

## Group 16: Deliverable E

### TESTING

COMPONENT	CONDITION TO BE MET / METRIC	HOW WE TEST
Sensor	<p>Must be able to accurately detect motion at the bat box's opening.</p> <p>For accuracy, we will aim for 95% accuracy for the sensor tracking the bats.</p> <p>For example, if there are 20 detections in a day, a maximum of 1 of those can be considered inaccurate. (ex. A double detection or missed detection)</p>	<p>Test the sensor using movements at approximately the distance of the width of the box opening.</p> <p>Test items of many sizes, to ensure that bats will not go undetected.</p> <p>Also, move the items at different speeds to make sure that they will be detected regardless of speed.</p>
Temperature	<p>The temperature must be comfortable for the bats.</p> <p>-&gt; Inside the box must be below 40°C.</p>	<p>Put the box under typical heat, using sunlight or a heat lamp, and make sure the inside does not pass 40°C under natural conditions.</p>
Weather Proofing	<p>The box cannot have large water leaking (ex. When it's raining)</p> <p>-&gt; A maximum of 2% of the total water load can enter the box. For example, if 60mm of rain falls, a <u>maximum</u> of 1.2mm can get in.</p>	<p>Pour water on the top to simulate rainfall. Test a range of strengths to make sure it will be able to withstand light and heavy rain.</p>
Durability of the Box (outside)	<p>The box must be able to withstand moderate impact (ex. if something falls on it)</p> <p>Since wind will be the strongest force acting on it, we will consider it as the maximum load.</p> <p>According to Ottawa Weather Stats, the maximum wind gust in Ottawa this year was 135 km/h. This translates to about 35kg of force.</p>	<p>Do a moderate impact test, to simulate branches falling or heavy wind.</p> <p>Of course, this will not be done by dropping 35kg on the box, but more of a gradual application like wind.</p> <p>A test of increasing force on the box will be done to ensure it will not break under natural weather conditions.</p>

Durability of the Box (inside)	<p>We are estimated to have a maximum of 250 bats, weighing around 15g each (<a href="https://animalia.bio/little-brown-bat">https://animalia.bio/little-brown-bat</a>). This translates to a load of 3.75kg.</p> <p>For our box, we'll factor in some <math>\pm</math> for the weight, so we will say the inside of our box should be able to handle 10kg.</p>	<p>We will place/hang weight adding up to approximately 10kg inside the box.</p> <p>This will ensure that even in the busiest times, our box can withstand above theoretical maximum capacity.</p>
Reliable Power	<p>The power source must be reliable, with no errors.</p> <p>The power should be able to function fully between maintenance days.</p>	<p>Run the power source for an extended time (ex. overnight). Make sure that the power source is reliable and will not fail.</p> <p>We will not be able to test a full month of power, but we will test an extended period (ex. 1 day) and base our results on that.</p>

## Materials for the Bat Box Construction

1. Plywood - For the bat box structure.
2. Screws or Nails (Weather-resistant) – For securing the box together.
3. Wood Adhesive (Eco-friendly) – To ensure joints are sealed tightly.

## Design Features for Bat Comfort

1. Ridged Slats ( $\frac{3}{4}$  inch spacing) – To create secure roosting areas inside the box.
2. Non-toxic Paint or Stain – temperature control

### Subsystem 2: Detection System

1. Motion Sensor (95% accuracy) – Installed near the base of the bat box to detect movement.
2. Microcontroller (Arduino) – For processing sensor data and logging events.
3. Power Supply (Battery pack or Solar-powered) – To power the microcontroller and sensor.
4. Wires and Connectors – For connecting sensors to the microcontroller.
5. Waterproof Enclosure for Electronics – To protect sensors and microcontrollers from the weather.

## Fasteners & Mounting

1. Weather-resistant Mounting Brackets – To secure the bat box to a wall or post.
2. Anchors and Screws – For mounting the box securely.

## Software and Libraries (If applicable)

1. Motion Detection Library – For processing sensor data.
2. Time-Stamping Library – To log the detected events with accurate timestamps.

# BUDGET

Table 1: Budget and Materials

Item	Dimension (if applicable)	Type/Make (if applicable)	Purpose	Quantity	Per Unit Cost (\$ CAD)	Cost (\$ CAD)
<a href="#">Plywood</a>	4ft x 8ft	Spruce	Bat Box Structure	1	\$28.980	\$28.98
<a href="#">Screws</a>	1 inch	#9	Bat Box Assembly	3	\$3.280	\$9.84
<a href="#">Exterior Wood Adhesive</a>	N/A	Gorilla Glue	Adhesive	1	\$5.970	\$5.97
<a href="#">Outdoor Paint</a>	N/A	Exterior Paint + Primer	Temperatur e Regulation and Water Retardant	1	\$24.970	\$24.97
<a href="#">Arduino Uno</a>	N/A	Arduino Uno	Runs Sensor	1	\$29.990	\$29.99
<a href="#">Motion Sensor</a>	N/A	Arduino Uno	Senses transits	1	\$12.990	\$12.99
<a href="#">Solar Panels</a>	10.66 x 6.88 x 0.1	N/A	Charging Sensor	1	\$15.990	\$15.99
<a href="#">Battery</a>	N/A	AA	Reserve Battery Power for Sensor	4	\$0.995	\$3.98
<a href="#">Battery Case</a>	N/A	N/A	Holds Batteries	1	\$7.490	\$7.49

<a href="#">Hinges</a>	3in x 3.19in	Reversible	Opens roof for maintenance	2	\$4.960	\$9.92
Total						\$150.12
Budget Remaining						-\$0.12

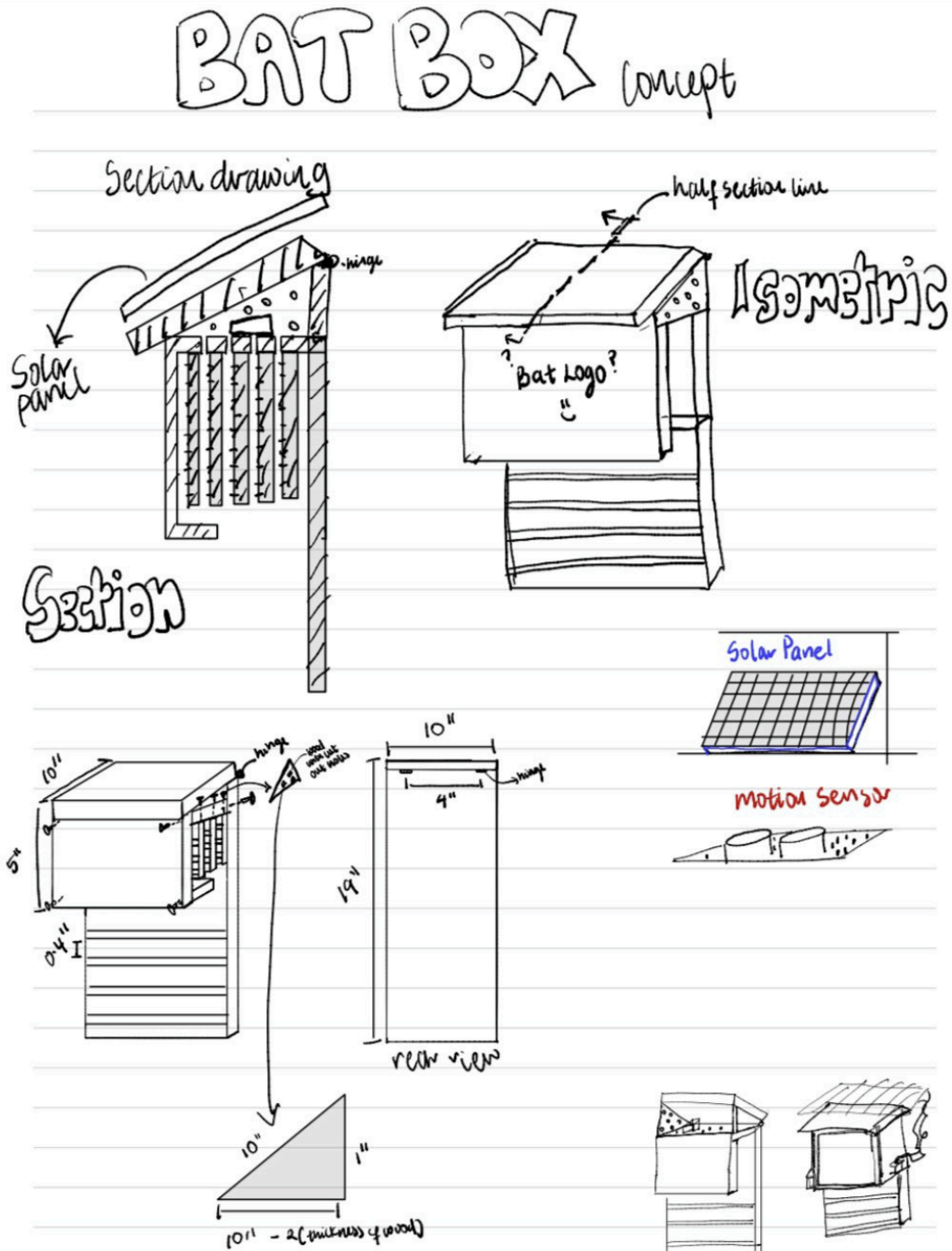
Table 1 is a representation of the estimated cost for building one prototype bat box. This will be a fully operational bat box, equipped with Bat Analytics: Temperature Monitoring and Nesting device (BATMAN). Cost estimates do not include Harmonized Sales Tax (HST), and if this product is to be mass produced, cost of materials may be substantially lower.

## Sources

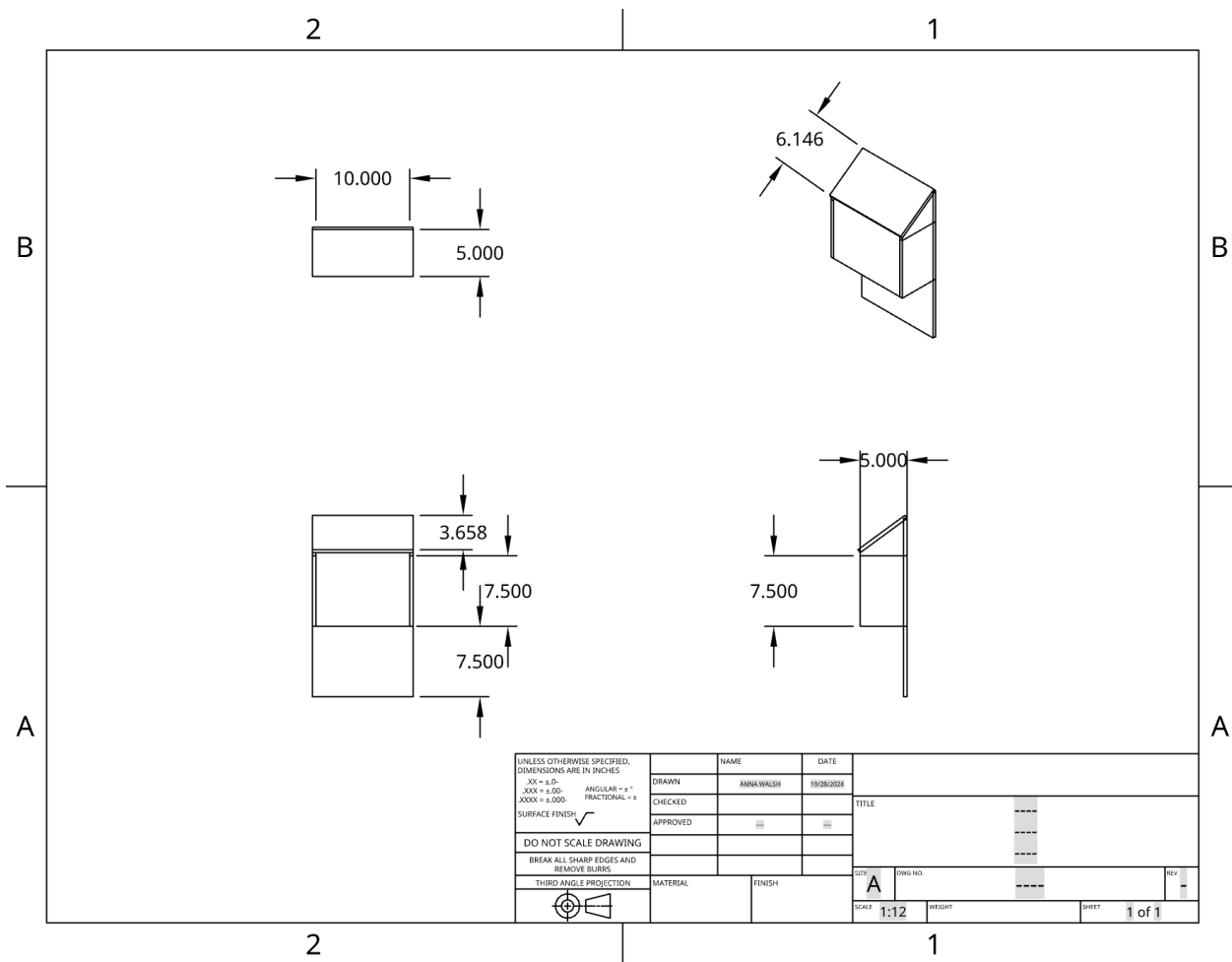
"Extremes: Maximum Wind Gust - Monthly Data for Ottawa (Kanata - Orléans)." *Amateur Weather Statistics for Ottawa (Kanata - Orléans), Ontario*, [ottawa.weatherstats.ca/charts/extreme\\_max\\_wind\\_gust-monthly.html](http://ottawa.weatherstats.ca/charts/extreme_max_wind_gust-monthly.html). Accessed 24 Oct. 2024.

"Little Brown Bat." *Little Brown Bat - Facts, Diet, Habitat & Pictures on Animalia.Bio*, [animalia.bio/little-brown-bat](http://animalia.bio/little-brown-bat). Accessed 24 Oct. 2024.  
<https://animalia.bio/little-brown-bat>. Accessed 24 Oct. 2024.

## Rough Sketch:

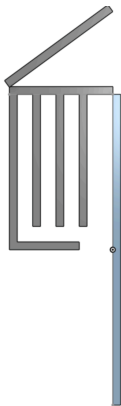


Technical Drawing:



Cad Design:

Inside:



Assembly:

