Electronics Document Round II

# Manufacturability

| **Component** | **Manufacturer** | **Procurement in India** | **Component Testing** |
| --- | --- | --- | --- |
| MPU 6050 | InvenSense | Mouser Electronics | Basic Calibration (using Adafruit Library) |
| TF-LUNA Micro LiDAR | Benewake | Robu.in | Elementary software testing (using the Serial library) |
| ESP-32 WROOM board | Espressif | Robu.in | Unit tests (using the ESP-IDF) |
| LG HG2 18650 Cells | LG | Battery Bro | Capacity tests and CCD tests |
| DC Motors | Kysan Electronics | Kysan Electronics | Direct testing to find temperature and efficiency |

# Serviceability

## Battery Pack

* The life of the battery pack is expected to be around 400 cycles till a significant drop in performance is noticed.
* In case of depreciated capacity, the batteries can easily be replaced with new ones.

# Failure Mode Effect Analysis

## Scope

* **Resolution -** The analysis will limit itself to the electrical and electronic components of the Robot vacuum cleaner. It will also consider the implementation of the path planning algorithms.
* **Focus -** Accuracy of working, Safety of user

## Potential Failure modes

### Damaged Sensors

* + **Cause :** The IMU and Lidar might get damaged due to constant exposure to water and other fluids.
  + **Effect :** Decrement in accuracy and total non-working in case of severe damage
  + **Detection :** If one sensor is damaged, the sensor fusion algorithm detects a significant amount of discrepancy in the values obtained from two sensors.
  + **Action :** Alert the user to replacement of the sensors

### Erroneous Navigation

* + **Cause :** The cumulative errors in the position of the bot leads to a significant deviation from the intended path
  + **Effect :** Fallacious values being fed into the path planning algorithm further reducing the efficiency of bot
  + **Action :** The following solutions are proposed :
    1. Implementation of an Extended Kalman filter algorithm to fuse the sensor data obtained from inertial measurement unit and LIDAR. ( Can be achieved via ROS Packages)
    2. Setting up a Proportional-Integral-Derivative controller in the navigation ROS stack to fine tune the control.

### Abnormal Temperature

* + **Cause :** Due to overload and continuous operations, the Lithium batteries might get over-discharged
  + **Effect :** Significant risk of abnormal temperatures and the batteries getting exploded
  + **Detection :** The internal temperature sensors monitor the temperature of the batteries and the system continuously
  + **Action :** The battery pack comes with a BMS which should handle this case forcing a shutdown of the power circuit. Further to prevent reaching abnormal temperatures, a proper ventilation system is considered while designing the model.