

## Test Plan for Prototype II

### Objective:

To improve upon the 1st prototype by enhancing durability, environmental resistance, and sensor functionality, and to gather further feedback to optimize the design.

### Key Testing Areas:

1. **Motion Sensor Accuracy**
  2. **Temperature Control**
  3. **Weatherproofing**
  4. **Structural Durability**
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### Components to Test and Metrics:

#### 1. Sensor Accuracy:

- **Objective:** Ensure the sensor detects motion at the bat box's entrance with a 95% accuracy rate (tracking small movements accurately and reliably).
- **Metric:** At most, only 1 incorrect detection (false positive/negative) out of 20.
- **Test:**
  - Simulate bat movements (using different object sizes and speeds) at the box's entrance.
  - Test the sensor's ability to detect these movements and record the accuracy.
  - Vary conditions, such as distance and lighting, to ensure the sensor functions under different scenarios.

#### 2. Temperature Control:

- **Objective:** Ensure the internal temperature of the bat box remains below 40°C in natural sunlight or under typical environmental conditions.
- **Metric:** Internal temperature of the box should stay below 40°C.
- **Test:**
  - Place the bat box under direct sunlight or heat lamps to simulate daytime conditions.
  - Use a thermometer to monitor the internal temperature over time.
  - Test with the roof open/closed to check ventilation efficiency.

#### 3. Weatherproofing:

- **Objective:** Prevent water infiltration during rainy conditions.
- **Metric:** Maximum 2% of water load entering the box (e.g., if 60 mm of rain falls, no more than 1.2 mm of water can enter).
- **Test:**
  - Simulate different levels of rainfall by pouring water on the bat box at varying strengths.

- Measure the amount of water that enters the box (if any), checking all seals and joints.

#### 4. **Structural Durability:**

- **Objective:** Ensure the bat box withstands external forces, such as wind gusts or falling branches.
  - **Metric:** The box should withstand forces around 35 kg (equivalent to 135 km/h wind gusts).
  - **Test:**
    - Apply force gradually to the box, mimicking the impact of strong winds or debris.
    - Check for structural integrity after each test to ensure no cracks or weaknesses.
    - Perform a **weight test** on the inside by applying 10 kg of load, ensuring the box handles the maximum estimated bat capacity.
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### **Stopping Criteria:**

Each test will be considered complete once the following conditions are met:

1. **Sensor Accuracy:** Achieves 95% accuracy across multiple test conditions (size, speed, distance).
  2. **Temperature:** Internal temperature remains consistently below 40°C for at least 4 hours under simulated sunlight.
  3. **Weatherproofing:** No more than 2% of water enters after simulating different rainfall levels.
  4. **Durability:** The box remains structurally intact after simulated wind forces and weight application.
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### **Fidelity and Adjustments:**

- This prototype aims to achieve a higher level of **accuracy and durability** than the first version.
- If any components fail to meet the stopping criteria, adjustments will be made to the design, and the test will be rerun until all criteria are met.
- Each failure will be analyzed, and we will make appropriate changes.

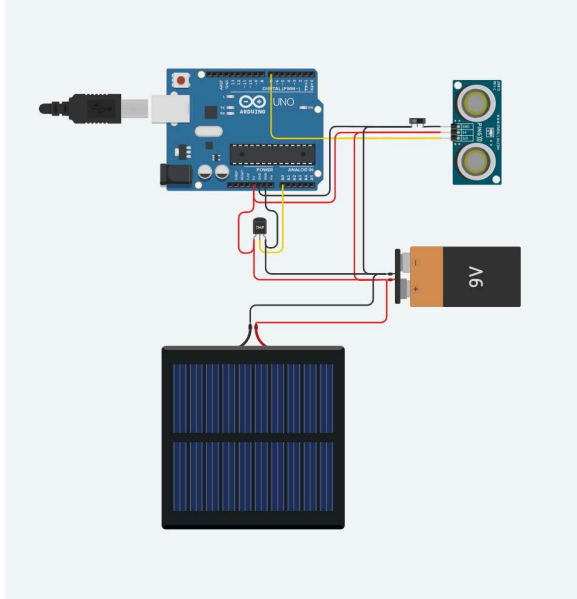
### **Note on Feedback:**

We will gather further feedback on this prototype from users (e.g., bat conservation experts or potential clients) regarding the overall design and performance, especially focusing on **sensor performance** and **environmental resistance**. Based on this feedback, we will refine the design. Furthermore, we will also ask for feedback on the dimensions, setup, and convenience of our design, and make changes if necessary.

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## Analysis of Components:

i) Circuit setup for the Arduino, Battery, and solar panel.



(In this setup, the battery acts as backup power for the components; however, in our real design, the battery will directly power the Arduino. The software that we used did not allow using the battery to power the Arduino.)

ii) General Design

Firstly, we are including ventilation holes near the top of the bat box, to help regulate temperature and airflow throughout the box. This is because the bats do not enjoy being in hot temperatures, so simple ventilation will help ensure the box does not overheat. Another component of our design is multiple roosting slabs in the interior of the box, creating more space for bats. This will increase the capacity of our box, making it more flexible to hold many more bats compared to a simple one-slab design.

In terms of weatherproofing, we are going to seal cracks as best as possible and create a sloped roof. Sealing cracks will help eliminate any risk of large quantities of rain entering, and the sloped roof will ensure that rain or snow does not build up on the top of the box.