Project Report

INTRODUCTION

1.INTRODUCTION

1.1 PROJECT OVERVIEW

Rapid increase in population, the issues related to sanitation with respect to garbage management are degrading immensely. It creates unhygienic conditions for the citizens in the nearby surrounding, leading to the spread of infectious diseases and illness. To avoid this problem, IoT based “Smart Waste Management” is the best and trending solution. In the proposed system, public dustbins will be provided with embedded device which helps in real time monitoring of level of garbage in garbage bins. The data regarding the garbage levels will be used to provide optimized route for garbage collecting vans, which will reduce cost associated with fuel. The load sensors will increase efficiency of data relatedto garbage level and moisture sensors will be used to provide data of waste segregation in a dust bin. The analysis of ceaseless data gathered will help municipality and government authorities to improve plans related to smart waste management with the help of various system generated reports.

1.2. PURPOSE

Smart waste management focuses on solving the previously mentioned solid waste management problems using sensors, intelligent monitoring systems, and mobile applications. The first smart waste management solution to make the waste collection process more efficient is sensors. Sensors can measure the fill level of the containers and provide updated information at any time and notify waste management services to empty them when they are full or almost full. These devices help optimize the best possible route containing fully filled containers and create smart schedules for drivers. The selection of the containers also minimizes the need for trash collection staff because their duties are deduced. They can also alert the waste management companies or municipalities if an undesirable incident happens such as sudden temperature rise or displacement of the container by their GPS features.

LITERATURE SURVEY

2.LITERATURE SURVEY

1.2 EXISTING SYSTEM

Around 80% of waste collections happen at the wrong time. Late waste collections lead to overflowing bins, unsanitary environments, citizen complaints, illegal dumping, and increased cleaning and collection costs. Early waste collections mean unnecessary carbon emissions, more traffic congestion, and higher running costs. The old way of doing waste management is highly inefficient. And in today's ever-technological world, an innovative and data-driven approach is the only way forward.

Traditionally, municipalities and waste management companies would operate on a fixed collection route and schedule. This means that waste collection trucks would drive the same collection route and empty every single waste container – even if the waste containerdid not need emptying. This means high labor and fuel costs – which residents ultimately foot the bill for. This is also an unsustainable way of working - the more vehicles on the road carrying out unnecessary collections means more carbon emissions are released into our planet's atmosphere.

1.3 REFERENCES

1. DOI : 10.17577/IJERTV9IS040490.Tejashree Kadus , Pawankumar Nirmal , Kartikee Kulkarni Paper ID : IJERTV9IS040490 Volume 09, Issue 04 (April 2020) Published (First Online): 05-05-2020 ISSN (Online) : 2278-0181 Publisher Name : IJERT Yann Glouche, Arnab Sinha, Paul Couderc HAL Id: hal-01198382 https://hal.inria.fr/hal-01198382 Submitted on 15 Jan 2016.

2. S M Labib 2017 Third International Conference on Research in Computational Intelligence and Communication Networks (ICRCICN) 03-05 November 2017 INSPEC Accession Number: 17452798 DOI: 10.1109/ICRCICN.2017.8234495 Publisher: IEEE Conference Location: Kolkata, India.

3. S. Srivastava, R. P. Chourasia, P. Sharma, S. I. Abbas, N. K. Singh, “RailwayTrack Crack detection vehicle”, IARJSET, Vol. 4, pp. 145-148, Issued in 2, Feb 2017.

4. David Rutqvist,Denis Kleyko,Fredrik Blomstedt IEEE Transactions on Industrial Informatics (Volume: 16, Issue: 1, January 2020) 08 May 2019 INSPEC Accession Number: 19348329 DOI: 10.1109/TII.2019.2915572 Publisher: IEEE.

5. Y.Sen Gupta,S.Mukherjee,R.Dutta & S.Bhattacharya Published: 24 July 2021.

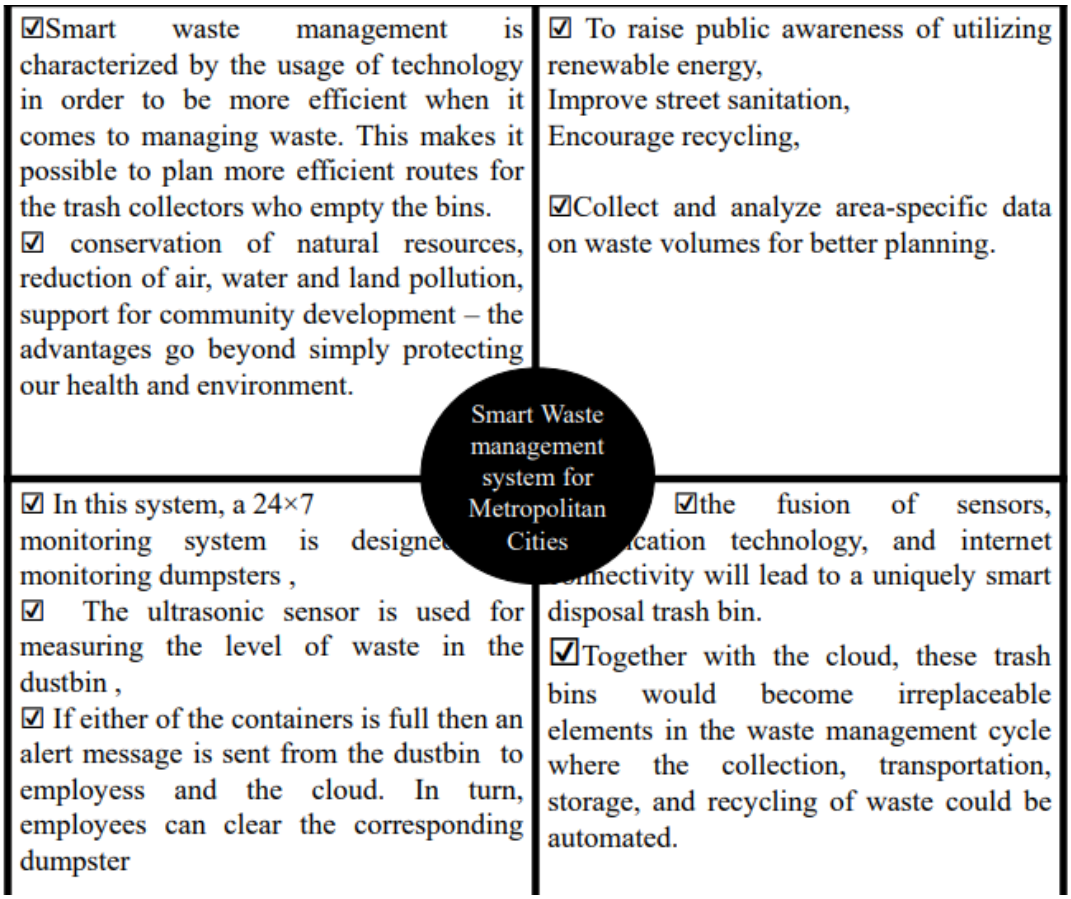
6. International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072 © 2019, IRJET ISO 9001:2008 Certified Journal Smart Dustbin using GPS Tracking Sonali Joshi1, Uttkarsh Kumar Singh, Sahil Yadav.

7. IOT Based Smart Dustbin Monitoring With Tracking System Using ATMega 2560 Microcontroller Publisher: IEEE Mohammad Abbas Hussain; Kvs Nikhil; Koppuravuri Yaswanth Pavan Kalyan December 2019 DOI: 10.1109/ICInPro47689.2019.9092295.
8. A Software-Defined Networking (SDN) Architecture for Smart Trash Can Using IoT T. Vairam, S. Sarathambekai & D. Vigneshwaran C19 October 2019.

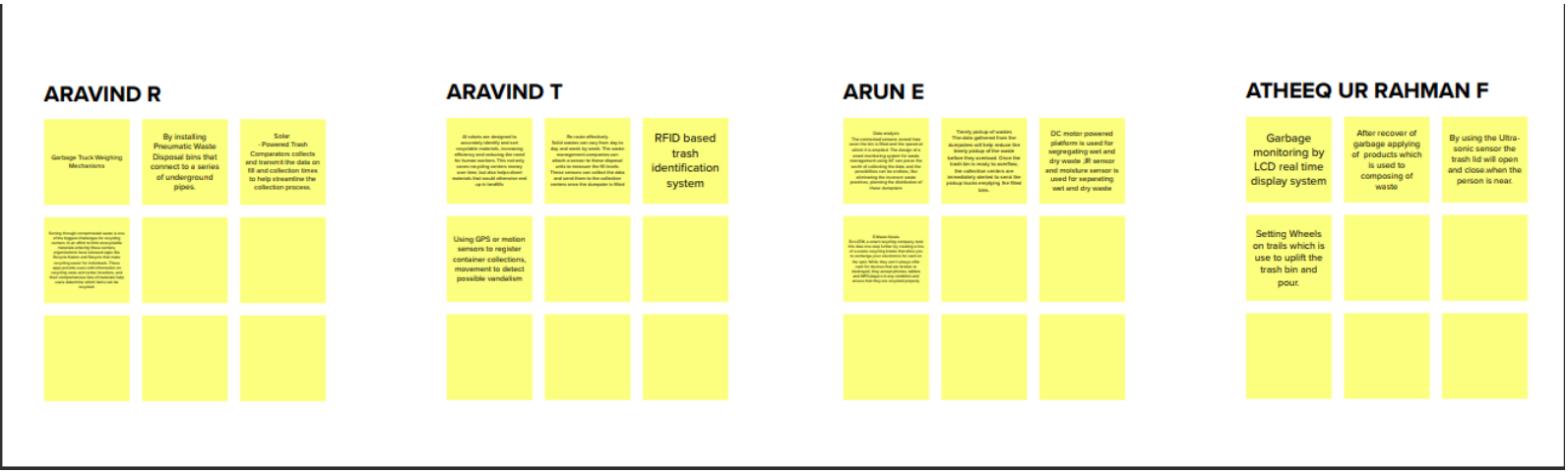
IDEATION AND PROPOSED SOLUTION

3. IDEATION AND PROPOSED SOLUTON

3.1 EMPATHY MAP CANVAS



3.2 IDEATION & BRAINSTORMING

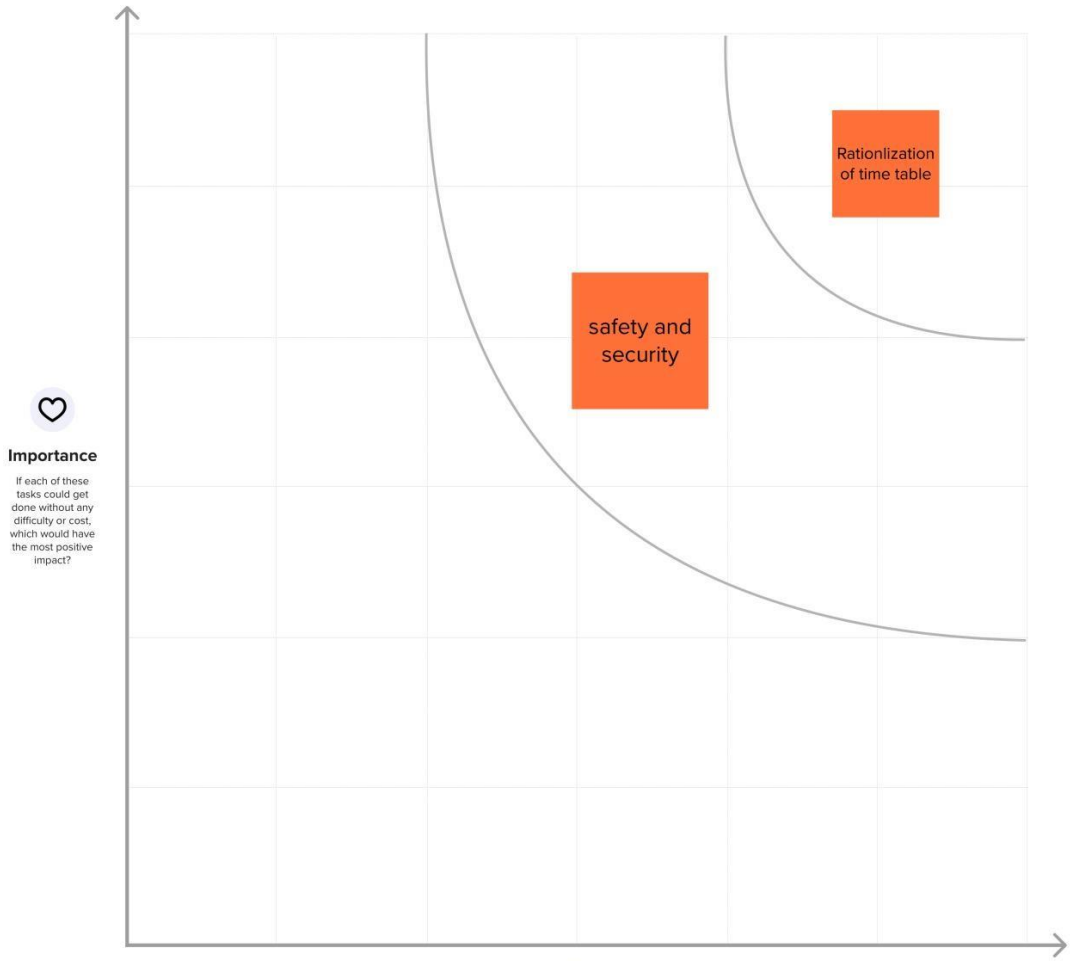


4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

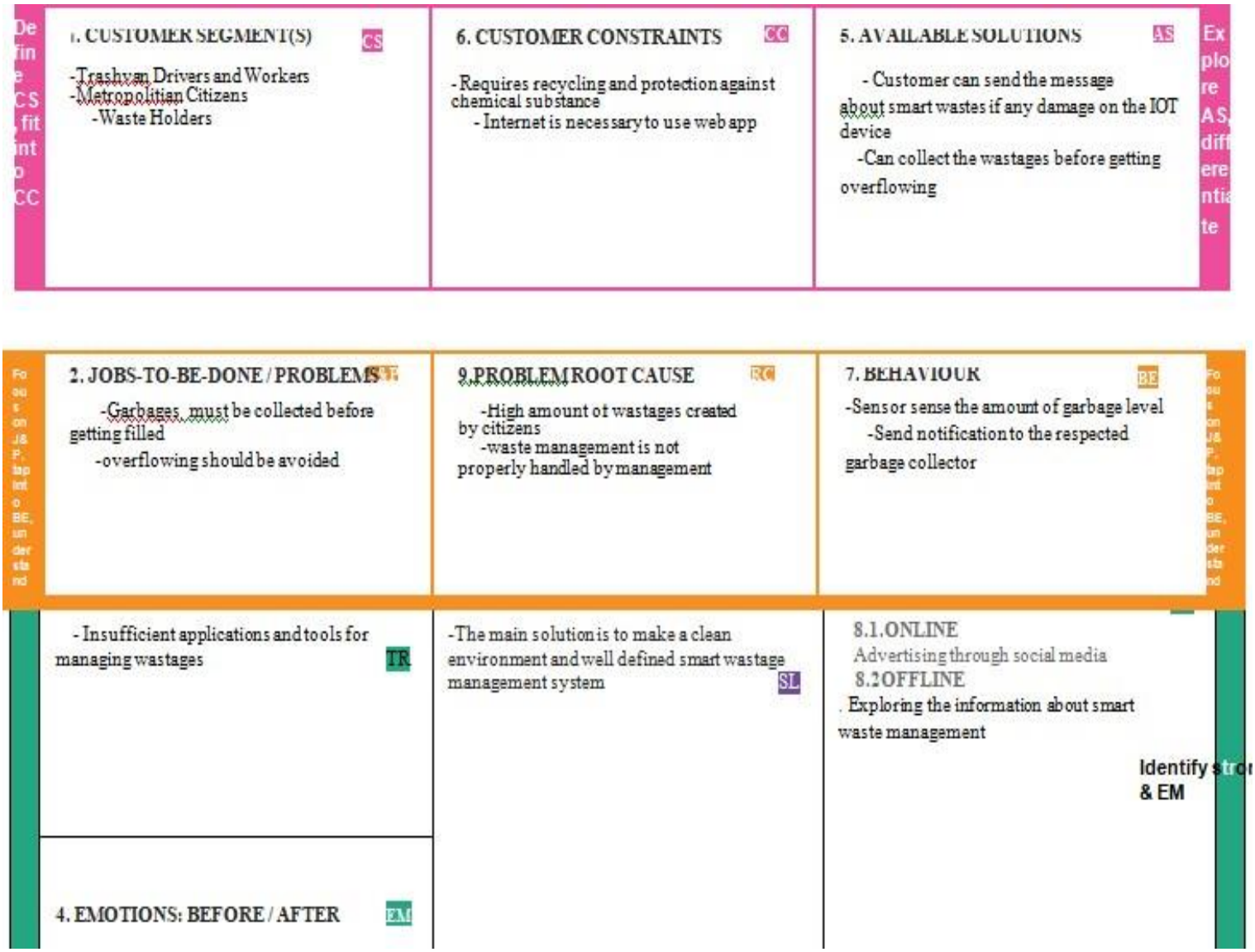


3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	**Problem Statement (Problem to be solved)**	Misunderstanding of the operations of smart sensors because this is a new and emerging technology, there is a general misunderstanding of its operations. A lot of people believe that it is a complicated and expensive method to dispose of waste, which is not. They are actually very affordable, easy to use, durable and save costs. Setting up the smart sensor, while smart sensors are easy to use, you cannot just buy one and install it on your waste bin. There are other steps that need to be taken after purchase to ensure its effectiveness.
2.	**Idea / Solution description**	For the Mis-Understanding of the operations to the public we aware the public by the rally,some program about smart waste system operations etc… To installing the sensors,the performance of the sensors will be pre-planned by the coding.wheather the garbage is renewable or not it will be detect and it is easy to recycling process.

3.	**Novelty / Uniqueness**	Novelty and uniqueness 1.Reduction in collection cost 2.No missed Follow ups 3.Reduced over flows 4.waste Generation analysis 5.CO2 Emission Reduction
4.	**Social Impact / Customer Satisfaction**	Its stops unwanted Follow ups. Because it Collecting of Trash Bin waste when it Full. So in society it creates a good impact and most useful. Customers also satisfy with this method because they won't seen any trash can is filled for a days
5.	**Business Model (Revenue Model)**	Waste Management generates revenue through the provision of various waste management and disposal services and recycling solutions to residential, commercial, industrial, and municipal clients. The Company derives its revenue in the form of various fees associated with its service offerings
6.	**Scalability of the Solution**	The IOT scalability to refer the ability to go form prototype to production in a seamless way.

3.4 PROBLEM SOLUTION FIT



REQUIREMENT ANALYSIS

4.REQUIREMENT ANALYSIS

4.1. FUNCTIONAL REQUIREMENTS

FR No.	Functional Requirement(Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Detailed bin inventory	All monitored bins and stands can be seen by the admin and he will go to the location and collect the waste from the bins whenever they filled.
FR-2	Real time bin monitoring	In the dashboard the current levels of the binsgot updated simultaneously whenever there isa change in waste in bin.
FR-3	Cost effective	We will help to collect the data from the various bins in all the locations and make the people to manage them efficiently with very less cost.
FR-4	Adjust bin distribution	Ensuring the bins available in all the locationsso people can dispose the waste safely to maintain a good environment.

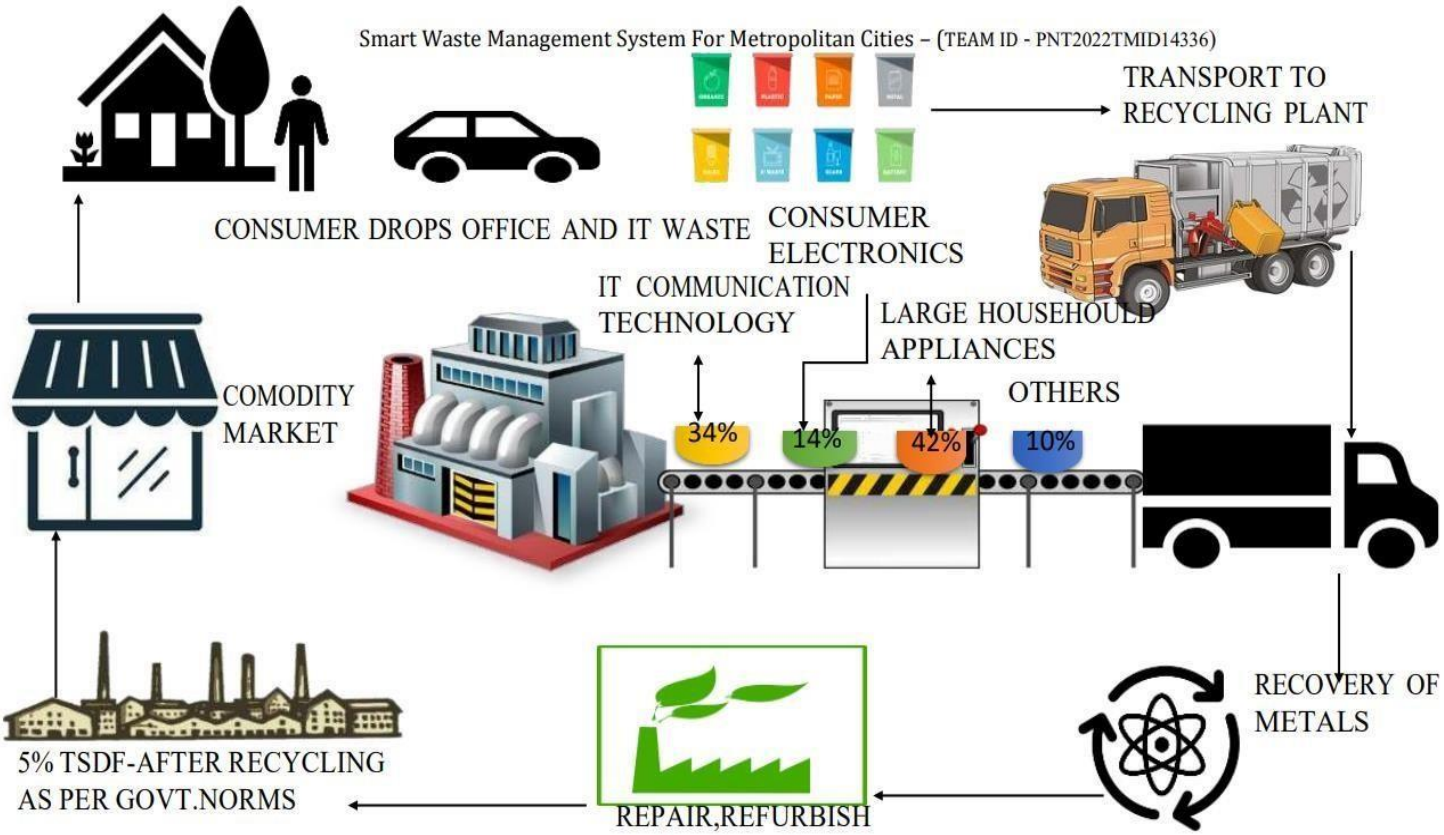
4.2. NON-FUNCTIONAL REQUIREMENTS

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	This site can easily understand by everyone since we are trying to develop in a very simplified manner.
NFR-2	**Security**	We will maintain high standards of security while maintain the data in our site.
NFR-3	**Reliability**	We ensure to provide a best quality and cost efficient of the product.
NFR-4	**Performance**	Our system provides one of the best ever experience to people.
NFR-5	**Availability**	We ensure to make available in all the locations across the city.
NFR-6	**Scalability**	Based on the location we will increase the capacity of the waste management.

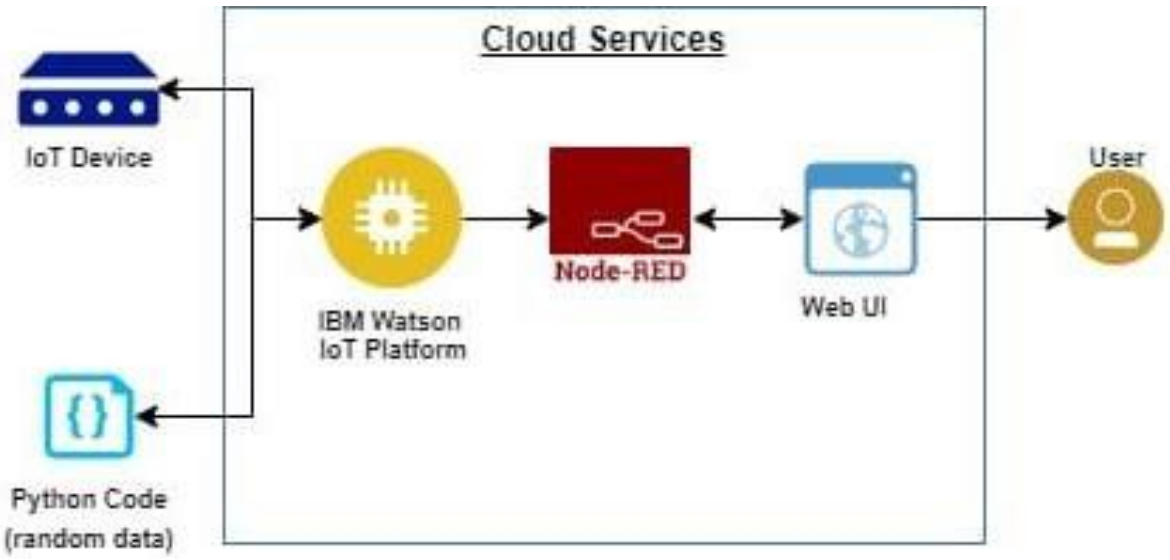
PROJECT DESIGN

5.PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS



5.2 SOLUTION & TECHNICAL ARCHITECTURE



5.3 USER STORIES

S.N0	Components	Description	Technology
1.	User interface	User interact with application using form,login,request notification	Python/HTML/MYSQL/JAVA
2.	Registration	User register in the application to connect bank account	Python/HTML/MYSQL/JAVA
3.	Verification	Verification in the application to connect bank account	Python/HDML/MYSQL/JAVA
4.	Sensors(IOT device)	A device that responds to a physical stimulus (such as heat,light,sound, pressure,magnetism, or a particular motion) and transmit a resulting impulse.	Raspberry pi/Arduino UNO/Temperature sensor/ultrasonic sensor
5.	Sends notification	Sends the notification to the cloud Database.	IBM Cloud
6.	Cloud Database (Node Red)	Database service on cloud.	Node Red
7.	Application	A computer software package that performs a specific function directly for an end user	IBM Wastson STT service

Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Framework	Open source is a term denoting that aproduct includes permission to use itssource code,design documents or content.	Bootsrap
2.	Scalable Architecture	It connected with scalable architecture	IBM Watson
3.	Availability	This application access is availble at the work time of the workers according to their corporation or municipality.	Python
4.	Performance	Record resource requests and saveregistered information. Availability of application.	IBM Watson

PROJECT PLANNING AND SCHEDULING

6.PROJECT PLANNING AND SCHEDULING

6.1. SPRINT PLANNING& ESTIMATION

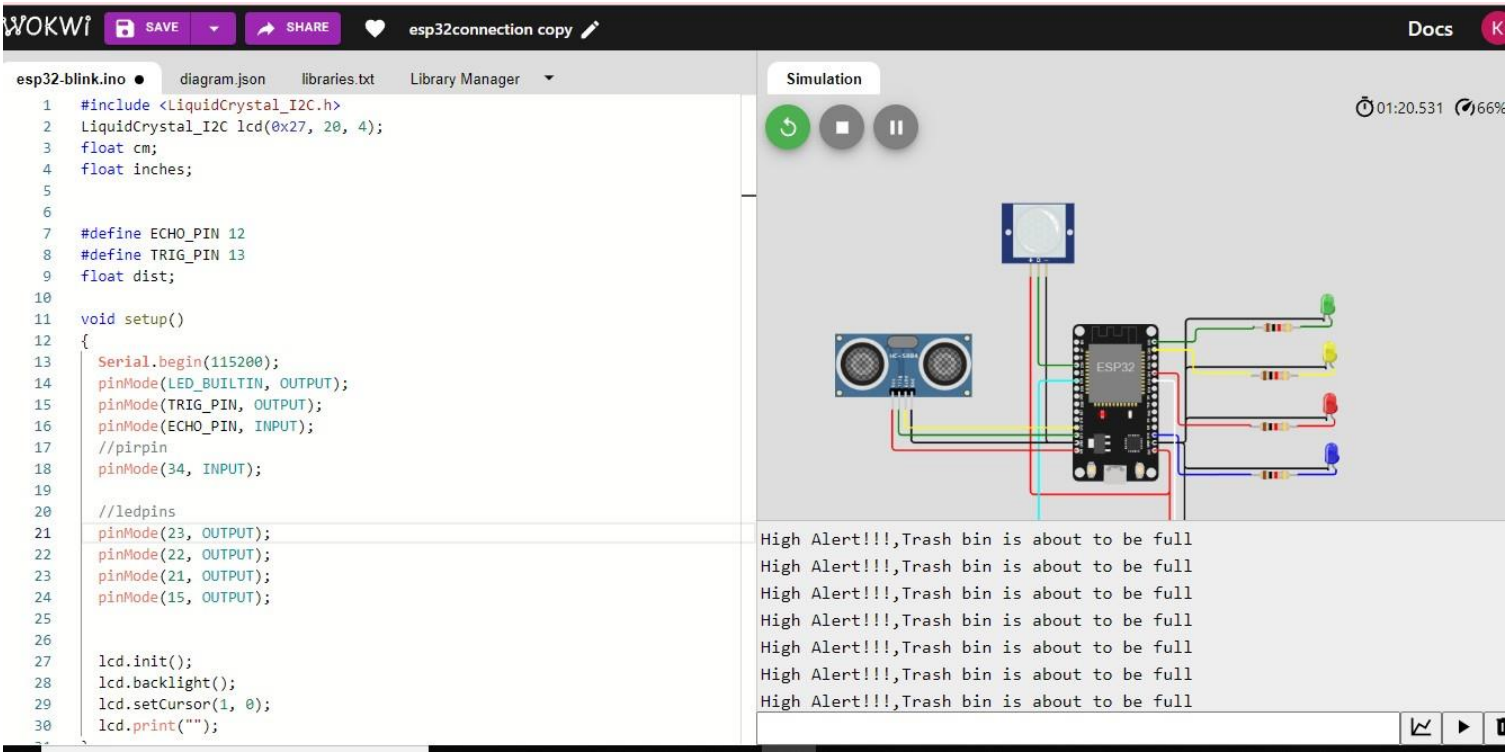
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Login	USN-1	As a Administrator, I need to give user id andpasscode for ever workers over there in municipality	10	High	Aravind
Sprint-2	Dashboard	USN-3	As a Truck Driver, I'll follow Co-Admin's Instruction to reach the filling bin in short rootsand save time	20	Low	Aravind
Sprint-3	Dashboard	USN-4	As a Local Garbage Collector, I'II gather all the waste from the garbage, load it onto a garbage truck, and deliver it to Landfills	20	Medium	Arun
Sprint-4	Dashboard	USN-5	As a Municipality officer, I'll make sure everything is proceeding as planned andwithout any problems	20	High	Atheeq ur Rahman

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	8 Days	24 Oct 2022	02 Nov 2022	20	02 Nov 2022
Sprint-2	20	8 Days	02 Nov 2022	10 Nov 2022	20	10 Nov 2022
Sprint-3	20	8 Days	10 Nov 2022	18Nov 2022	20	18 Nov 2022
Sprint-4	20	8 Days	18 Nov 2022	26 Nov 2022	20	26 Nov 2022

CODING AND SOLUTIONING

7.CODING AND SOLUTIONING



TESTING

8.TESTING

8.1.TEST CASES

Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result
Login page	Verify user is able to log into application with InValid credentials		Enter invalid username/email in email text box . Enter valid password text box. Click on log in button	username:speed password:123456	Application should show 'Incorrect email or password ' validation message.	Working as expected
Login page	verify user is able to connect with open weather api		if open weather api was connected it will show connected.		open weather api will connected	Working as expected
Login page	verify user is able to see the temperature and visibility		click the link the temperature and the visibility will be shown		if the user click on link the value will be shown otherwise it will not shown	Working as expected

			NFT - Risk Assessment					
S.No	Project Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score
1	signs with smart con	Existing	Low	No Changes	moderate	No downtime	>5 to 10%	GREEN

8.2Performance Testing

			NFT - Risk Assessment					
S.No	Project Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score
1	signs with smart con	Existing	Low	No Changes	moderate	No downtime	>5 to 10%	GREEN

RESULTS

9.RESULTS

9.1. PERFORMANCE METRICS

This project used to measure garbage level and send alert message to trash collector. Reducing waste will not only protect the environment but will also save on costs or reduce expenses for disposal. In the same way, recycling and/or reusing the waste that isproduced benefits the environment by lessening the need to extract resources and lowers the potential for contamination**.**

ADVANTAGES &DISADVANTAGES

8. ADVANTAGES &DISADVANTAGES

10.1. ADVANTAGES

It saves time and money by using smart waste collection bins and systems equipped with fill level sensors. As smart transport vehicles go only to the filled containers or bins. It reduces infrastructure, operating and maintenance costs by upto 30%.

1. It decreases traffic flow and consecutively noise due to less air pollution as result of less waste collection vehicles on the roads. This has become possible due to two way communication between smart dustbins and service operators.
2. It keeps our surroundings clean and green and free from bad odour of wastes,emphasizes on healthy environment and keep cities more beautiful.
3. It further reduces manpower requirements to handle the garbage collection process.
4. Applying smart waste management process to the city optimizes management,resources and costs which makes it a "smart city".
5. It helps administration to generate extra revenue by advertisements on smart devices.

10.2. DISADVANTAGES

1. Sensor nodes used in the dustbins have limited memory size.
2. It reduces man power requirements which results into increase in unemployments for unskilled people.
3. The trainining has to be provided to the people involved in the smart waste management system.

CONCLUSION

11.CONCLUSION

1) Optimization of the garbage collection process, reduction of labor and resource costs,increase in efficiency and comfort of citizens

2) Improvement of the ecological situation in the city

3) Increasing environmental awareness and motivation of the citizens.

FUTURE SCOPE

9. FUTURE SCOPE

There are several future works and improvements for the proposed system,

1. Change the system of user's authentication and atomic lock of bins which would help in securing the bin from any kind of damage or theft.

2. Concept of green-points that would encourage the involvement of the residents or the end users making the idea successful and helping to achieve joined efforts for the waste management and hence fulfilling the idea of Swachch Bharath.

3. Having a case study or data analytics on the type and times the waste is collected on the type of days or season making the bin filling predictable and removing the dependency on electronic components and fixing the coordinates.

4. Improving graphical interfaces for the Server and complete Android applications has possibility of extending the system adding other use cases and applications for smart cities.

5. Moreover, the proposed solution is flexible and decoupled with respect to the determination of optimal number of bins and vehicles or to the algorithm that define the best route for vehicles. Therefore, future works can be made in the study of models that offer the best results in terms of decision-making.

APPENDIX

10. APPENDIX

13.1. SOURCE PROGRAM

```
 #include
<LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 20,
4); float cm;
float inches;
#define ECHO_PIN 12
#define TRIG_PIN 13
float dist;void setup()
{
Serial.begin(115200); pinMode(LED_BUILTIN, OUTPUT);
pinMode(TRIG_PIN,OUTPUT); pinMode(ECHO_PIN, INPUT);
//pir pin pinMode(34, INPUT);
//ledpins
pinMode(23, OUTPUT); pinMode(22,
OUTPUT); pinMode(21, OUTPUT);
pinMode(15, OUTPUT); lcd.init();
lcd.backlight(); lcd.setCursor(1, 0);
lcd.print("");
}
float readcmCM()
{
digitalWrite(TRIG_PIN, LOW); delayMicroseconds(2);
digitalWrite(TRIG_PIN, HIGH);delayMicroseconds(10);
digitalWrite(TRIG_PIN, LOW);
int duration = pulseIn(ECHO_PIN, HIGH); return duration * 0.034 / 2;
}
void loop()
{
      if(digitalRead(34)) //pir motion detection
{
```

```
Serial.println("Motion Detected"); Serial.println("Lid Opened");
digitalWrite(10, HIGH);delay(10000);
Serial.println("Lid Closed");
}
else
{
digitalWrite(10, LOW);
}

if(cm <= 100)    //Bin level detection
{
digitalWrite(21, HIGH);
Serial.println("High Alert!!!,Trash bin is about to be full"); digitalWrite(22,
LOW);digitalWrite(23, LOW);
}
else if(cm > 150 && cm < 250)
{
digitalWrite(22, HIGH);
Serial.println("Warning!!,Trash is about to cross 50% of bin level");
digitalWrite(21,LOW);
digitalWrite(23, LOW);
}
else if(cm > 250 && cm <=400)
{
digitalWrite(23, HIGH); Serial.println("Bin is available");
digitalWrite(21, LOW);digitalWrite(22, LOW);
}

float inches = (cm / 2.54);  //print on lcd
lcd.setCursor(0,0);lcd.print("Inches");
lcd.setCursor(4,0); lcd.setCursor(12,0);
```

```
lcd.print("cm"); lcd.setCursor(1,1); lcd.print(inches, 1);
lcd.setCursor(11,1); lcd.print(cm,1); lcd.setCursor(14,1); delay(1000);
lcd.clear();

}
```

Diagram.json file

```
{
"version": 1,
"author": "Uri Shaked", "editor": "wokwi", "parts": [
{ "type": "wokwi-esp32-devkit-v1", "id": "esp", "top": 0, "left": 0, "attrs": {}
},
{
"type": "wokwi-led",
"id": "led1",
"top": -43.97,
"left": 296.62,
"attrs": { "color": "limegreen" }
},
{
"type": "wokwi-led",
"id": "led2",
"top": 15.48,
"left": 299.36,
"attrs": { "color": "yellow" }
},
{
"type": "wokwi-led",
"id": "led3",
"top": 140.83,
"left": 302.1,
"attrs": { "color": "blue" }
},
```

```
{
"type": "wokwi-led",
"id": "led4",
"top": 79.19,
"left": 300.24,
"attrs": { "color": "red" }
},
{
"type": "wokwi-resistor",

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"left": 224.81,
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},
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"attrs": { "value": "1000" }
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"left": 221.1,
"attrs": { "value": "1000" }
},
{
"type": "wokwi-resistor",
"id": "r4","top": 119.28,
"left": 220.77,
"attrs": { "value": "1000" }
```

```
},
{
"type": "wokwi-lcd1602",
"id": "lcd1",
"top": 248.08,
"left": 161.61,
"attrs": { "pins": "i2c" }
},
{
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"id": "ultrasonic1",
"top": 13.99,
"left": -295.33,
"attrs": { "distance": "57" }
},
{
"type": "wokwi-pir-motion-sensor",
"id": "pir1","top": -147.86,
"left": -88.23,
"attrs": {}
}

],
"connections": [
[ "esp:TX0", "$serialMonitor:RX", "", [] ],
[ "esp:RX0", "$serialMonitor:TX", "", [] ],
[ "led1:A", "r1:2", "green", [ "v0" ] ],
[ "led2:A", "r2:2", "yellow", [ "v0" ] ],
[ "led4:A", "r4:2", "red", [ "v0" ] ],
[ "led3:A", "r3:2", "blue", [ "v0" ] ],
[ "led1:C", "esp:GND.1", "black", [ "v-2.56", "h-170.98", "v116.48" ] ],
[ "led2:C", "esp:GND.1", "black", [ "v-2.24", "h-173.72", "v91.96" ] ],
```

["led4:C", "esp:GND.1", "black", ["v-3.11", "h-174.6", "v27.59"]],
["led3:C", "esp:GND.1", "black", ["v-1.92", "h-177.99", "v-32.18"]],
["r1:1", "esp:D23", "green", ["v2.63", "h-71.91", "v19.92"]],
["r2:1", "esp:D22", "yellow", ["v-1.65", "h-71.58", "v-30.65"]],
["r4:1", "esp:D21", "red", ["v-1.01", "h-89.32", "v-64.37"]],
["r3:1", "esp:D15", "blue", ["v0.22", "h-89.65", "v-53.64"]],
["lcd1:GND", "esp:GND.1", "black", ["h-26.5", "v-129.82"]],
["lcd1:VCC", "esp:3V3", "red", ["h-44.89", "v-131.65"]],
["pir1:VCC", "esp:3V3", "red", ["v268.96", "h172.77", "v-55.17"]], [
"pir1:GND",
"esp:GND.2", "black", ["v0"]],
["pir1:OUT", "esp:D34", "green", ["v0"]],
["esp:D32", "lcd1:SDA", "cyan", ["h-46.74", "v226.73", "h207.35"]],
["lcd1:SCL", "esp:D19", "white", ["h-38.76", "v-0.46"]],
["ultrasonic1:GND", "esp:GND.2", "black", ["v0"]],
["ultrasonic1:ECHO", "esp:D12", "yellow", ["v0"]],
["ultrasonic1:TRIG", "esp:D13", "green", ["v0"]],
["ultrasonic1:VCC", "esp:VIN", "red", ["v0"]]
]
}

13.2. GIT HUB LINK

https://github.com/IBM-EPBL/IBM-Project-45030-1660727918