**Methodology:**

**Waypoint Generation:**

Technology involved: Global Positioning System(GPS), Global Navigation Satellite System (GLONASS).

Trajectory planning Algorithm: Global Positioning System (GPS), Angle of Arrival(AOA), Received signal strength indication(RSSI), LOCALIZER BEE, VERIFIER BEE.

**Verifier BEE:**



* *Figure 1 Verifier Bee*
* We have prior knowledge of the position of the nodes.
* we have to impose that the node is reachable by all the waypoints forming the verifiable triangle that contains it.
* Verifier Bee operates in three phases:
* initial path construction
* iterative improvement
* waypoint reordering [1]

**Collection of Data:**

* Collection of data
* Internet.
* Drone (Collecting from the various streets).
* Videos of local street (Various Cities).



* Total images: 1858
* Clean roads:1000
* Potholes:550
* Garbage:308

More data will be gathered once we get the devices.

**Deep Learning Inception Model:**

Inception-v3 is trained for the ImageNet Large Visual Recognition Challenge using the data from 2012. This is a standard task in computer vision, where models try to classify entire images into 1000 classes, like "Zebra", "Dalmatian", and "Dishwasher". Likewise, we classify the images into 3 categories: clean roads, dirty roads, potholes.

Technology Involved: Google Inception Model, python script, dataset gathered by drone.

Here is the initial result by training 1858 images,



**Diagram:**

Below is the system design.

Hardware modules:

* Hardware Modules
* Quadcopter: For flight and gathering data
* Raspberry Pi/ Arduino/ Node MCU: GPS Trajectory, Data Logger
* RFID Module (Warehouse Drone)
* Software Module
* Python
* GazeboSim
* Matlab
* Waston IoT
* Google Inception module
* Verifier bee



**Analysis Table:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No** | **No of training images.** | **No of testing images** | **Type of testing images** | **Probability** | **Accuracy** |
| **1** | **3** | **750** | **Garbage roads** | **garbage dataset 0.9999995**  **potholes dataset:4.3115966e-07**  **clean roads 4.2900403e-08** | **98 %** |
| **2** | **20** | **750** | **potholes** | **potholes dataset 0.99998975**  **garbage dataset 8.9043315e-06**  **clean roads 1.2984551e-06** | **87.33%** |
| **3** | **50** | **1200** | **Clean roads** | **clean roads 0.997109**  **garbage dataset 0.0020415883**  **potholes dataset 0.00084943604** | **93%** |
| **4** | **100** | **1200** | **potholes** | **potholes dataset 0.999675**  **garbage dataset 8.9043315e-06**  **clean roads 1.2984551e-03** | **68%** |
| **5** | **150** | **1200** | **Garbage** | **garbage dataset 0.9999445**  **potholes dataset 5.31455966e-07**  **clean roads 5.2900403e-10** | **88%** |
| **6** | **25** | **1200** | **Clean roads** | **clean roads 0.997109**  **garbage dataset 0.0020415883**  **potholes dataset 0.00084943604** | **98%** |
| **7** | **100** | **1200** | **Clean roads** | **clean roads 0.9909473**  **garbage dataset 0.0020232389**  **potholes dataset 0.000882349** | **91%** |
| **8** | **28** | **1200** | **garbage** | **garbage dataset 0.9999995**  **potholes dataset 8.3345966e-08**  **clean roads 6.2700403e-09** | **76%** |
| **9** | **125** | **1200** | **garbage** | **garbage dataset 0.99994556**  **potholes dataset 1.3115966e-08**  **clean roads 3.2900403e-05** | **99%** |
| **10** | **65** | **1200** | **potholes** | **potholes dataset 0.9998111**  **garbage dataset 2.96453315e-05**  **clean roads 3.23332551e-06** | **94%** |

**Analysis after image processing:**



**Information Decimate:**

After the work is completed, and if the waste is detected, further action will be taken in form of notification to the concern party.

Software Used: Android application, Windows Application.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Image** | **Location** | **Date** | **Time** | **result** |
| **Image\_1** | Longitude  Latitude | November 4, 2024 | 10:56 AM | Garbage / Clean / Potholes |
| **Image\_2** | Longitude  Latitude | November 4, 2024 | 10:57 AM | Garbage / Clean / Potholes |

**Bar Diagram:**

**References**

[1] Analysis of localization for drone-fleet By Jin-Hyeok Kang, Kyung-Joon Park, Hwangnam Kim 28-30 october 2015-IEEE