

Theme: Sustainability

Effective Waste Management

Problem

The increased population increases the waste generation. This puts pressure on waste management facilities, which are already in short supply.



Solution

Automate most parts of a waste management cycle. From source to recycling unit with proper tracking of the waste.

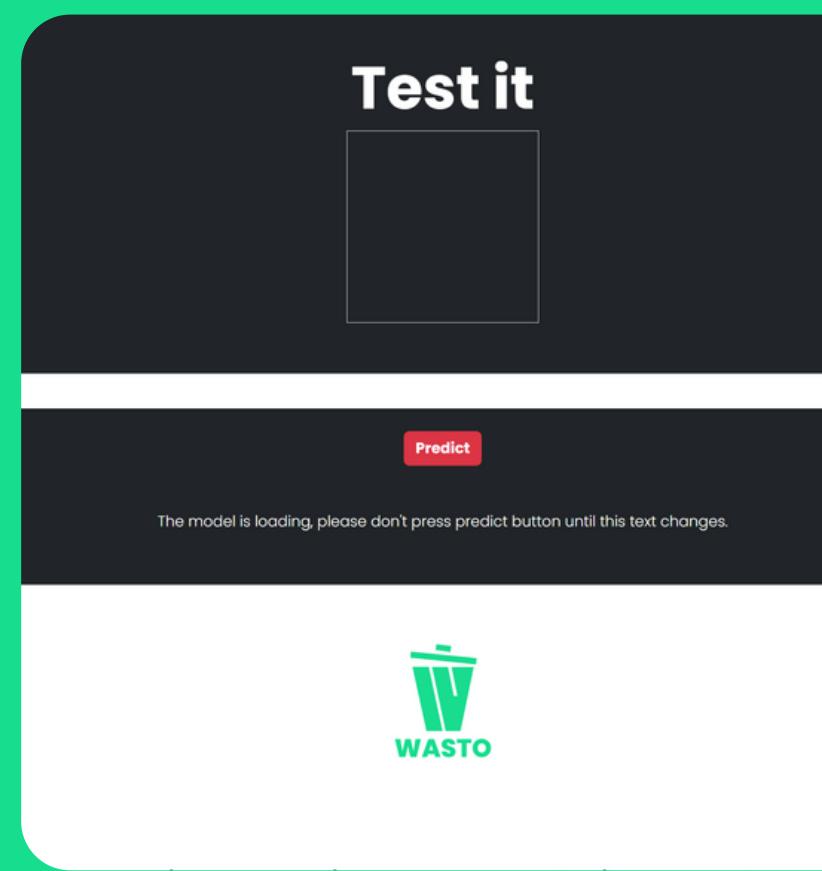


Target Variables

Identification of different types of waste, a record of waste travel, segregation, and recycling statistics.

Further Discussion A green rounded rectangular button containing the text "Further Discussion" in white, with a small circular icon containing a white right-pointing arrow to its right.

Project Introduction



Wasto

We are an organization for better waste management in society. We have developed an ML algorithm to detect and segregate the waste according to organic, Non-Biodegradable, and recycling products at the recycling unit and also we have developed a website & app prototype to track the waste from source to recycling unit and designed in a way to improve the situation of waste management units to control the waste and recycle more products from source, pickup, and units.

Key Problems

**01**

Source Level

- No base level of Segregation and awareness
- No regular tracking of the usage of the dustbin leads to no response when a dustbin gets filled, which leads to waste in random places.
- .No awareness about the base level of segregation.
- No proper maintenance of the dustbins and no awareness to prevent the intermixing of dry and wet waste.

02

Pick up level

- No regular pickup due to no trackage of the waste generated in different locations.
- No proper information about the waste generated daily in different locations.
- Intermixing of Organic, recycle, plastic waste (Wet & Dry).
- Delay in pickup due to lack in man force and other logistics issues.
- Very few pickup Locations.

03

Unit

- No proper differentiation between Organic, Plastic, and recycling waste.
- A lot of money is consumed by the current waste unit and plants. No Source of income and power.
- A lot of landfills are filled up without compressing the waste, increasing the level of waste.
- No proper statistics are generated regarding the efficiency in recycling.

Proposed Solutions



01

Source Level

- Tracking of filling of busy dustbins using ultrasonic sensor and Arduino digital weight sensor and passing information to authorities to transfer the waste to bigger dustbins and replace with the spare dustbins.
- Alert Notifications to use disinfectants (through WASTO).
- Alert Notifications to pass the info once the bigger dustbin gets filled to Institute authorities and waste management unit to pick up the waste from bigger bins in the segregation way using our ML model.
- The bigger dustbins will have level and weight sensors to record the quantity of wet and dry waste shared among institutes and units.
- Usage of WASTO bins(Explained in later slides)

Proposed Solutions

02

Pick up level

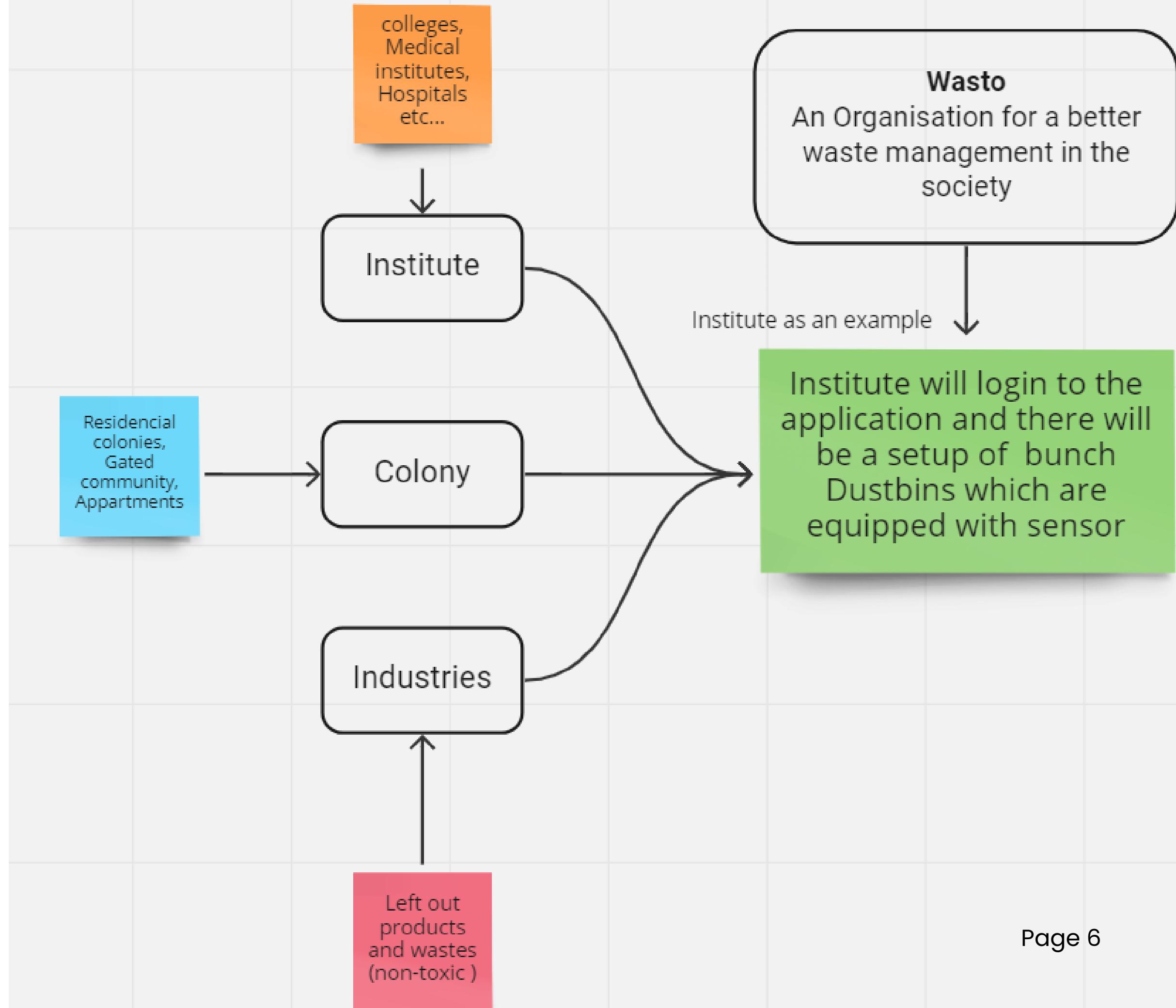
- Regular pick-up with the alert notifications and labeled zones according to the waste generation through the WASTO App/Website.
- Segregating the waste using our ML model while collecting the waste from different places.
- More Pick-up locations according to the waste generated in the different locations
- Installing different blocks for different waste (Like organic, plastic, and recycle) in the collecting van.

03

Unit

- Our ML algorithm segregates the waste according to organic, non-biodegradable, and recycling waste while we pass it on a conveyor belt.
- Complete statistics about the waste generated and recycled waste from it.
- The pyrolysis process is used on Non-Bio Degradable wastes so that power is generated -Power management
- Landfills are managed
- The good that comes through recycling can be sold - Cost management

Target Audience



Intro to Wasto Dustbins

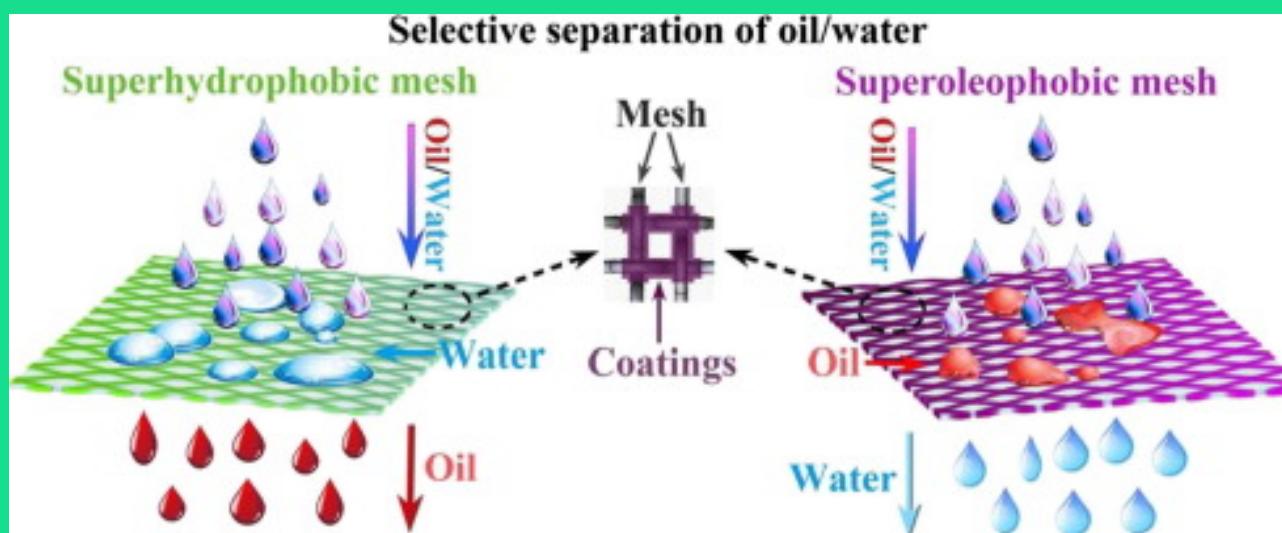
- Clear Visualisation with proper installation of stickers like compost(No plastic), Waste(Plastic) instead of dry or wet is installed on these dustbins for clear identification to throw waste.
- Press Mechanisms to open the dustbins are included.
- A selective separation layer is installed 40 cm from the bottom of the dustbin to separate the wet waste. (reference image is given below)
- All the Bigger Dustbins and a few smaller dustbins where wastage generation is more will be equipped with sensors to alert the authorities about the complete filling of the big dustbin, which leads to contact with the Waste Collectors.
- These big Dustbins contain level and weight sensors, which will record the quantity of wet and dry waste.

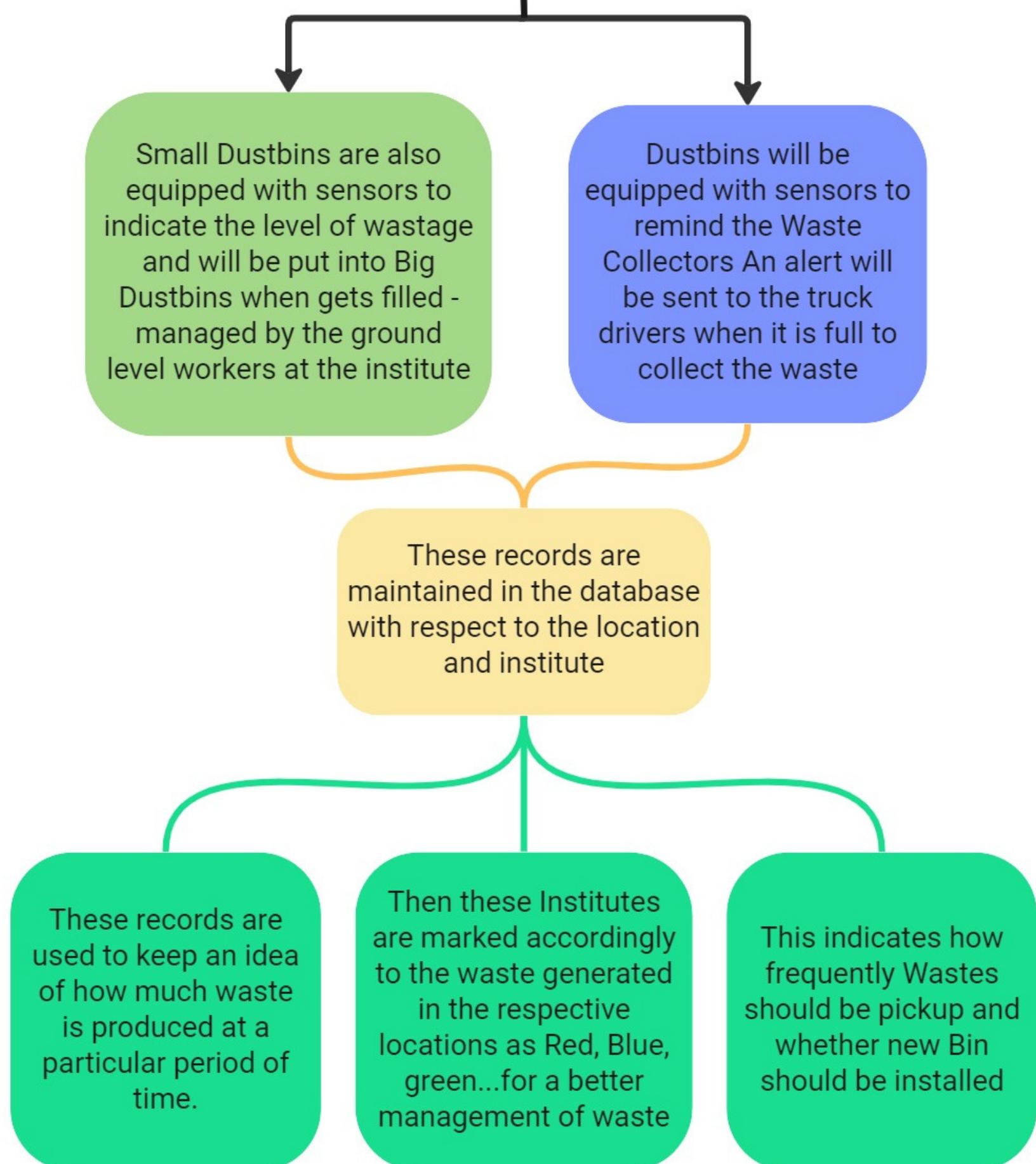


Small Dustbins which are present across the institutes



Big Dustbins relatively bigger to hold many small Dustbins Waste





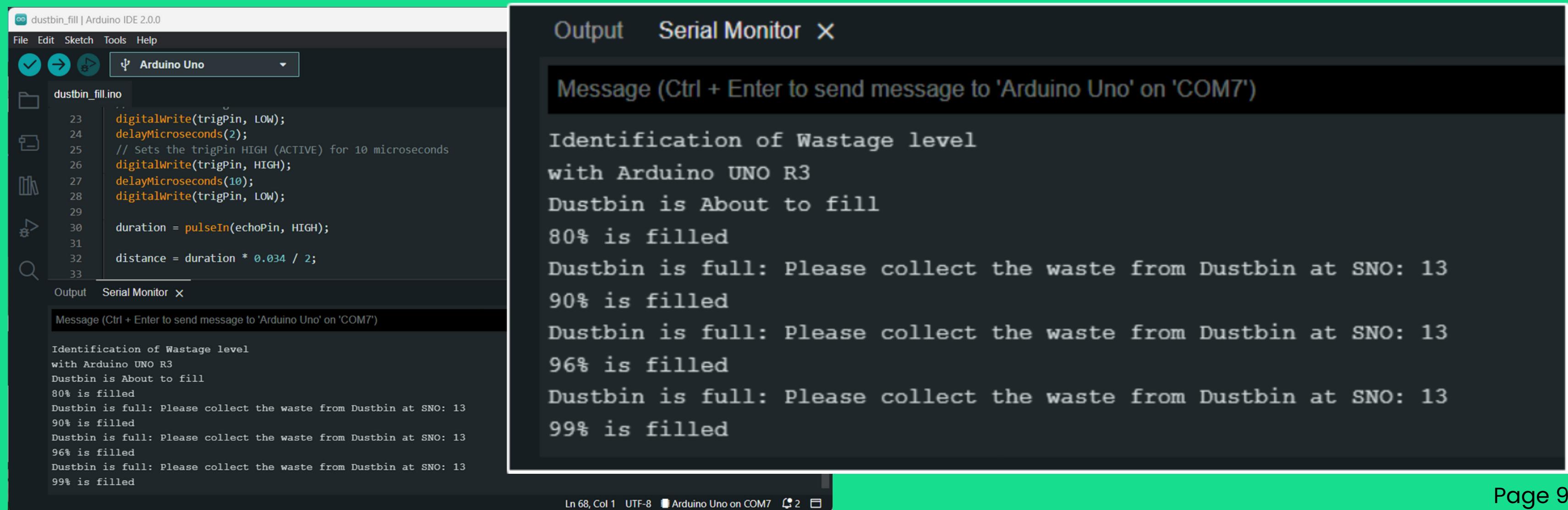
This Mind Map gives the idea about our prototype working model that we implemented in the dustbin.

To view the Concept map

Click on this link:

<https://miro.com/app/board/uXjVPLY5IEA=/>

- The weight and ultrasonic sensors detect the filling percentage of the labeled dustbins around the institute and pass the information to the respective authority through our **wasto**.
- This will help us to control the waste and leads to better waste management at the source level.
- We tested on a few busy dustbins installing the sensors and Arduino, and we got the results below. The information is passed to the governing authority of the college to take measures accordingly (to transfer the waste to more giant bins and replace them at the respective location with spare bins).
- A similar mechanism works with bigger bins where the info will be passed to respective college authorities and recycling units so that it will be picked up on time. The waste generation data (including organic plastic ..etc) will be stored in the Wasto and notified to the institute daily and provide weekly and monthly analysis.



The screenshot shows the Arduino IDE interface with the 'dustbin_fill' sketch open in the code editor and the Serial Monitor window displaying the real-time data from the Arduino Uno.

Arduino IDE Code (dustbin_fill.ino):

```

23   digitalWrite(trigPin, LOW);
24   delayMicroseconds(2);
25   // Sets the trigPin HIGH (ACTIVE) for 10 microseconds
26   digitalWrite(trigPin, HIGH);
27   delayMicroseconds(10);
28   digitalWrite(trigPin, LOW);
29
30   duration = pulseIn(echoPin, HIGH);
31
32   distance = duration * 0.034 / 2;
33

```

Serial Monitor Output:

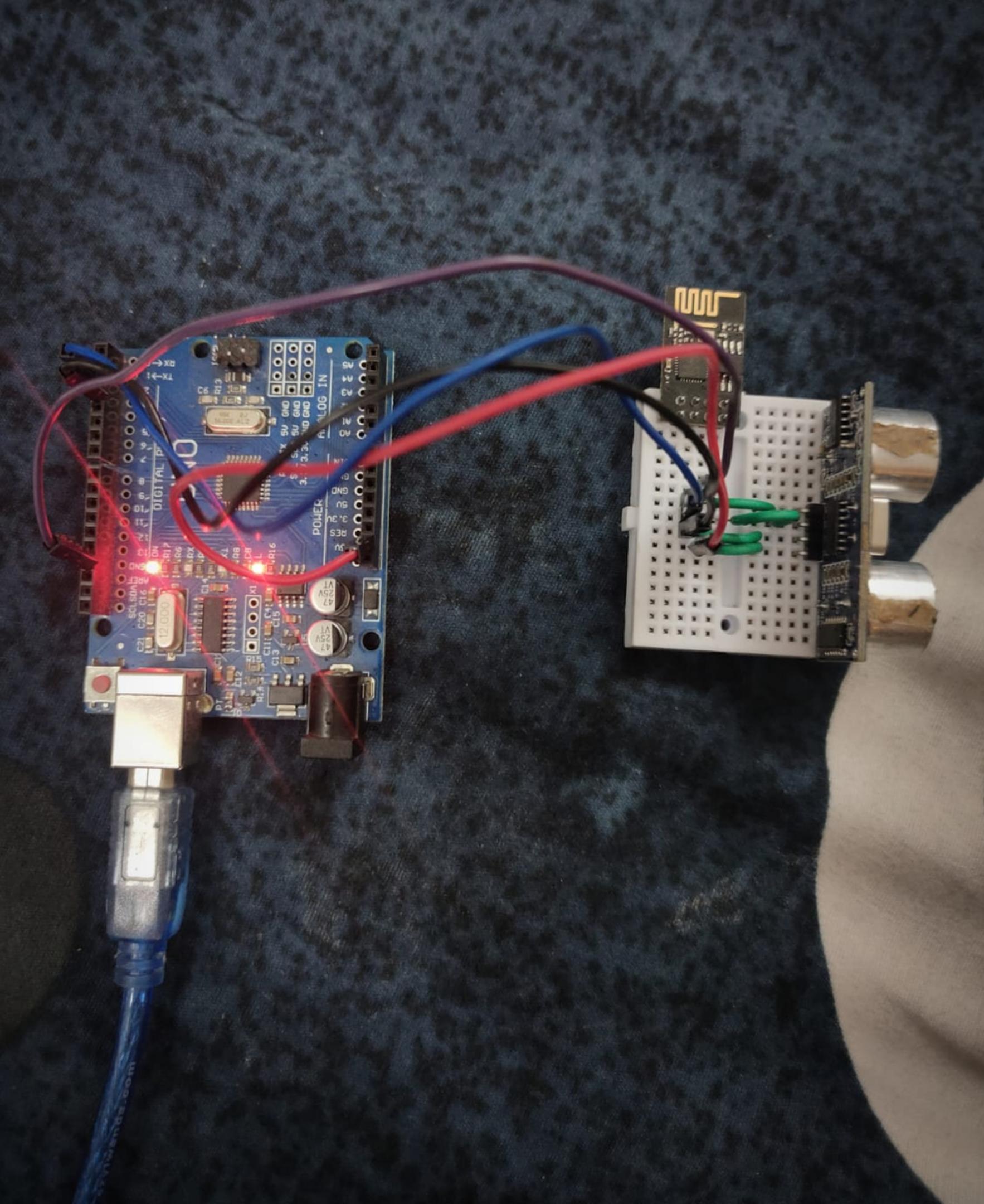
```

Message (Ctrl + Enter to send message to 'Arduino Uno' on 'COM7')

Identification of Wastage level
with Arduino UNO R3
Dustbin is About to fill
80% is filled
Dustbin is full: Please collect the waste from Dustbin at SNO: 13
90% is filled
Dustbin is full: Please collect the waste from Dustbin at SNO: 13
96% is filled
Dustbin is full: Please collect the waste from Dustbin at SNO: 13
99% is filled

```

Ln 68, Col 1 UTF-8 □ Arduino Uno on COM7 4 2



Circuit Design

This is the prototype we have made to check the level of Dustbins: When the dustbin is about to fill with waste the waste collectors get the notification through the wifi module

*Check out the code uploaded on GitHub

Wasto

An Organisation for a better waste management in the society

Institute as an example

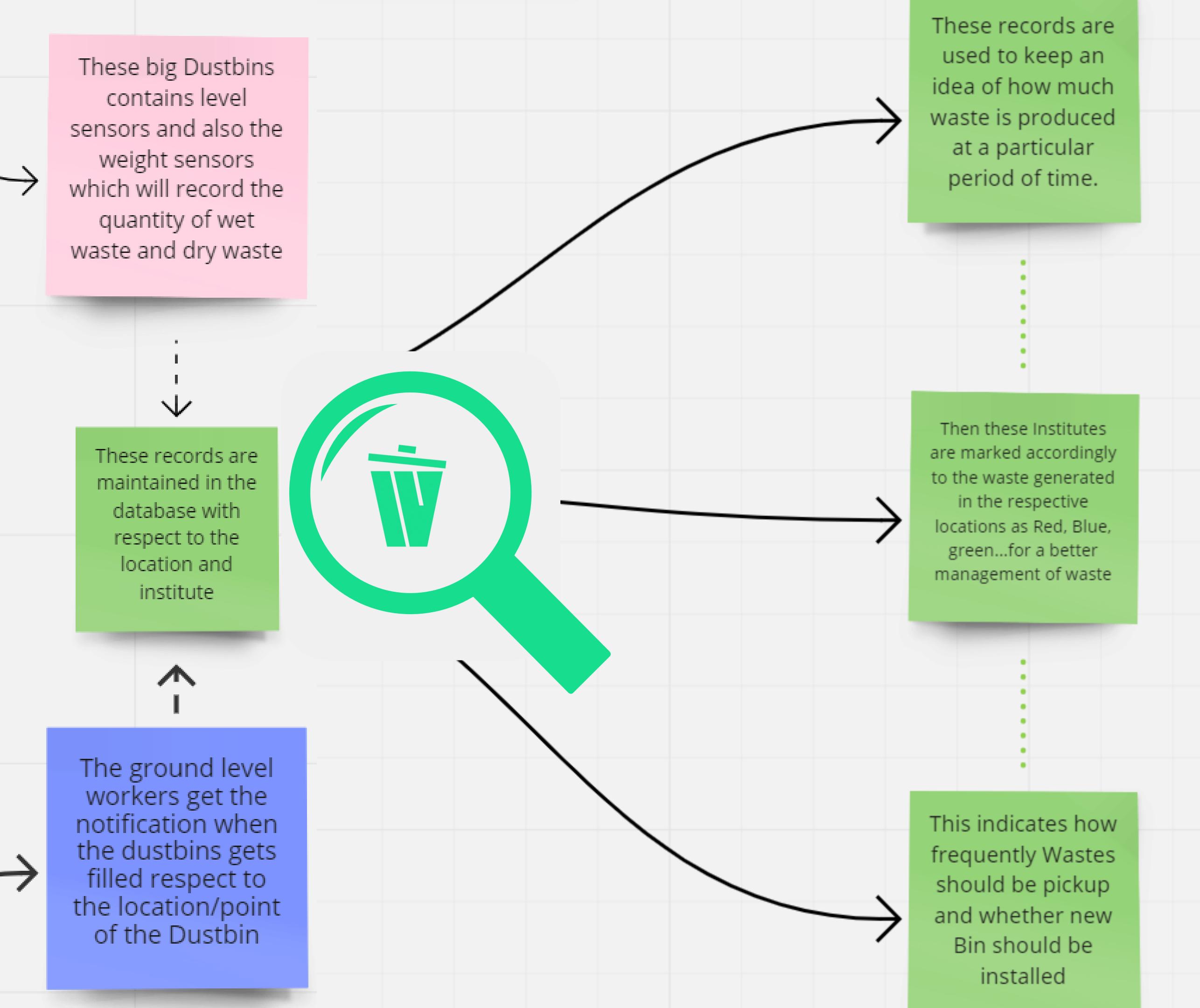
Institute will login to the application and there will be a setup of bunch Dustbins which are equipped with sensor

Big Dustbins relatively bigger to hold many small Dustbins Waste

Small Dustbins which are present across the institutes

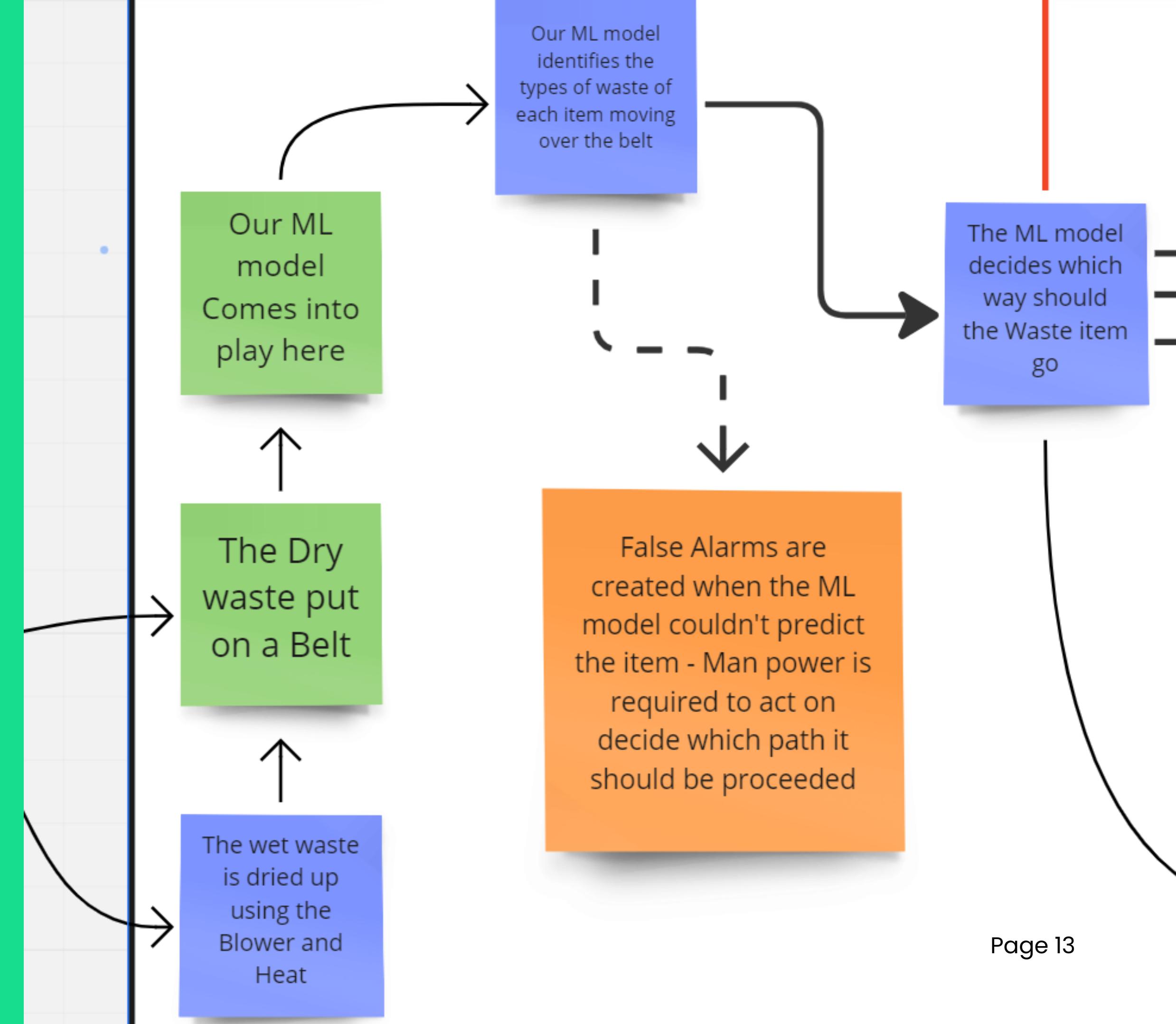
Dustbins will be equipped with sensors to remind the Waste Collectors An alert will be sent to the truck drivers when it is full to collect the waste

Small Dustbins are also equipped with sensors to indicate the level of wastage and will be put into Big Dustbins when gets filled - managed by the ground level workers at the institute



- Dustbins will be equipped with sensors to remind the Waste Collectors An alert will be sent to the truck drivers when it is full to collect the waste
- After empty the Bins Disinfectant is used to kill all the germs and remove bad Odour (a distinctive smell, especially an unpleasant one.)
- The trucks with Collected waste from the institute, takes it to the Waste segregation plant

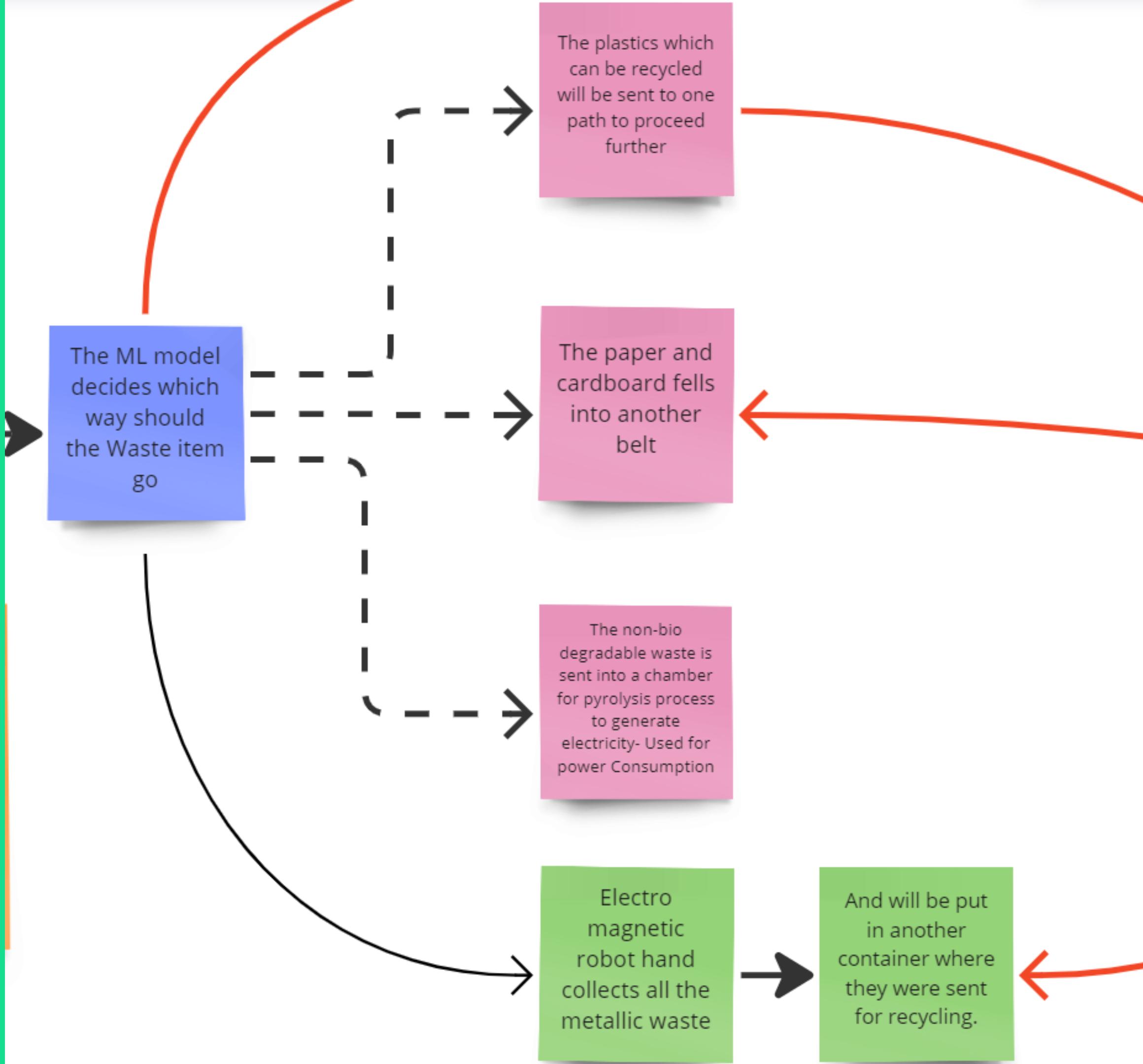
The waste segregation plant



The screenshot shows a user interface for a machine learning model. On the left, there is an input image area labeled "input_image" containing a photograph of a clear glass bottle with "SOLUT VODKA" printed on it. Below this are two buttons: "Clear" (gray) and "Submit" (orange). To the right of the image area, there is a "Flag" button. Above the "Flag" button, the output is displayed in two sections: "output 0" which says "glass", and "output 1" which says "It is Biodegradable". At the bottom left, there is a section titled "Examples" showing three small images: a set of colorful plastic utensils, a piece of pizza, and a green bottle.

This ML Model classifies an image of waste material as
"Bio-Degradable" or "Non-biodegradable."

[view api](#) • built with gradio

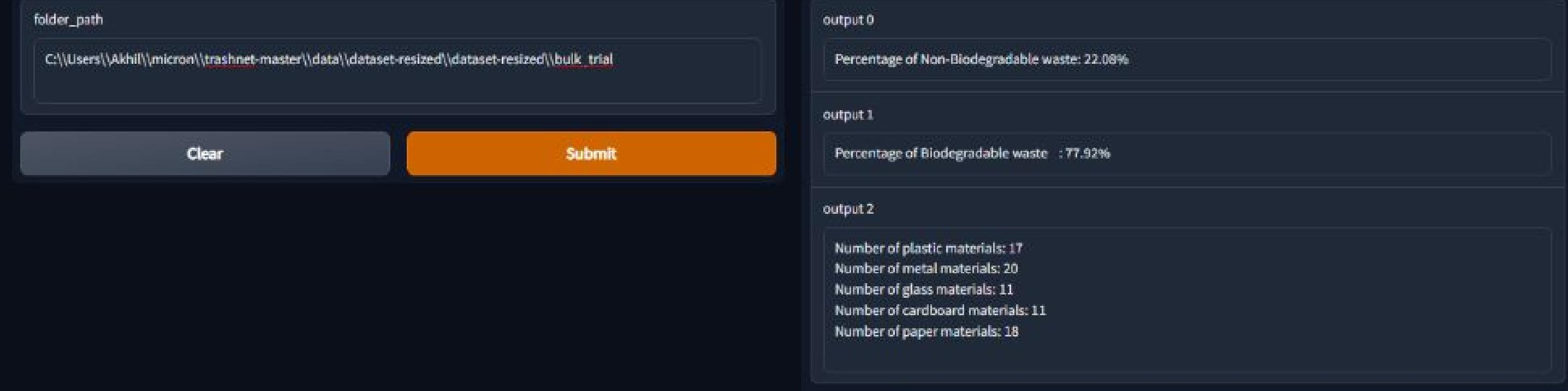




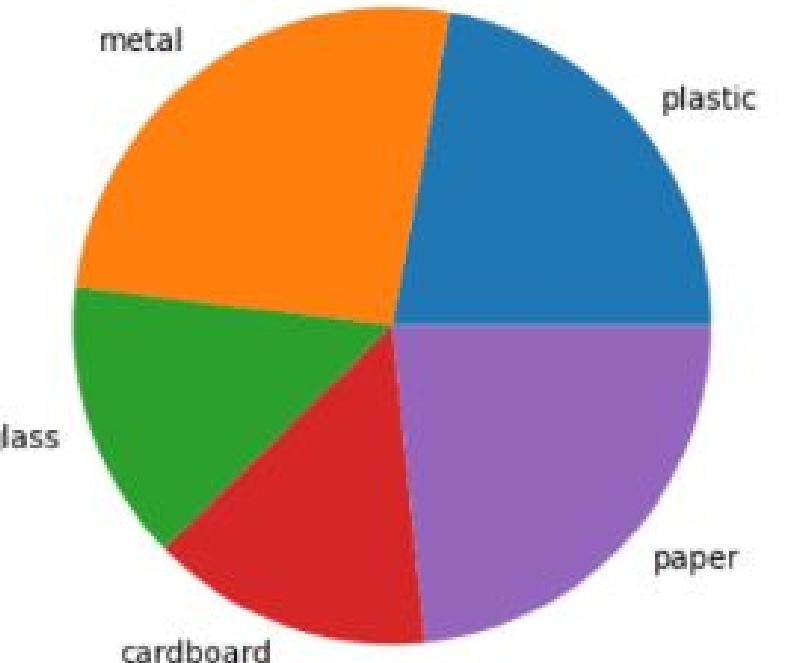
Our ML Model will keep a record of all the wastes which is collected from the institute and will provide a stats of how much waste is recycled



Also it send the stats to the Institute login on our website where they get the stats :
Also the Awareness stating to use less plastic if the quantity is more than certain amount.



This ML Model classifies a set of images into different types of waste and visualizes it in a graph.



folder_path

C:\\\\Users\\\\Akhil\\\\micron\\\\trashnet-master\\\\data\\\\dataset-resized\\\\dataset-resized\\\\bulk_trial

Clear **Submit**

output 0

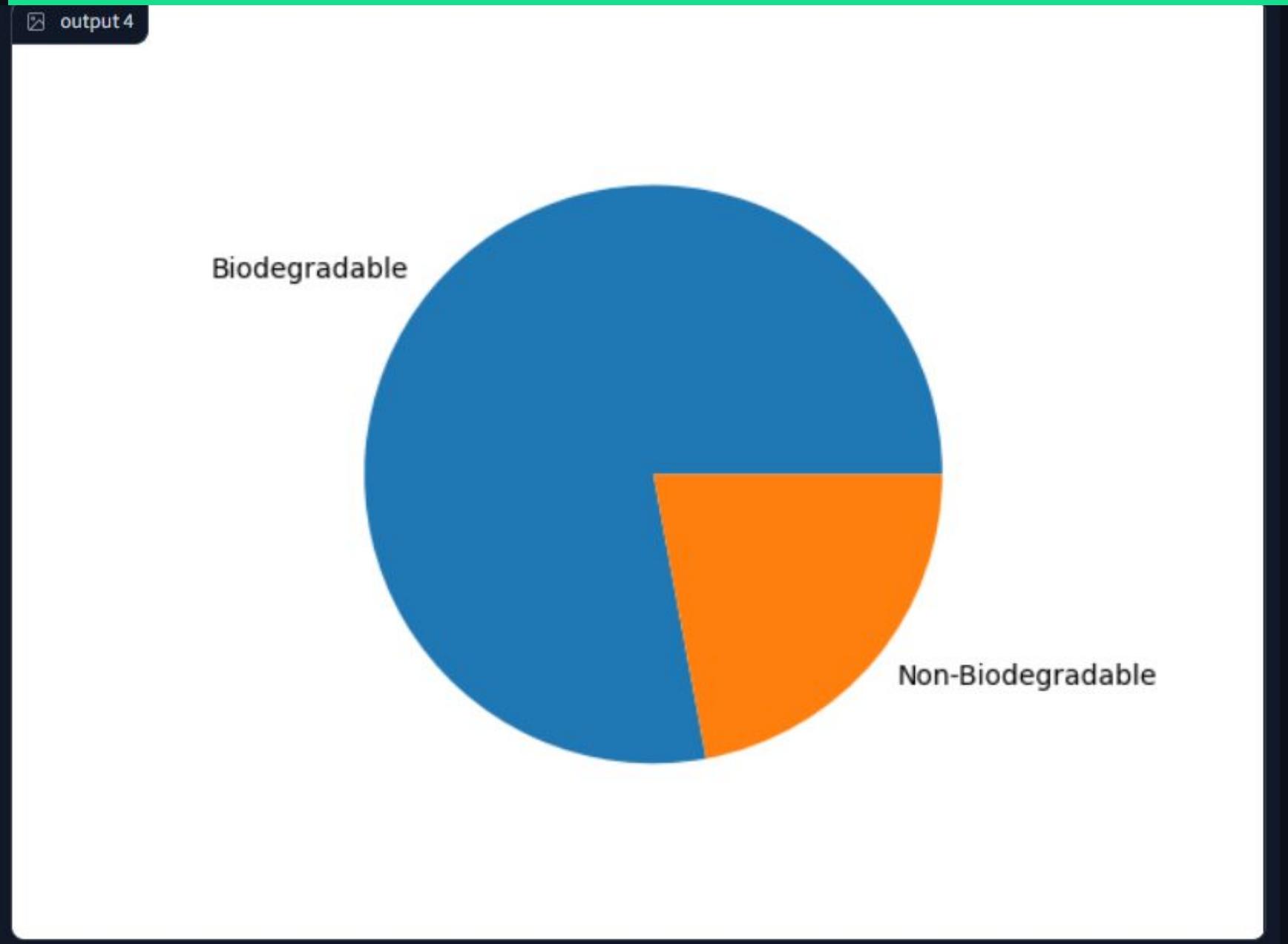
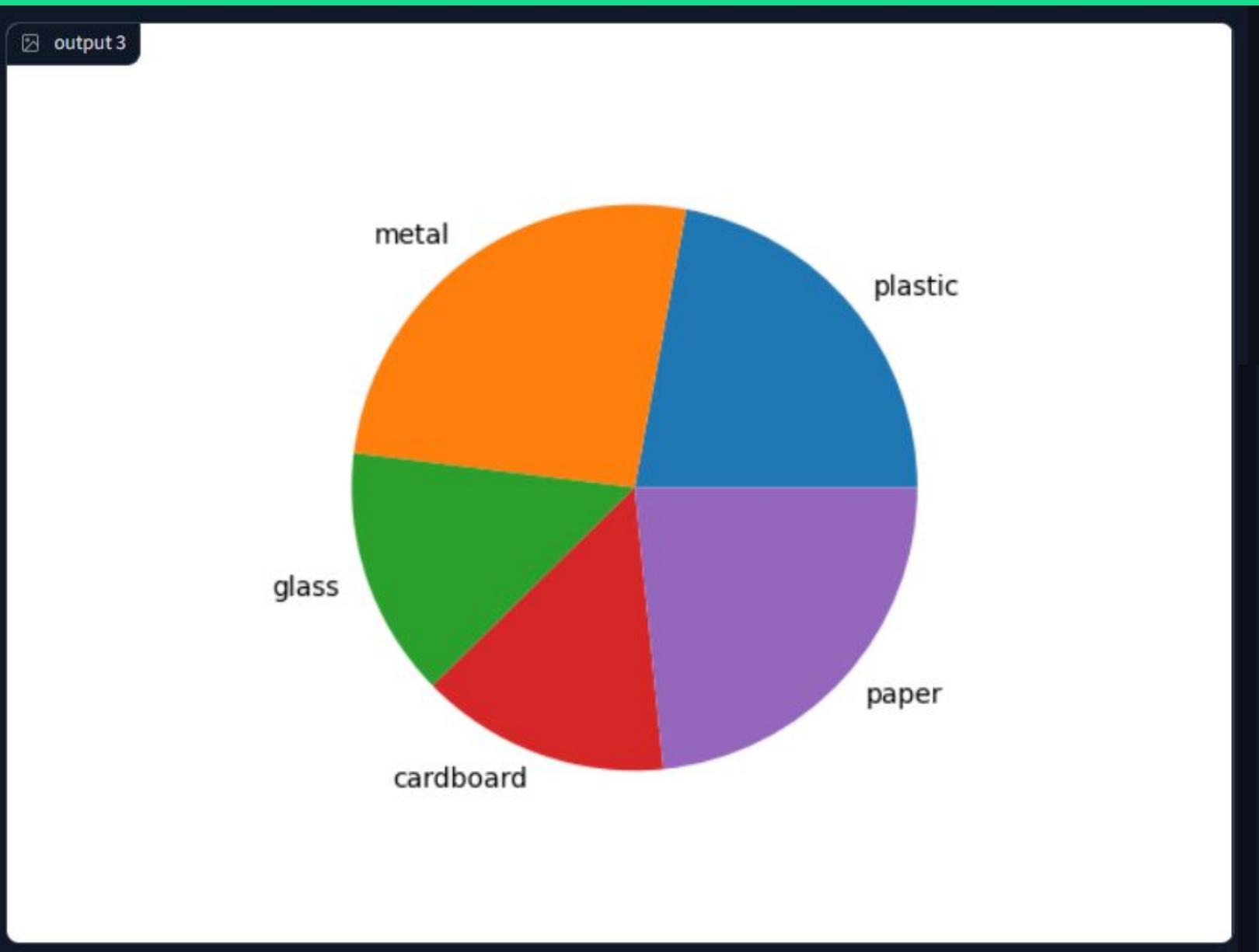
Percentage of Non-Biodegradable waste: 22.08%

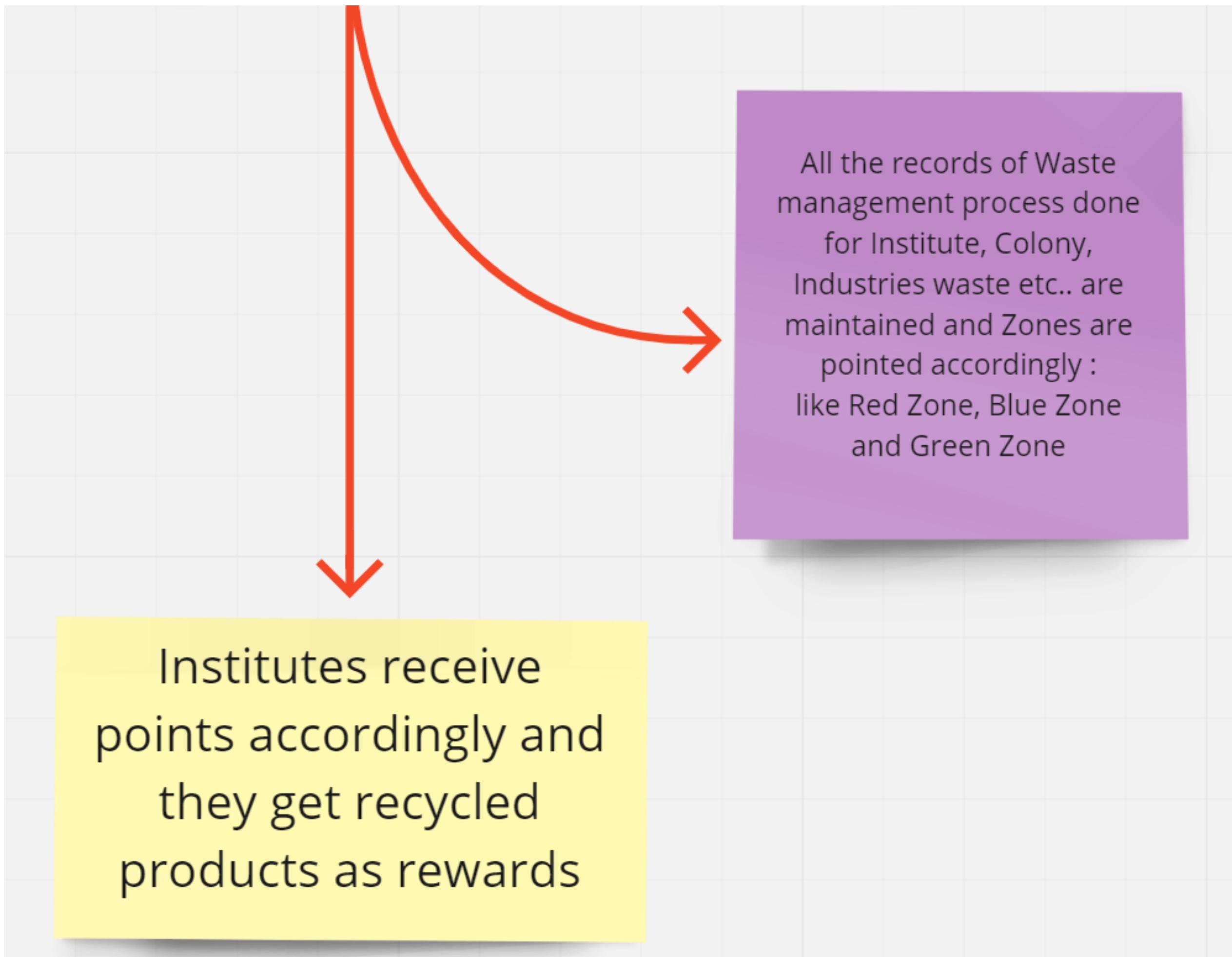
output 1

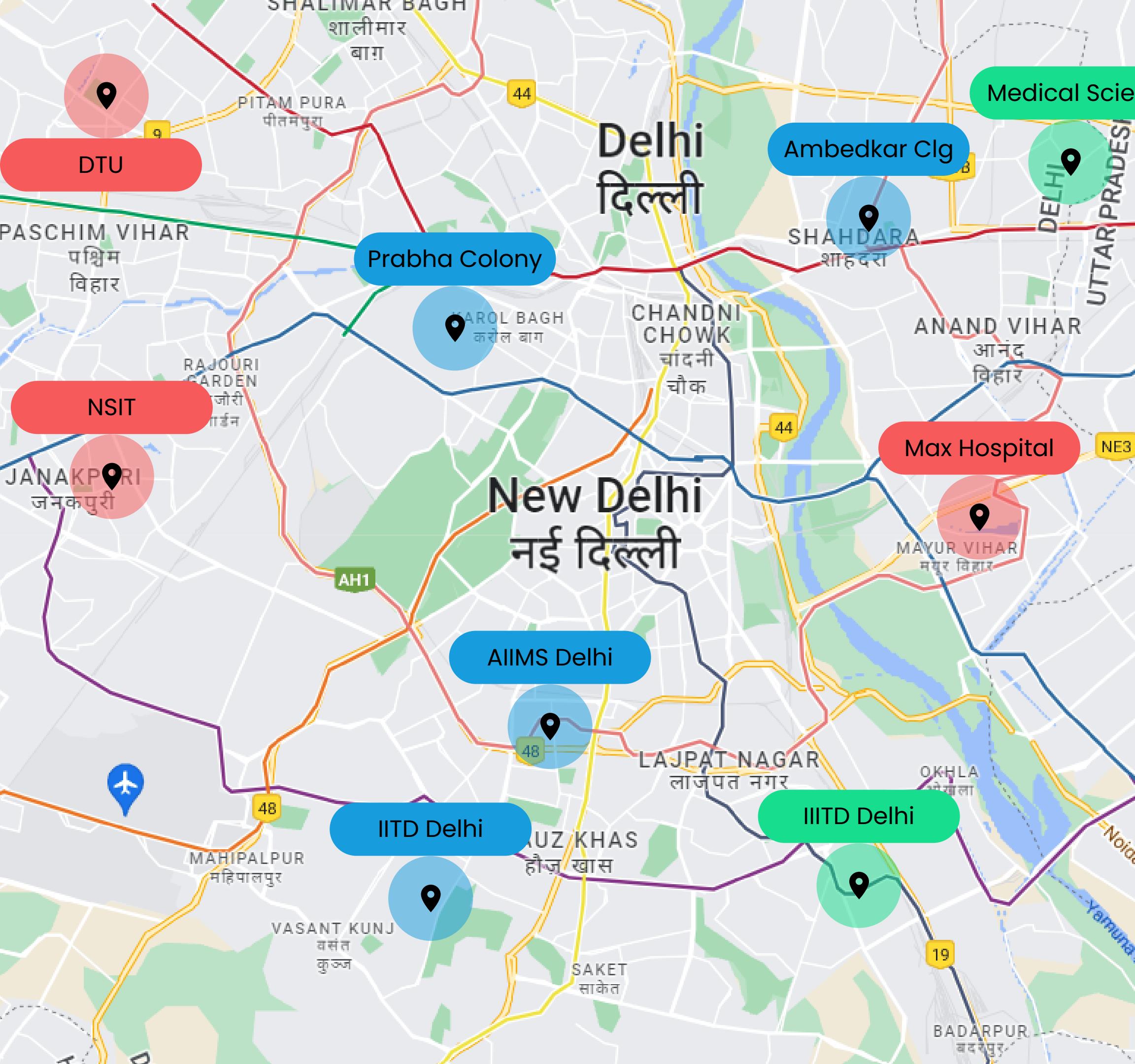
Percentage of Biodegradable waste : 77.92%

output 2

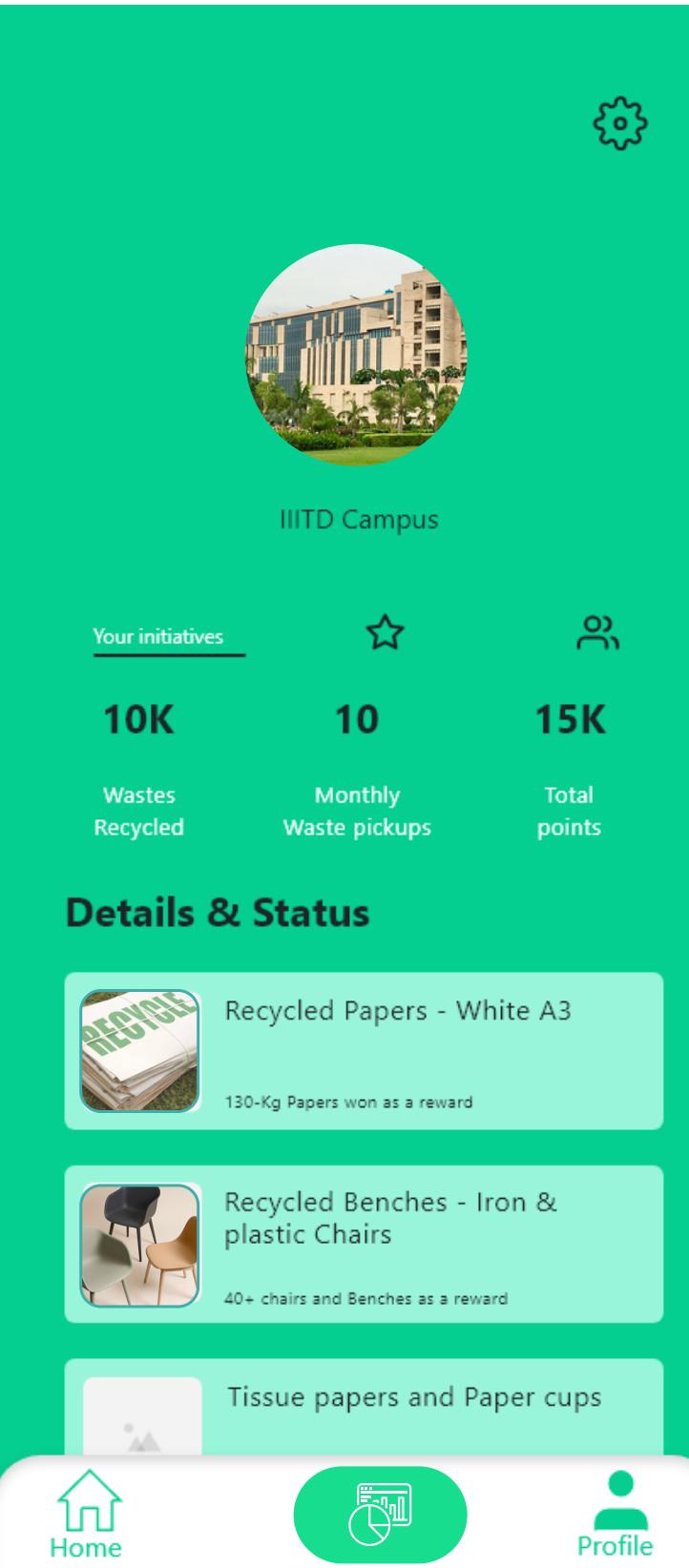
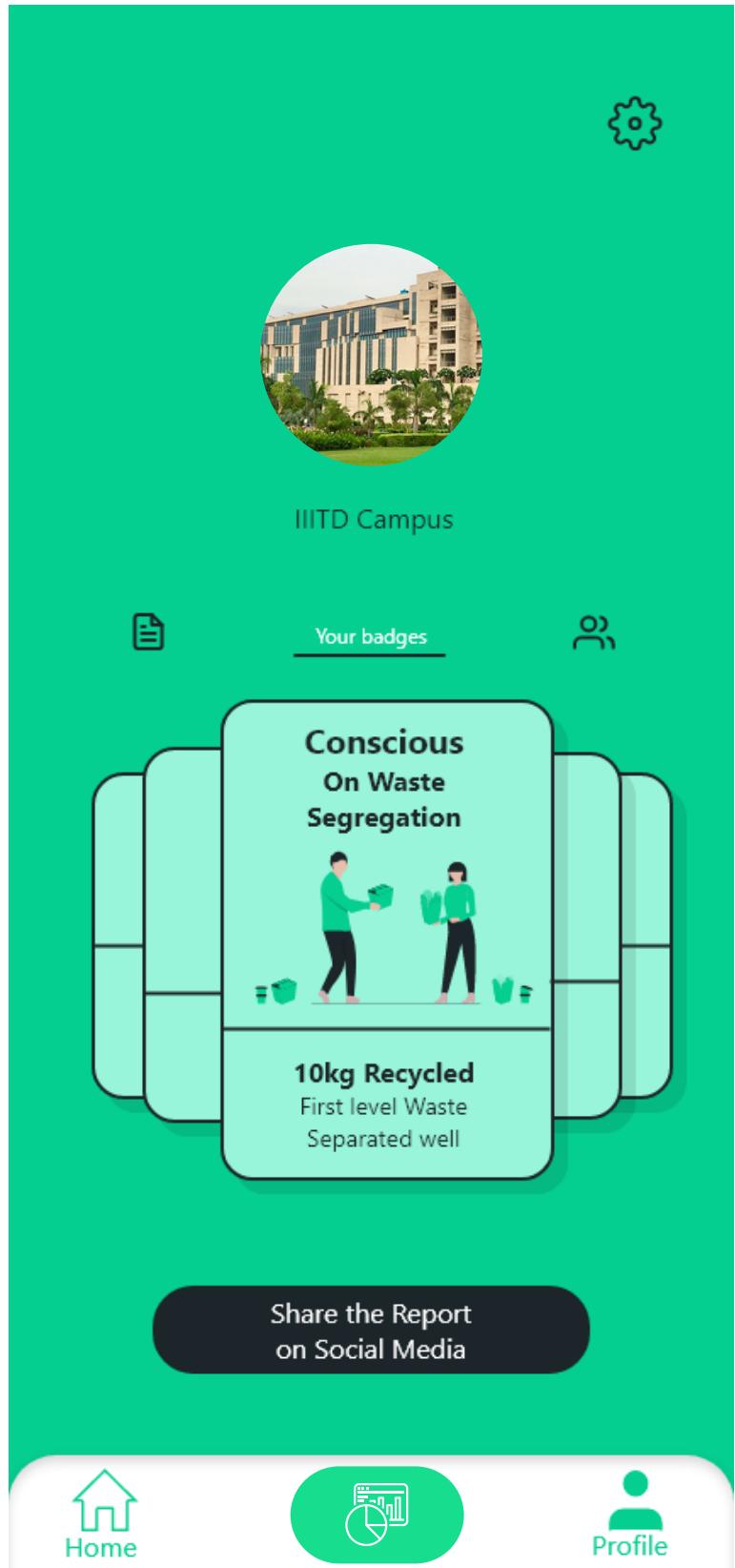
Number of plastic materials: 17
Number of metal materials: 20
Number of glass materials: 11
Number of cardboard materials: 11
Number of paper materials: 18







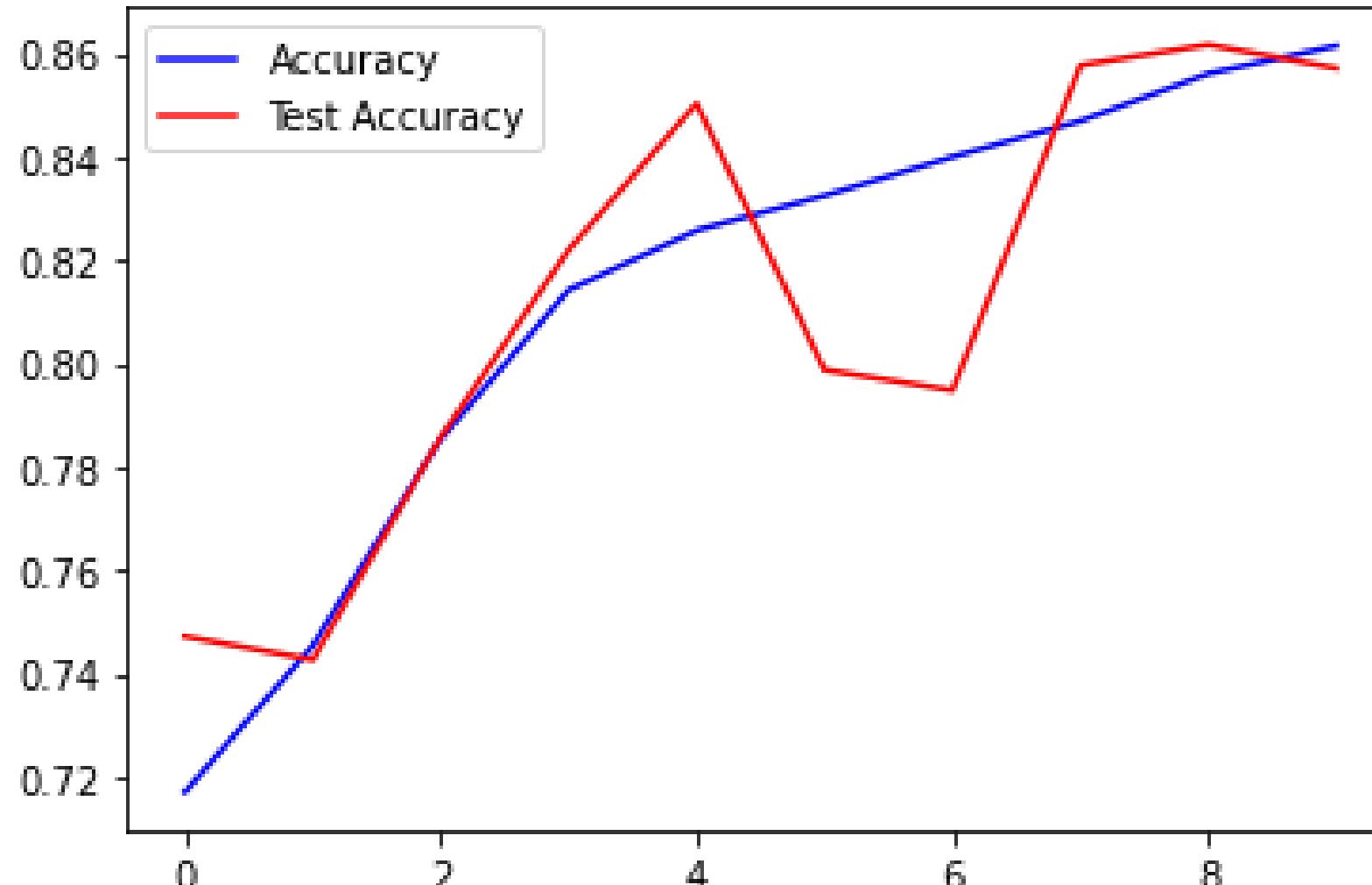
- The zones are assigned according to the waste generated daily.
- The Waste management unit works accordingly for regular pickups, and measures will be taken to reduce the waste according to the zones so that the waste will be recycled in a better way and leads to control of the waste.
- Everything will be notified from the **WASTO** to respective organizations/units, and will be given points accordingly for rewards and to control the waste in the respective locations.
- Every organization will have separate login in the WASTO APP/WEBSITE to track their waste, the measures, and reward points.



- Institutes receive points accordingly and they get recycled products as rewards
- Recycled papers and Tissue papers, cardboards and some other benches made with iron will be sent to Institute etc..
- Our ML Model will keep a record of all the wastes which is collected from the institute and will provide a stats of how much waste is recycled

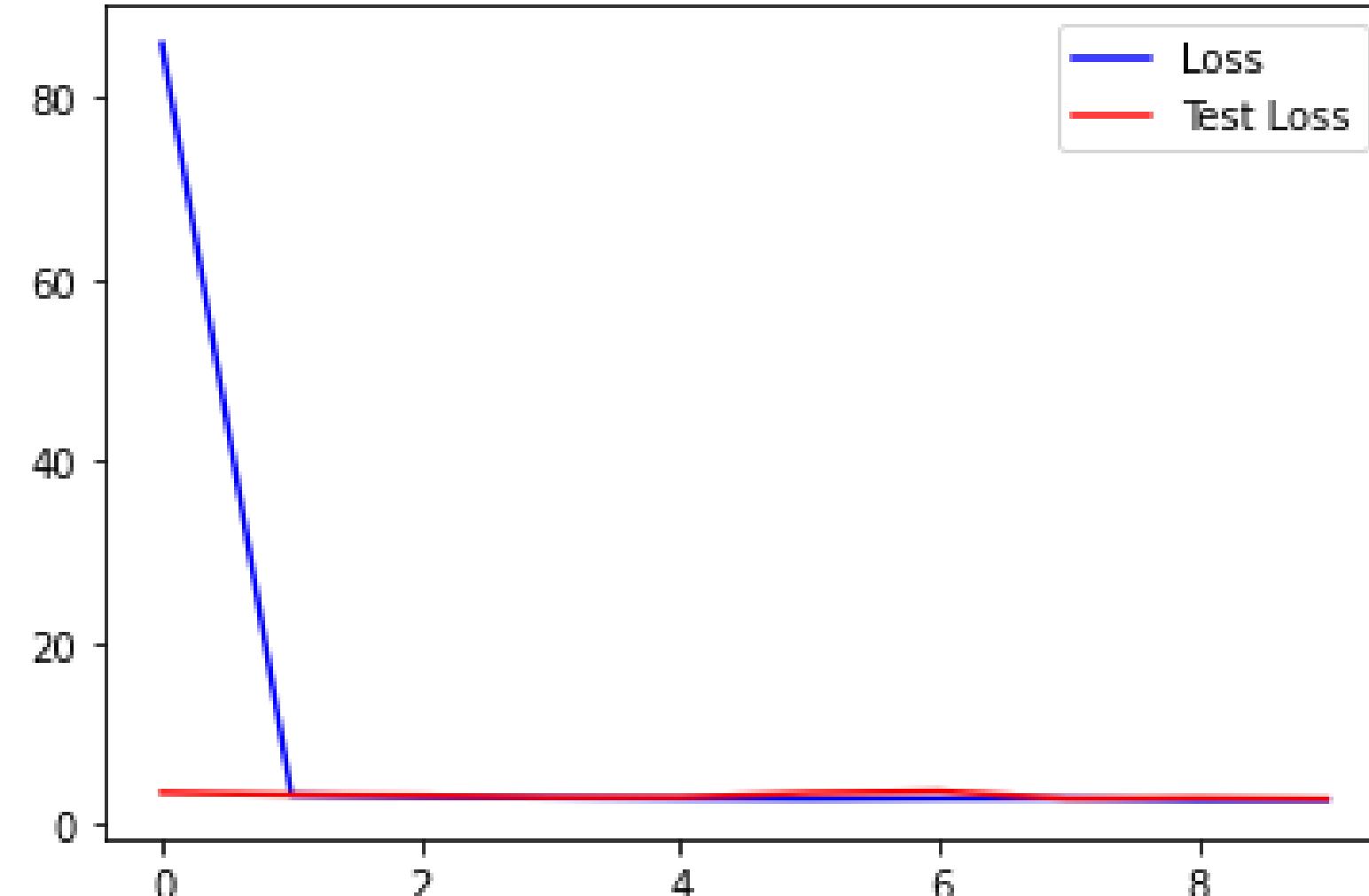
How the ML Model Works?

ML model uses a neural network trained by more than 20,000 images which process images to classify the waste depending on the container to which it must be deposited.



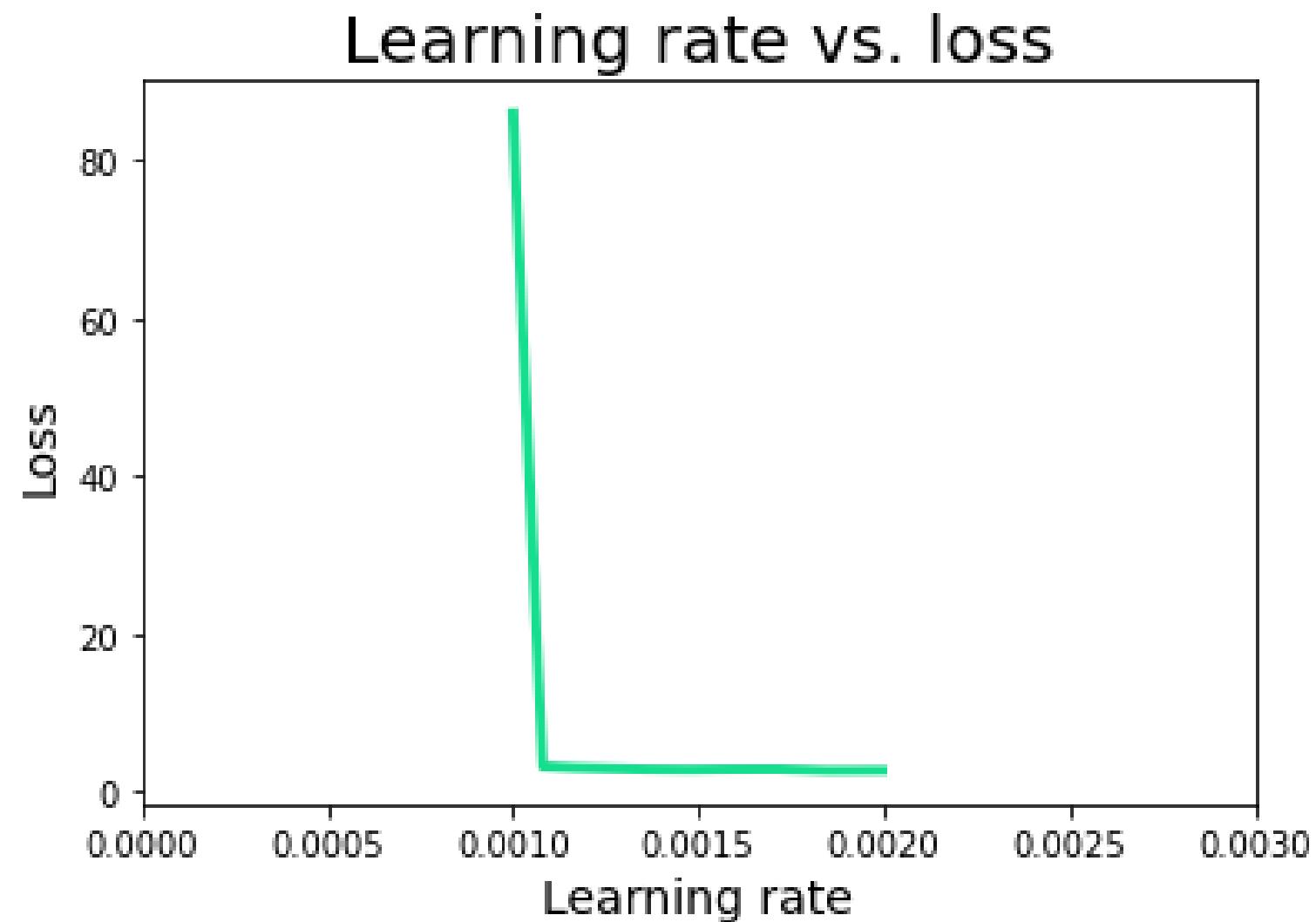
Traning Accuracy vs Test Accuracy

Training accuracy means that identical images are used both for training and testing, while test accuracy represents that the trained model identifies independent images that were not used in training.



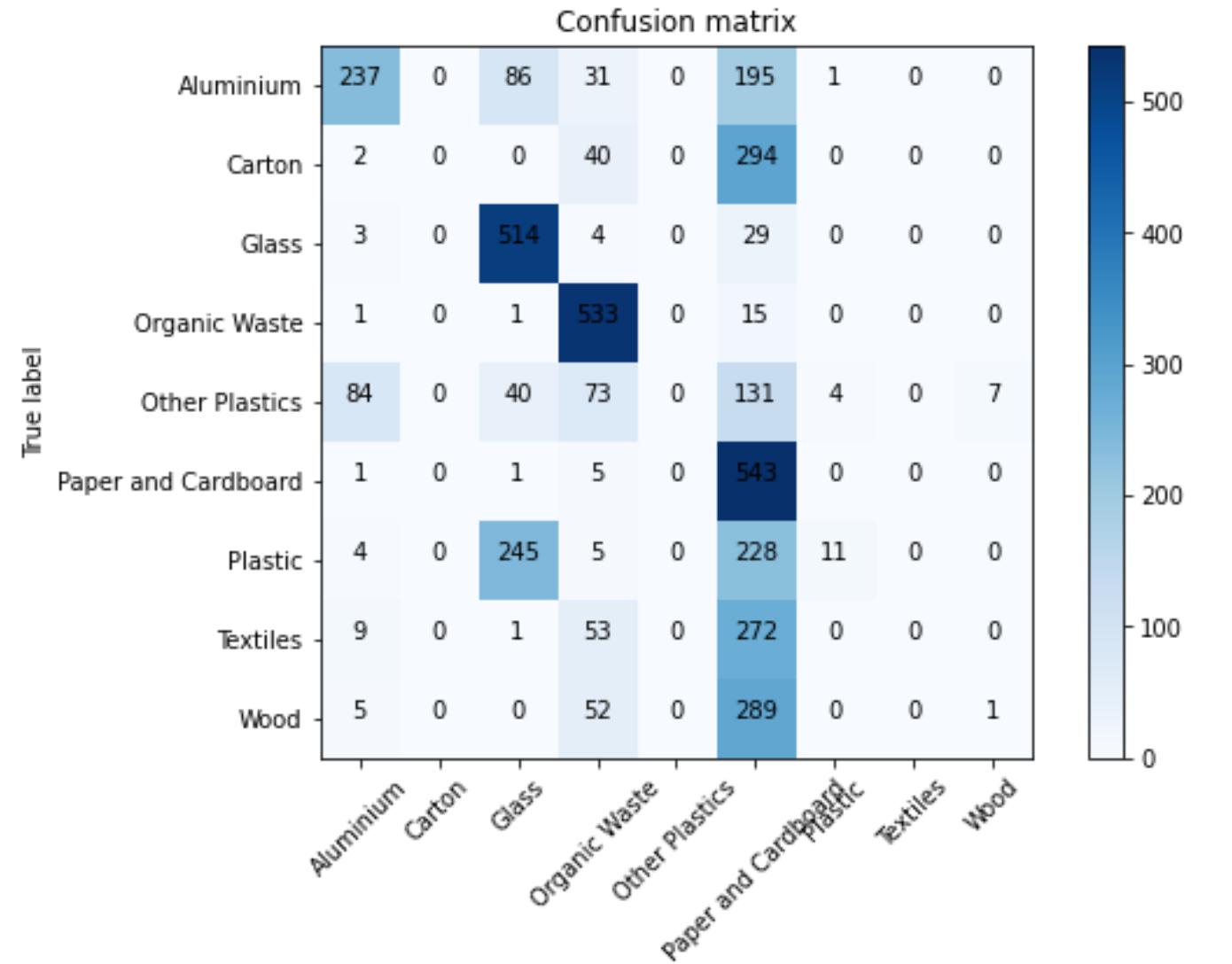
Training Loss Vs Validation Loss

The training loss indicates how well the model is fitting the training data, while the validation loss indicates how well the model fits new data



Learning rate vs Loss

The learning rate is a hyper-parameter that controls the weights of our neural network concerning the loss gradient. It defines how quickly the neural network updates the concepts it has learned.



Confusion Matrix

A confusion matrix is a summary of prediction results on a classification problem. The number of correct and incorrect predictions is summarized with count values and broken down by each class.

Working ML model of WASTO

- The ML detects and helps us to segregate the waste accordingly into Organic, Non-biodegradable, and recycling waste.
- We will use the ML model in two scenarios.
- At the base level (institutional/colonies/hospitals) to, process an image and output its type.
- At the industrial level, to process bulk images and store their statistics.
- We'll use those statistics to calculate reward points for each organization and classify them as zones for better waste management.
- This helps us to get a better overview of the recycling statistics and help us to improve the recycling situation.
- Also, to better manage the waste and improve the management unit's situation from source to recycling.
- The ML model helps us to note the waste generation in different locations and help us to improve the waste management in those locations by taking measure accordingly, like regular pickup and more small recycling units.

Resources

[Miro Board](#)

[ML Model Deployed](#)

[Github](#)

**Please follow these links to get a clear view of
the presentation**



Thank You!

Team Members



Vasanth Kumar

lakavath20386@iiitd.ac.in



Devi Sri Charan

valupadasu20412@iiitd.ac.in



Akhil Vamsi

konam20513@iiitd.ac.in



Manoj Reddy

donthireddy20375@iiitd.ac.in