {
      entry=entry+1;
      Serial.println(entry);
    }
    else if (ldr_value2<300 && ldr_value1>300){
      exits=exits+1;
      Serial.println(exits);
    }
  }
  delay(200);
}
```

Trello Board Updates

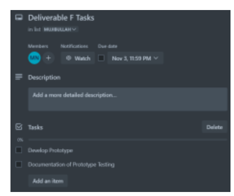
Individual tasks for each group member have been updated to accurately reflect the tasks each member is responsible for.

Ryley



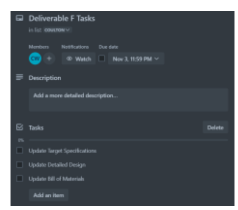
- Trello board updates
- Abstract
- Client feedback
- Abstract

Mujibullah



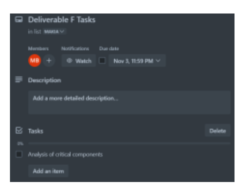
- Develop prototype
- Documentation of prototype testing

Coulton



- Update target specification
- Update detailed design
- Update bill of materials

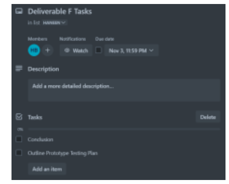
Makia



- Analysis of critical components

Haneen

- Conclusion
- Outline prototype testing plan



Prototype and Test Results

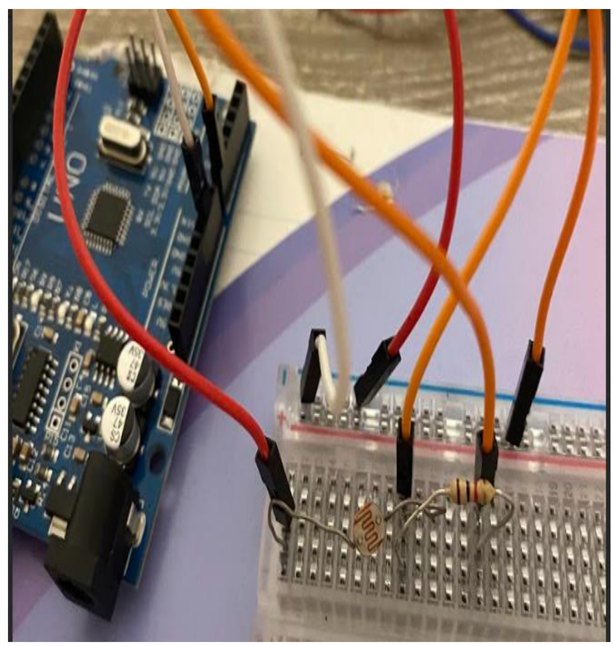
Test	Why?	What?	Results
Testing laser sensors at various ranges by increasing the distance the laser is from the photoresistors.	Finding the range at which the laser sensor functions is required for knowing where the sensors can be placed.	Looking for the maximum range that the laser sensor can be used at. Sensors must function at least 40 cm away, since that is the width of the entrance of our bat box.	The sensor could function when the laser was 80 cm away from the photoresistors, but the range did not change results.
Testing the distance that the photoresistors must be apart from each other so bats represented by paper 5 cm wide trigger both sensors and so, it does not trigger both when bat poop represented by paper 1.5 cm by 1.5 cm. Lasers are 40 cm away from photoresistor.	To make sure the entry or exits for bats does not increase when guano falls from the box.	Looking for the proper distance to put the photoresistors apart from each other.	Test 1: 5 cm apart: When 5cm wide paper goes through the sensors sometimes both sensors do not trigger. Test 2: 3.5 cm apart: When 5cm wide paper goes through the sensor from anywhere or any side both laser sensors trigger, while the 1.5 cm by 1.5 cm paper does not trigger sensor at the same time.

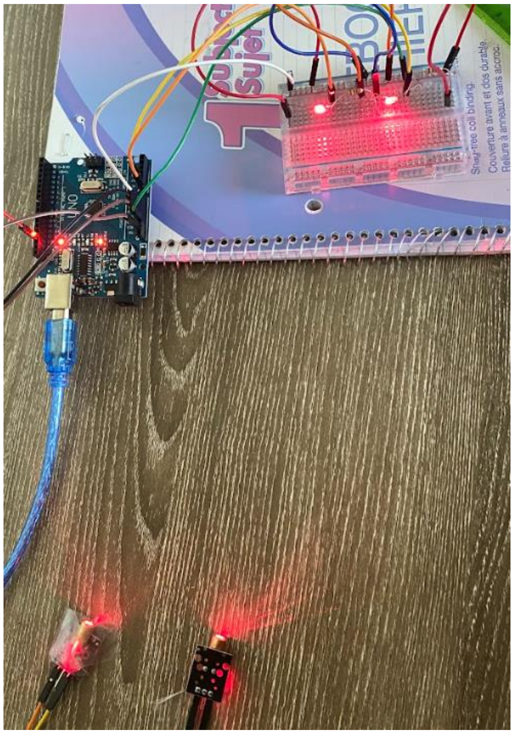
Testing the laser sensors with various speeds of objects. by performing several experiments where objects (my hand and piece of paper that has a width of 5 cm mimicking the dimensions of bats) move past the laser sensors.	Since the sensors are being used to track bats and bats can be coming into the caves at various speeds, sensor must be tested to work with objects of different speeds	Looking for any speeds where sensors do not read the object passing them.	Very slow speeds: both sensors were successful and worked at this speed for the ten trials done Slow speeds: both sensors were successful and worked at this speed for the ten trials done. Medium speeds: both sensors were successful and worked at this speed for the ten trials done. Fast speeds: both sensors were successful and worked at this speed for the ten trials done. Very fast speeds: Senors were only successful 3/10 times, however these speeds are not necessary since bats will not go this fast.
Testing laser sensor in various degrees of light, by using the laser sensor in a dark room to mimic darkness of box, and in a bright room.	Since the laser sensor must function all day long there will be various degrees of light getting into the bat box.	Looking for discrepancies in light environments.	Laser sensor functioned the same in a bright room in direct sunlight than in a dark room with no light.
Testing accuracy of the laser sensors by using the 5 cm wide paper as a bat and testing for over 30 minutes.	It is important for the laser to be accurate because providing false data to the client can be very determinately to their cause.	Looking for any errors in the number of entries or exits.	There were no errors, and the number of entries and exits were correct.

Laser connection:

Prototype:

Photoresistor connection:





Analysis of Critical Components

The following section outlines an analysis of the critical components needed for the testing of Prototype I. For this portion, only the components required for the bat detection subsystem are included as that will be tested in this deliverable.

Critical Components	Analysis
Laser sensor (2)	-Operating voltage of 5V -Wavelength of 650 NM -PCB size of 15*24 mm -20 mAx2
Photoresistor (2)	-around 2mAx2
1k ohm resistor (2)	-Resistance of 1000 Ohms -Power rating of 1/6W -5mAx2
Arduino board	-around 50mA

Required capacity (mAh) = 730 hours x 104 mA

=75 920 mAh

This is just too large for batteries. (new power source in updated detailed design)

Feedback

The feedback the client gave during the client meeting consisted of points such as ensuring that all parts of the solution are well thought out and have a reason for being used. The client also mentioned that the solution presented demonstrated a good understanding of the problem being presented. Feedback from other potential users is to ensure that the power usage is well thought out and that the source of power being used is strong enough to power the tracker as well as being cost efficient. Additional feedback from users consists of thinking about data transfer more thoroughly and ensuring there is enough space for the storage of the electronics for the tracker without interfering with the usage by the bats.

Updated Detailed Design

- Photoresistors are 3.5cm apart.
- The power source will change to a USB adapter, and a USB cable attached to the Arduino instead of batteries to account for the large power draw.

Updated Bill of Materials

- USB adapter and cable for power source instead of battery power

Items Added	Cost	Source
10FT Power Cord for Arduino	$29.99	https://www.amazon.ca/Extra-Power-Supply-Adapter-Arduino/dp/B09T6VNPF8
Items Removed		
Two 18650 3.7V Batteries	$20.12	https://www.temu.com/ul/kuiper/un9.html?subj=goods-un&_bg_fs=1&_p_jump_id=894&_x_vst_scene=adg&goods_id=601099581914852&sku_id=17592469896669&adg_ctx=a-e7ccb7ea~c-d0bca71b~f-3055a07f&_x_ads_sub_channel=shopping&_p_rfs=1&_x_ns_prz_type=-1&_x_ns_sku_id=17592469896669&_x_ns_gid=601099581914852&mrk_rec=1&_x_ads_channel=google&_x_gmc_account=695390730&_x_login_type=Google&_x_ads_account=6910707695&_x_ads_set=21445363611&_x_ads_id=170102327448&_x_ads_creative_id=705206038285&_x_ns_source=g&_x_ns_gclid=CjwKCAjwyfe4BhAWEiwAkIL8sMpK_p8hRGN3peG1cfdNemuLC8v8rSKTprtYcTXvFeCCmbUdlc3pPhoCVoIQAvD_BwE&_x_ns_placement=&_x_ns_match_type=&_x_ns_ad_position=&_x_ns_product_id=17592469896669&_x_ns_target=&_x_ns_devicemodel=&_x_ns_wbraid=Cj4KCAjwpvK4BhBuEi4AC275K0g3_FJOKcEtTWCafELKmmpEhS6iZrTUWEOa7MaSNfgY5mkvT1nh4-

		qMGgJCvw&_x_ns_gbraid=0AAAAAo4mICHzz7uFCllvd2WXEhqdy2DlB&_x_ns_targetid=pla-2323199550871&gad_source=1&gclid=CjwKCAjwyfe4BhAWEiwAkIL8sMpK_p8hRGN3peG1cfdNemuLC8v8rSKTprtYcTXvFeCCmbUdlc3pPhoCVoIQAvD_BwE
Original Estimate	$131.49	
Updated Estimate	$141.36	

Prototype Test Plan II

Test ID	Test Objective	Description of Prototype used and of Basic Test Method	Description of Results to Be Recorded and How They Will Be Used	Estimated Duration and Planned Start Date
1	Verify seal on box to ensure no water leakage	The bat box prototype will be sealed at the edges of the wood with caulk and painted with waterproof paint. This will allow for testing in simulated rain. Water will be sprayed onto the box with fans to simulate rain and wind.	After each session of spraying water, the inside of the box will be checked for any water that may have seeped in. Any signs of water leakage into the box will be noted. These results will be used to improve the weatherproofing systems of our bat	The test stops when water leakage into the box is noticed or after multiple trials of successful tests.

			box in the next prototype.	
2	Evaluate effectiveness of ventilation system on temperature control	The prototype will include ventilation holes on the box's sides and a slit in the front to regulate the internal temperature. The box will be placed in direct sunlight for a prolonged period with a thermometer. Temperature readings will then be taken, ensuring they do not exceed 40°C.	The internal temperature data will be monitored every 30 minutes and compared to the maximum and minimum required temperatures. The results will indicate if any modifications need to be made in the ventilation systems.	The test is stopped after 2 days in direct sunlight and the needed temperature is observed and stable.
3	Test mounting system durability under stress and added weight	The full bat box prototype will be mounted to any vertical surface using the chosen brackets and screws. Weight will be added gradually inside and/or outside the box to test the limit of the mounting system and its stability.	Any visible stress or instability will be documented. Possible breaking or loosening of the brackets will also be noted. These results will be used to determine the strength and reliability of the brackets and if any adjustments should be made to the mounting apparatus.	The test will stop when a maximum of 1kg has been applied successfully to the box or when mounting becomes unstable.
4	Test durability of wood in simulated rain conditions	Water will be sprayed onto the complete bat box prototype to test the absorption and durability of the wood.	Document the level of water absorption from the wood or any surface damage. The results will be used to decide whether more waterproofing is needed to protect the wood.	The test will stop when water damage is visible or after multiple trials with no effect.

Conclusion

In this deliverable, we have documented the development of our first prototype which focuses on the sensor and detection component of the box. This includes an analysis of the critical components of our detection system, documentation of the prototyping and testing process, and an update to the target specifications and BOM based on this prototype. Feedback from the client and users on our design is also included and was considered for this prototype and future iterations. Also included is the outline of the test plan for our next prototype. The next phase will involve testing the bat box prototype based on this plan to evaluate its durability and effectiveness in real world conditions.