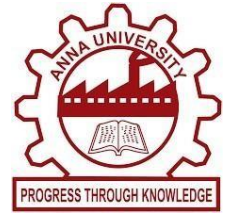


SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES



IBM NALAIYA THIRAN PROJECT REPORT

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in partial fulfilment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

MEPCO SCHLENK ENGINEERING COLLEGE



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1. INTRODUCTION

1.1 Project Overview

The IoT based Smart Waste Management project is solely focused on easing up the lives of municipality and corporation workers in the waste management sector. The workers toil every day to take out our trash to waste-dump land so that we could live in a healthy environment and a bad-odour free environment. Not only this, they do this inspite of the societal-criticism kept upon them. They are also employees who do this job to bring food to the table for their families like us, but they are treated differently just because they do this job. By taking up this project we not only wanted to give those workers a better and modern solution to make their body and mind at ease but also to break the barrier of criticism over job description. This project consists of an IoT implemented system by which the work of monitoring and notifying about the prolonging garbage is done effectively and instantly. We proposed a prototype model where the system can update the status of the garbage bins with their location and can eventually notify the workers about the filled bins and to trash out them as fast as possible.

1.2 Purpose

The purpose of this project is to make a smart and modern way to reduce the work of the corporation workers on taking trash and also increasing efficiency for that matter. Rather than doing hard-work with two legs, smart-work can be done with an android and a click button. We wanted to ease the work of the Corp. Workers and the citizens in cleaning the bin which normally takes a dozen phone call but what we intend to do is to make it happen with a single notification and click.

2. LITERATURE SURVEY

2.1 Existing Problems

Waste management has become an alarming challenge in local towns and cities across the world. Often the local area bins are overflowing and the municipalities are not aware of it. This affects the residents of that particular area in numerous ways like disease and unsafe surroundings. Poor waste management ranging from non-existing collection systems to ineffective disposal causes air pollution, water and soil contamination. Open and unsanitary areas contribute to contamination of drinking water and can cause infection and transmit diseases.

2.2 References

- [1] DharmendraKumarTripathi,SandeepDubey,Sandeep Kumar Agrawal (2020).Survey on IOT Based Smart Waste Bin.2020 IEEE 9th International Conference on Communication Systems and Network Technologies (CSNT).
- [2] Banuselvasaraswathy, B. and Rathinasabapathy, V., 2020. Self-heat controlling energy efficient OPOT routing protocol for WBAN. Wireless Networks, pp.1-12.
- [3]PadmakshiVenkateswaraRao,PathanMahammedAbdul-Azeez,SaiSasank Peri,VaishnaviKumar,R.SanthiyaDevi, Amirtharajan-Rengarajan, K.Thenmozhi, and Padmapriya Praveenkumar(2020).IoT based Waste Management for Smart Cities. 2020 International Conference on Computer Communication and Informatics (ICCCI).

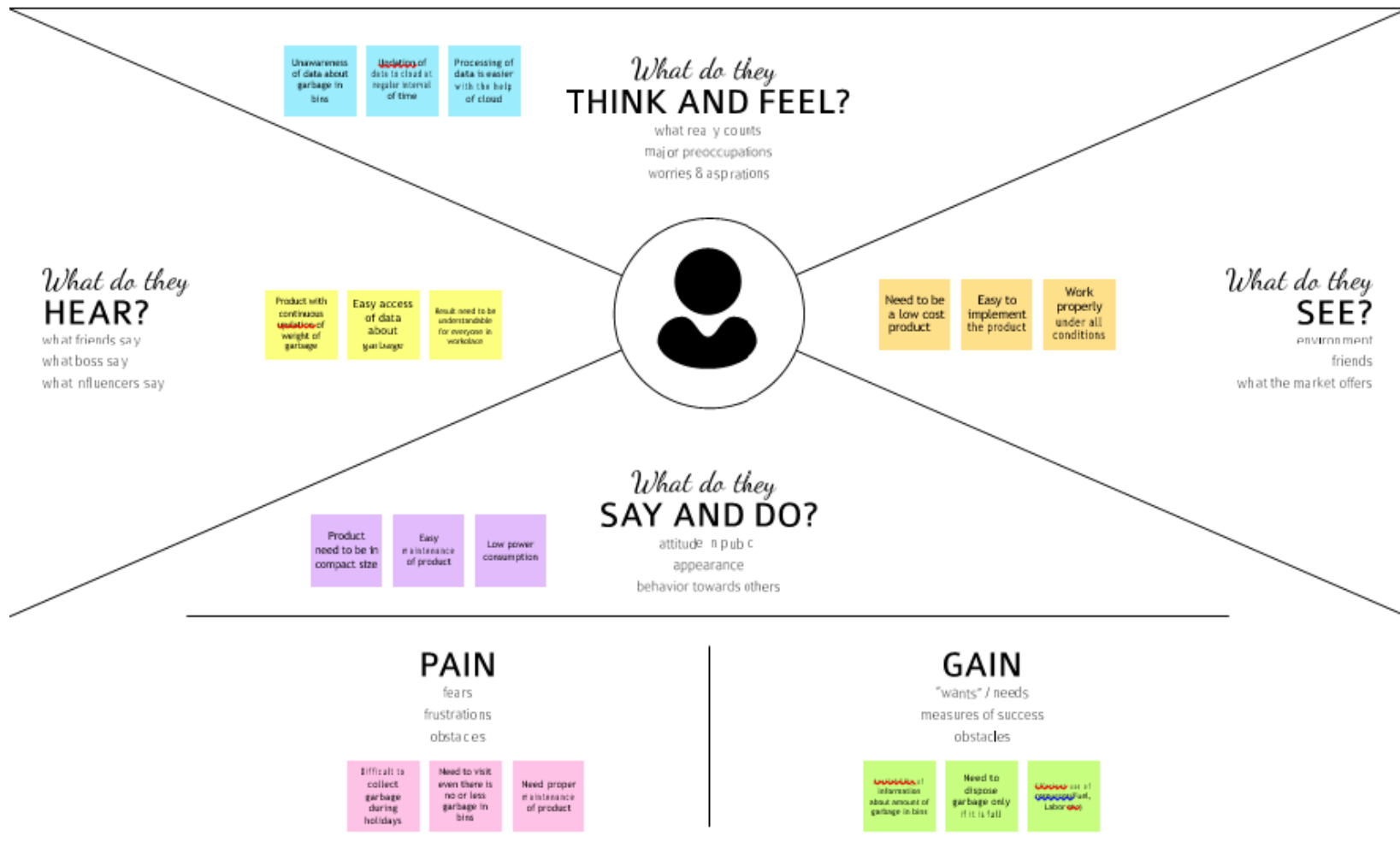
- [4] AnaghaPraveen,R.Radhika,RammohanM.U,SidharthD,
Sreehari Ambat,Anjali T(2020).IoT based Smart Bin:A Swachh-Bharat Initiative.2020 International
Conference on Electronics and Sustainable CommunicationSystems (ICESC).
- [5]ShashankMithinti,AmanKumar,ShivaniBokadia,Suryansh-Agarwal,Isha
Malhotra,N.Arivazhagan(2019). IoT Based Smart Bin for Smart City Application.2019 International
Conference on Intelligent Computing and Control Systems (ICCS).

2.3 Problem Statement Definitions

1. Need for this IOT based smart bin is an inefficient waste management may create serious environmental impacts like infectious diseases, land and water pollution, climate changes.
2. The garbage collecting authority in traditional waste management system doesn't know about the level of garbage in dustbin, if the dust bins gets full by garbage then it gets overflowed as well as spilled out from the dustbin leading to unhygienic condition in cities.
3. Sometimes due to any functions in the city nearest bin may gets full .At that instance alert message should be send to the corresponding cleaners.
4. By having a more convenient route garbage trucks spend less time on the road. This means that truck drivers and citizens are saving less time stuck in traffic jams.

3. IDEATION AND PROPOSED SOLUTION

3.1 Empathy Map Canvas

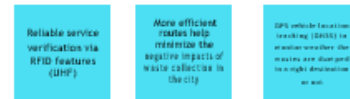


3.2 Ideation & Brainstorming

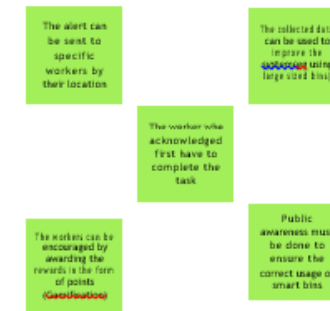
Mohamed Hashir



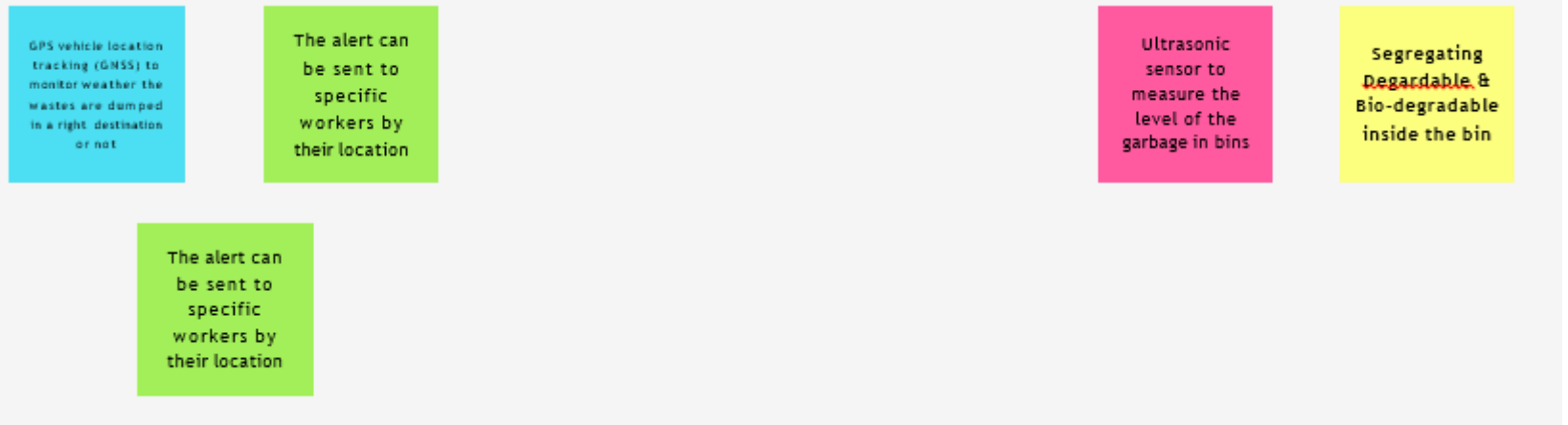
Siva Ganesh



Godbin James Y



Vijay Vignesh





3.3 Proposed Solution

| S.No. | Parameter | Description |
|-------|--|--|
| 1. | Problem Statement (Problem to be solved) | <ul style="list-style-type: none"> ➤ As the world population is increasing day by day, the waste generated in the form of plastics, food waste etc is also increasing drastically day by day ➤ Mostly in the urban areas the waste generated is very much higher than the rural environment and the waste bins are located in most of the places in the urban environment. ➤ The waste bins in different areas are getting filled randomly based on the population density of that particular area ➤ This information is not known to the workers, which makes the garbage collection by the municipality workers work more hard and in addition to that most of the energy is getting wasted, so this mechanism which is used at present is less efficient. |
| 2. | Idea / Solution description | <ul style="list-style-type: none"> ➤ The inefficiency in the garbage collection can be solved by IOT ➤ First by placing sensors to detect the garbage level of the bins and other parameters like humidity, toxic gases concentration is monitored and the information is updated in the cloud. ➤ Along with that GPS is also used in the smart bins to send the exact location of the bins along with the sensor information ➤ When the parameters go above the threshold the cloud will alert the municipality workers through the website notifications ➤ Thus the work of the municipality workers is made easy and the garbage bins also emptied as and when it is filled. |
| 3. | Novelty / Uniqueness | <ul style="list-style-type: none"> ➤ The fill level of the garbage bins are known in advance ➤ The location of the bins are also made available to the municipality workers by the GPS in the bins ➤ Efficient routing algorithms are used to make the increase energy efficiency |

| | | |
|----|---------------------------------------|--|
| | | <ul style="list-style-type: none"> ➤ The municipality workers are given with reward points through software on completion of any particular work to make their work more enjoyable. |
| 4. | Social Impact / Customer Satisfaction | <ul style="list-style-type: none"> ➤ The bins are maintained and regulated which makes the area more clean and odourless. ➤ Provides data on real-time which makes it easier for them to navigate to bins before overflowing. ➤ Stakeholders no need to waste their time and fuel to find the bin being emptied already. ➤ Working labour and hours are reduced compared to door to door bin emptying. |
| 5. | Business Model (Revenue Model) | <ul style="list-style-type: none"> ➤ Everytime a bin is emptied using the website a part of commission is deducted. ➤ Number of users logging in as the customer churn rate will be minimum (due to earning from the website). ➤ To keep users motivated, points are given for the bins they empty and using these points in subsidies as ration. |
| 6. | Scalability of the Solution | <p>This market could turn over into as go-to-job platform even as part-time and not no-way-out job. By introducing Municipalities as partners the users can get more subsidies from the government excluding payslip. Monitoring with UV lights as advancements could give way healthier environment for the stakeholders and the public.</p> |

3.4 Problem Solution Fit

| | | | | |
|--|---|--|---|--|
| Define CS, fit into CC | 1. CUSTOMER SEGMENT(S) CS Municipality and Local authorities of Metropolitan cities of India are our customers. | 6. CUSTOMER CONSTRAINTS CC 1. Availability of internet all the time for data updation. 2. Constant power supply for the product. 3. Need proper maintenance of the product. 4. Product need to be in a compact size. | 5. AVAILABLE SOLUTIONS AS 1. Recycling 2. Knowing location of garbage bins for better resource management. 3. Smart loader trucks 4. Segregation of biodegradable and non-biodegradable waste for better waste management. | Explore AS, differentiate |
| | 2. JOBS-TO-BE-DONE / PROBLEMS J&P 1. <u>monitoring</u> the levels of bins and alerting the user to clean provide location of the bin. 2. <u>improper</u> placement of garbage bins. 3. Proper Segregation of wastes. 4. Avoid fixed routine for waste Collection. | 9. PROBLEM ROOT CAUSE RC 1. Workers unawareness of amount of garbage in bins leads to messy environment. 2. Following the regular routine is not effective all the time i.e., Garbage bins fill faster in holidays which cause overflow of garbage from bins. 3. Wastage of resource like fuel <u>labour</u> i.e., need to visit the place even the garbage bin is not full | 7. BEHAVIOUR BE <u>1. Find</u> the required sensor based on the requirements and get the expected results. <u>2. Verify</u> whether the cloud database giving the correct information to check the correctness of sensors is must and <u>webapp</u> should be updated at each instance. | |
| Focus on J&P, tap into BE, understand RC | 3. TRIGGERS TR 1. Motivate & influence people to follow proper waste disposal. 2. Reading about more advanced technologies used by the people in the other countries to manage waste. | 10. YOUR SOLUTION SL 1. Ultrasonic sensor to detect the level of garbage in bins. 2. Weight sensor to obtain the weight of garbage bins 3. Combining the result of ultrasonic sensor and weight | 8. CHANNELS of BEHAVIOUR CH 8.1 Online 1. We can monitor in live. 2. People can give complaints and feedback about the work. 3. A customer can also notify the receivers where the | Focus on J&P, tap into BE, understand RC |

4 REQUIREMENT ANALYSIS

4.1 Functional Requirements

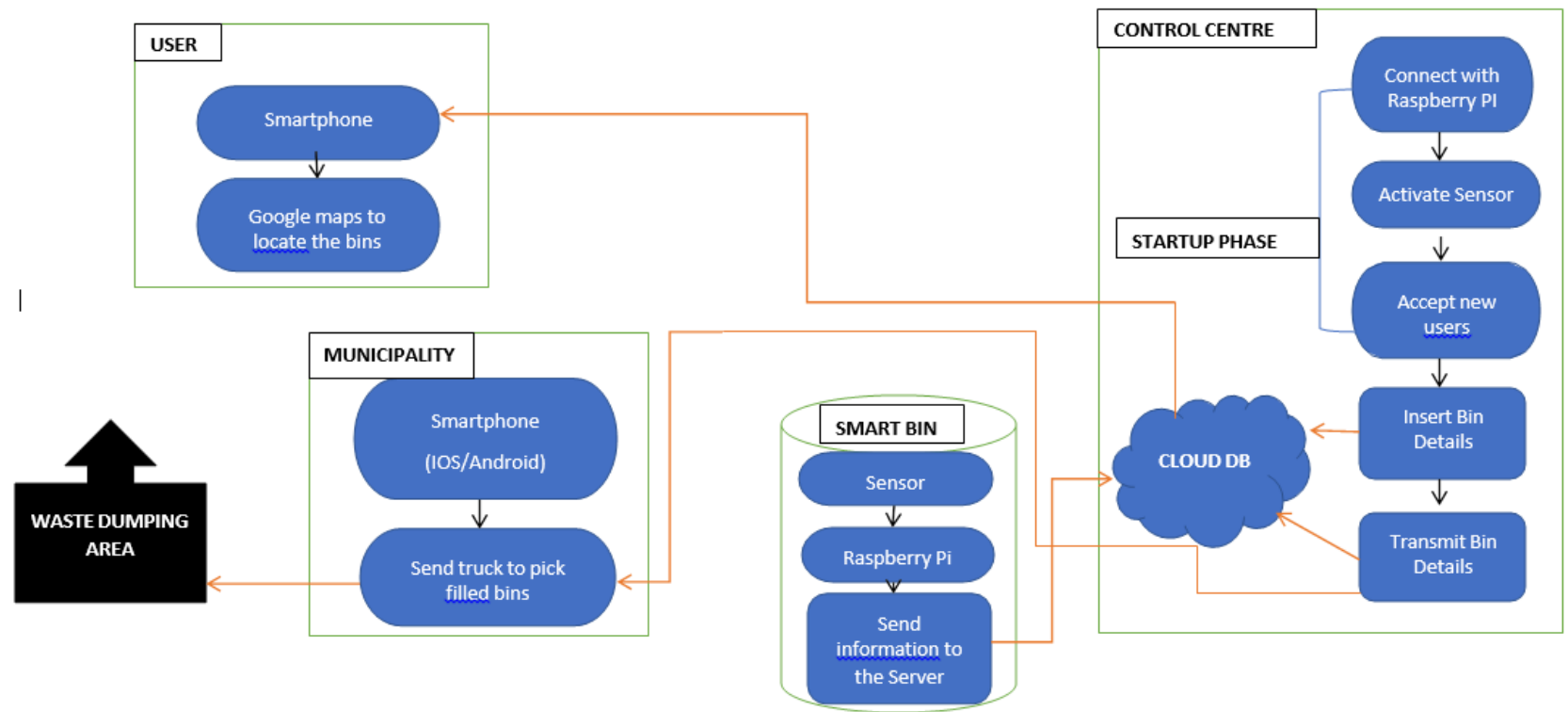
| FR No. | Functional Requirement (Epic) | Sub Requirement (Story / Sub-Task) |
|--------|-------------------------------|---|
| FR-1 | Registration and Login | <p>➤ User needs to login to the app by using their Gmail.</p> <p>Registration needs to be done by giving their name, mobile number and their locality. This is the required field.</p> |
| FR-2 | Free access | The users are given with free access to the app. The revenue is generated as in the times a bin is emptied by the workers. |
| FR-3 | Smart Bin Locations | <p>Based on the locality entered by the user, nearby active smart bins can be viewed by using Google maps.</p> <p>The active bins will be highlighted in orange dots.</p> |
| FR-4 | Bin Monitoring Details | <p>This process gives a brief description of bins. When the user presses the orange dot, brief description of the bin will be popped up. It mainly includes the fill level of the bins and the types of waste to be disposed.</p> <p>When the user clicks the orange dot, he/she will be able to know whether the bin is full or empty.</p> <p>When the color of dot changes to red, it represents that the bin is full and when the color is green, it signifies that the bin is empty or semi filled.</p> |
| FR-5 | Rating | Based on the efficient use, feasibility and interactions with the app, user can rate between 1-10. |

4.2 Non-Functional Requirements

| FR No. | Non-Functional Requirement | Description |
|--------|----------------------------|---|
| NFR-1 | Usability | Usability is a method for improving ease-of-use during the design process. Smart waste management prototype was built using IoT sensors and Cloud based Server running with custom software incorporating specialized algorithms and a graphical user interface. A model was simulated on a local machine network to check if the required goals can be met and if the proposed solution serves the purpose. So it assesses how easy user interfaces are to use |
| NFR-2 | Security | Buy reusable water bottles, straws and lunch containers reduce trash and use of non-recyclable plastics. Choose to purchase from companies that value sustainable practices. Composting the food waste helps to provide you with a beneficial return on your investment of time and effort & Shop eco-friendly with reusable bags |
| NFR-3 | Reliability | Waste Management helps business make their supply chain more effective, improve ordering, reduce waste materials and save money. It works best for developing waste to energy recycling and landfill restoration solutions. It is suited for situations where a business |
| NFR-4 | Performance | Sensors attached to the trash bin used to measure the fill level of the trash. Measured data is sent to the Cloud for further processing and analysis. By exploiting this data, trash collection can be planned as well as truck routes can be optimized. Thus a reduction in the number of waste collections needed by up to 80%, resulting in less manpower, emissions, fuel use and traffic congestion |
| NFR-5 | Availability | By using sensors, cloud server and Real-time GPS assistance directs the garbage truck drivers to the pre-decided route. Hence the waste is collected before bins get filled and unhealthy conditions occur. So the waste is managed smarter and creates a pollution-free environment |
| NFR-6 | Scalability | The proposed system focuses on the implementation of sensor on preparing a community to effectively manage waste, maximize recycling, minimize waste, reduce consumption and ensures that products are made to be recycled back into nature or the marketplace. Thus it provides to be a user-friendly and makes it cheaply available in the market. |

5. PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture

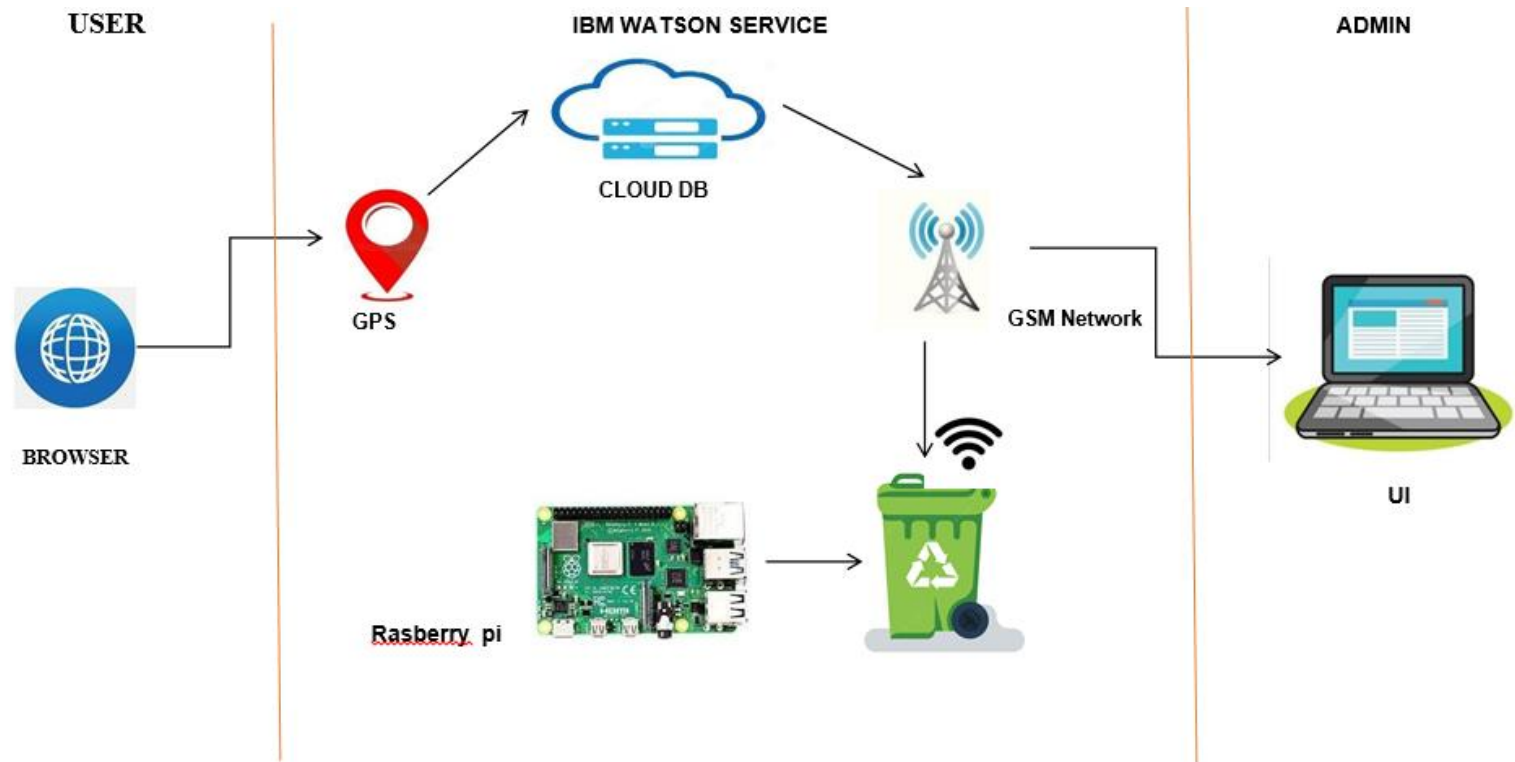


Table-1: Components & Technologies:

| S.No | Component | Description | Technology |
|------|---------------------------------|---|--------------------------|
| 1. | User Interface | Web UI, Mobile App. | HTML, CSS, JavaScript |
| 2. | Application Logic-1 | Logic for a process in the application | Python |
| 3. | Application Logic-2 | Logic for a process in the application | IBM Watson STT service |
| 4. | Application Logic-3 | Logic for a process in the application | IBM Watson Assistant |
| 5. | Cloud Database | Database Service on Cloud, to store data | IBM DB2, IBM Cloudant |
| 6. | File Storage | File storage requirements, To retrieve data | IBM Block Storage |
| 7. | Machine Learning Model | To recognize the things | Object Recognition Model |
| 8. | Infrastructure (Server / Cloud) | Local Server Configuration:MAMP Cloud Server Configuration : Cloud Config Server | Local, Cloud Foundry |

Table-2: Application Characteristics:

| S.No | Characteristics | Description | Technology |
|------|--------------------------|---|-----------------------------|
| 1. | Open-Source Frameworks | Provides permission to use the source code | IBM Cloud |
| 2. | Security Implementations | Sends alert to the admin once the bin get filled | UI |
| 3. | Scalable Architecture | Ensures that product are made to be recycled back | IBM Watson Platform |
| 4. | Availability | Directs the truck drivers to pre-decide routes. | Real Time GPS, Cloud Server |
| 5. | Performance | Measured data is send to the cloud, Trash is collected based on that. | IOT |

5.3 User Stories

| User Type | Functional Requirement (Epic) | User Story Number | User Story / Task | Acceptance criteria | Priority | Release |
|--------------|-------------------------------|-------------------|---|----------------------------------|----------|---------|
| Mobile user | Registration | USN-1 | As a user, I can register for the application by entering my email, password, and confirming my password. | I can access my account. | High | sprint |
| Admin | Registration and login | USN-2 | As an Admin, I will manage the details entered by the user. | I can manage the account | High | sprint |
| Co Admin | Login | USN-3 | As a Co Admin, I will manage bin details and I will send the information to the municipality. | I can handle bin details. | High | sprint |
| Truck Driver | Login | USN-4 | As a Truck driver, I will collect the trash from the filled bins. | I can reach the bin location. | Medium | sprint |
| Municipality | Login | USN-5 | As a Municipality, I will monitor the entire process. | I can manage the entire process. | High | sprint |

6. PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning & Estimation

| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority | Team Members |
|----------|-------------------------------|-------------------|--|--------------|----------|---|
| Sprint-1 | Registration | USN-1 | As a user, I can register for the application by enteringmy email, password, and confirming my password. | 15 | High | MOHAMED-HASHIR GODBIN JAMES VIJAY VIGNESH SIVA GANESH |
| Sprint-1 | Confirmation | USN-2 | As a user, I will receive confirmation email once I haveregistered for the application | 5 | Medium | MOHAMED-HASHIR GODBIN JAMES VIJAY VIGNESH SIVA GANESH |
| Sprint-2 | Login | USN-5 | As a user, I can log into the application by enteringemail & password | 10 | High | MOHAMED-HASHIR GODBIN JAMES VIJAY VIGNESH SIVA GANESH |

| | | | | | | |
|---------------|--------------------------------------|--------------------------|---|---------------------|-----------------|--|
| Sprint-2 | Dashboard | USN-3 | As a user, I can see the status of the garbage levels in garbage bins through website | 10 | High | MOHAMED-HASHIR GODBIN JAMES VIJAY VIGNESH SIVA GANESH |
| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority | Team Members |
| Sprint-3 | Notifications | USN-4 | As a user, I will get request from the garbage bins once they are full | 10 | High | MOHAMED-HASHIR GODBIN JAMES VIJAY VIGNESH SIVA GANESH |
| Sprint-3 | Profile | USN-3 | As a user, I'll accept the request from bins and my status gets updated | 10 | High | MOHAMED-HASHIR GODBIN JAMES VIJAY VIGNESH SIVA GANESH |
| Sprint-4 | Dashboard update | USN-5 | As a user, I will unload the garbage bins and update the status of the bin to 'empty' | 20 | High | MOHAMED-HASHIR GODBIN JAMES VIJAY VIGNESH SIVA GANESH |

6.2 Sprint Delivery Schedule

| Sprint | Total Story Points | Duration | Sprint Start Date | Sprint End Date (Planned) | Story Points Completed (as on Planned End Date) | Sprint Release Date (Actual) |
|-----------|--------------------|----------|-------------------|---------------------------|---|------------------------------|
| Sprint-1 | 20 | 6 Days | 24 Oct 2022 | 29 Oct 2022 | 20 | 29 Oct 2022 |
| Sprint-2 | 20 | 6 Days | 31 Oct 2022 | 05 Nov 2022 | 20 | 05 Nov 2022 |
| Sprint-3 | 20 | 6 Days | 07 Nov 2022 | 12 Nov 2022 | 20 | 12 Nov 2022 |
| Sprint -4 | 20 | 6 Days | 14 Nov 2022 | 19 Nov 2022 | 20 | 19 Nov 2022 |

7. CODING & SOLUTIONING

7.1 Feature 1 – Alert system

In this project we have added an alert system, where if the dustbin in a particular location is full and need to be trashed out then the alert system pops up a message saying “ALERT (*particular location*) dustbin is full” which makes it easier for the worker to monitor the bins and take necessary action in that instant.

(1) WhatsApp xIBM Watson lxNode-RED : nxNode-RED D x(1032) Node-f xInbox (4,984) xnode red pop x(1032) Creatin xResource list x

node-red-lxeia-2022-10-06.eu-de.mybluemix.net/ui/#1/0?socketid=78nJ4IOscc8IPsRkAABQ

10991

Smart Waste Management

0Level100

Smart bin - Madurai

ALERT Viruthunagar Dustbin is full

OK

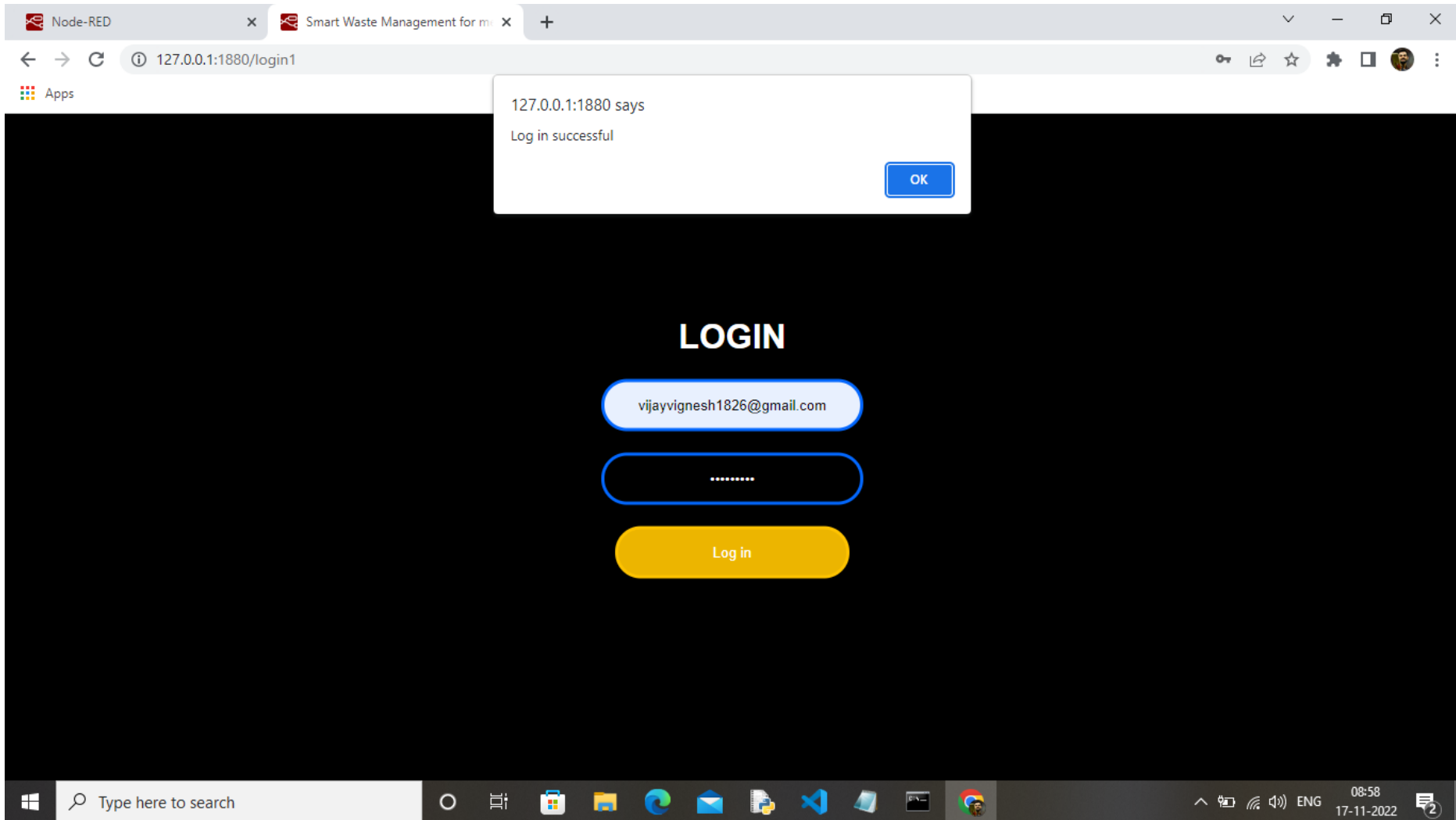
0Level100

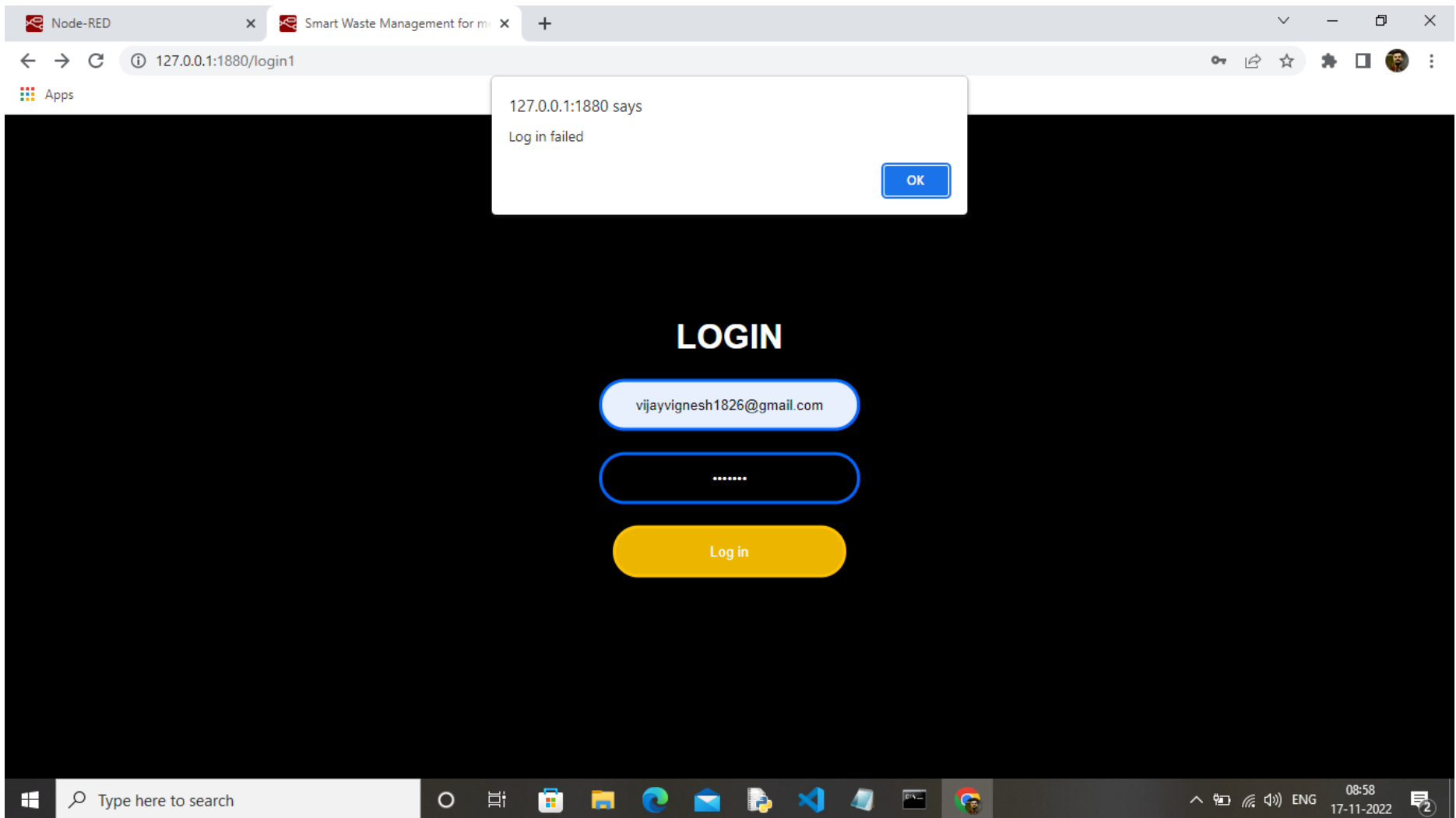
Smart bin - kuntram

0Level100

7.2 Feature 2 – Validation of user

Without the use of Database, the login of user is checked to be a legitimate user or not (robot). Using the HTML form, the javascript and PHP code is used to check for password and valid username which has gmail information. The username box is checked for “@gmail.com” as to only use gmail in username and a pre-saved password is registered by the user and this password is retrieved and checked with the inputted password at that instant. It can reduce misuse of the user account and password.





8. TESTING

8.1 Test Cases

- ✓ The user gets confirmation login after they login
- ✓ User is validated successfully
- ✓ The status of the bins are shown
- ✓ Location of the bin is shown
- ✓ Alert is popped up when the bin is full with their location
- ✓ After unloading the status of the bin is updated

8.2 User Acceptance Testing

1. By using this application we can monitor the status of the trash can in on-demand basis which means we can able to access this application whenever we need because of its running on the cloud.
2. The main advantage of using this app is even non-educated people can able understand how to use it. Because they are providing the service in all the regional languages.
3. This app needs very lower network speed as compared to other applications.
4. This is an ad-free application.
5. Everyone can easily use this application. because of it is very user friendly to use.
6. This application is free of cost .we can able to download it from playstore itself.so this is very helpful for poor peoples.

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Smart Waste Management System project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

| Resolution | Severity 1 | Severity 2 | Severity 3 | Severity 4 | Subtotal |
|----------------|------------|------------|------------|------------|----------|
| By Design | 10 | 4 | 3 | 3 | 20 |
| Duplicate | 1 | 0 | 3 | 0 | 4 |
| External | 2 | 3 | 0 | 1 | 6 |
| Fixed | 11 | 2 | 4 | 20 | 37 |
| Not Reproduced | 0 | 0 | 1 | 0 | 1 |
| Skipped | 0 | 0 | 1 | 1 | 2 |
| Won't Fix | 0 | 5 | 2 | 1 | 8 |
| Totals | 24 | 14 | 13 | 26 | 78 |

3. Test Case Analysis

This report shows the number of test cases that have passed ,failed ,and untested.

| Section | Total Cases | Not Tested | Fail | Pass |
|---------------------|-------------|------------|------|------|
| Print Engine | 7 | 0 | 0 | 7 |
| Client Application | 51 | 0 | 0 | 51 |
| Security | 2 | 0 | 0 | 2 |
| Outsource Shipping | 3 | 0 | 0 | 3 |
| Exception Reporting | 9 | 0 | 0 | 9 |
| Final Report Output | 4 | 0 | 0 | 4 |
| Version Control | 2 | 0 | 0 | 2 |

9. RESULTS

9.1 Performance Metrics

1. When multiple bins got filled at the same time, at first it created some issue, we resolved this issue by showing notifications at multiple places in the dashboard.
2. We verified that this app can be opened simultaneously by multiply users at the same time and no problems were found.
3. The UI is made user friendly by decreasing the number of input from the user.
4. As we are decreasing the number of inputs we can make exception handling much more easier

10. ADVANTAGES AND DISADVANTAGES

Unlike us, the Municipality workers doesn't work comfortably in an office room. They had to literally put their sweats into this job to bring food to the table. And this IoT based project can really help them save time in emptying garbage bins daily. By this project, they know where to go to unload the bins instantly rather than a citizen making dozen calls to reach to them. Even the citizens don't need to worry about lack of information to workers as the workers can see the status of the bins and they will come to unload the bin one way or another. As the status of the bins are updated other workers can also view if they had to take up the same "bin full" request or not and also it widely helps the supervisors to supervise the workers on their work and give a recognition to them. The major disadvantage in this project is to educate the people about the website and all other features available and it helps only if they have a smartphone.

11. CONCLUSION

The IoT based Smart Waste Management project has set out to be a problem solver for the municipality workers, citizens and totally the government. Now, the major setback on Waste management industry is compromised and sparked a digital revolution through this prototype. Not only the users but the government can rely upon IoT applications like this to enhance their modern world and make it ease. From performance metrics we can infer that the prototype is stable and can be relied upon.

12. FUTURE SCOPE

The future of this technology can be modeled with insertion of Machine learning and A.I algorithms so that the users can be so sure about which bin will be full at its capacity beforehand and also the big data that is processed through ML can say about the status of the bins as in which bin gets at it full capacity

during which times or days (such as festivals, inauguration and wedding ceremonies). By this data the user can be so sure to unload them than to wait for the call from supervisors or citizens about the decomposition inside the bin. Not only this, with Big data analysis we can produce a reward model for which the users get subsidies for the work they do apart from their payslips and also the work of cleaning bins will not be seen as “the last to go” job rather it will be seen as an opportunity for the users to uplift their economy and lifestyle. Even more intriguing, the bins can segregate bio-degradable with non-biodegradable by itself with the help of image processing and robotic automations.

13. APPENDIX

13.1 Source Code

```
import time  
  
import sys  
  
import ibmiotf.application  
import ibmiotf.device  
  
import random  
  
  
#Provide your IBM Watson Device Credentials  
  
organization = "w63fd1"  
  
deviceType = "JehoNi"  
  
deviceId = "123"  
  
authMethod = "token"  
  
authToken = "12345678"
```

```
# Initialize GPIO
```

```
def myCommandCallback(cmd):
```

```
    print("Command received: %s" % cmd.data['command'])
```

```
    status=cmd.data['command']
```

```
    if status=="lighton":
```

```
        print ("led is on")
```

```
    else :
```

```
        print ("led is off")
```

```
    #print(cmd)
```

```
try:
```

```
    deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod,  
                    "auth-token": authToken}
```

```
    deviceCli = ibmiotf.device.Client(deviceOptions)
```

```
    #.....
```

```
except Exception as e:
```

```
    print("Caught exception connecting device: %s" % str(e))
```

```
    sys.exit()
```

```
# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type "greeting"  
10 times
```

```
deviceCli.connect()
```

```
while True:
```

```
    #Get Sensor Data from DHT11
```

```
    time.sleep(10)
```

```
    garbageLevel1=random.randint(0,100)
```

```
    garbageLevel2=random.randint(0,100)
```

```
    garbageLevel3=random.randint(0,100)
```

```
    garbageLevel4=random.randint(0,100)
```

```
    garbageLevel5=random.randint(0,100)
```

```
data = { 'garbageLevel1' : garbageLevel1, 'garbageLevel2': garbageLevel2, 'garbageLevel3' :
garbageLevel3, 'garbageLevel4': garbageLevel4, 'garbageLevel5':garbageLevel5}

#}

#print data

def myOnPublishCallback():

    print (data)


    success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
    on_publish=myOnPublishCallback)

if not success:

    print("Not connected to IoTF")

time.sleep(4)


deviceCli.commandCallback = myCommandCallback


# Disconnect the device and application from the cloud

deviceCli.disconnect()
```

13.2 GitHub & Project Demo Link

| Content | Link |
|---------------------|---|
| GitHub – Video Demo | https://github.com/IBM-EPBL/IBM-Project-4715-1658738232/blob/main/Final%20Deliverables/IBM%20project%20Demo.mp4 |