SMART WASTE MANAGEMENT SYSTEM

1. INTODUCTION :

1.1 Project Overview :

This Waste management is one of the serious challenges of the cities, the system now used in cities, we continue to use an old and outmoded paradigm that no longer serves the entail of municipalities, Still find over spilled waste containers giving off irritating smells causing serious health issues and atmosphere impairment. The Smart Waste Management System will simplify, with the Web applications and mobile phone, the solid and hydric waste inspecting process, and the management system of this presentation's total collection process. The proposed system is a GPS based. The suggested device and implementation will track waste storage and monitor the vehicle's waste driver. This method helps to make the customer aware of accountability behind the job such as the system for solid waste inspection and management, integrating communications technology for truck control systems such as GPS .

1.2 Purpose :

Smart waste management is about using technology and data to create a more efficient waste industry. Based on IoT (Internet of Things) technology, smart waste management aims to optimize resource allocation, reduce running costs, and increase the sustainability of waste services.

Urban India generates tonnes of wastes annually. Our country faces major challenges associated with waste management.
Conventional garbage collection is not efficient since the authorities are not notified until the waste bin is full, and this leads to overflow of waste material. Efficient way of waste disposal and collection of disposed garbage is essential for a sustainable and clean India. This paper presents smart waste management using IoT based waste bin for collection and monitoring the level of waste inside bin. The system is implemented using two ultrasonic sensors which is being controlled by Node MCU. One of the ultrasonic sensor detects the level of the waste in the bin and other detects the person approaching the bin to dispose the waste. This

detection helps in automatic opening and closing of the lid. Servo motor is connected to the lid which serves the action of closing and opening of the lid. In this system, level of waste in the bin will be sent to concerned authorities. The IoT data is stored and monitored using Blynk app. The proposed system is reliable, cost effective and can be easily implemented.

2.LITERATURE SURVEY :

This is not an original idea, IOT based dustbin was implemented and effectuated much before. Some authors presented systems where the sensors in the bin checked if the bin are filled up to the brim or not. If it was filled an automated message was sent to the server end of the system, through the Arduino SIM module, which used the application of the Arduino board. Once the server received the message it forwarded the message to the worker in charge, if the worker was available, he would notify his/her presence by accepting the work and would reach the required destination. If the worker was not available, the work would be transferred to another worker.

Some authors also implemented real time waste management system by using smart dustbins to check the filled level of dustbins whether they were filled. In this system the information of all smart dustbins can be accessed from anywhere and anytime by the concern person and he/she can

take a decision accordingly. By implementing this proposed system, the cost reduction, resource optimization, effective usage of smart dustbins was carried out. This system indirectly reduced traffic in the city. In major cities the garbage collection vehicle visited the area's everyday twice or thrice depending on the population of the particular area. The System informed the status of each and every dust bin in real time so that the concerned authority can send the garbage collection vehicle only when the dustbin is full.

Some proposed smart garbage management system using IR sensor, microcontroller and Wi-Fi module. This system assured the cleaning of dustbins soon when the garbage level reached its maximum. If the dustbin was not cleaned in specific time, then the records were sent to the higher authority who took appropriate action against the concerned contractor. This system also helped to monitor the fake reports and hence helped to reduce the corruption in the overall management system. It ultimately helped to keep cleanliness in the society

Progressively the Dustbin with Wi-Fi Router attached in it was also introduced. The Dustbin had a Passive Infrared Sensor. The Wi-Fi router was programmed to display the temporary connecting code. When the user throwed trash in the dustbin, the PIR sensor detected the trash and sent signals to the microcontroller. The microcontroller detected the signals and forwarded it to the router device. The router verified the signals and generated random codes and then forwarded it again to the microcontroller. The microcontroller scanned the signals and forwarded it to the LCD Display. The LCD Display displayed it. The user entered the random code generated by the router on the PHP interface which was hosted on the server. The server then responded to the request and displayed the Master Wi-Fi password to the user. The user then used the Master Wi-Fi password to connect to the internet. The user got the internet access for 10 minutes and automatically got disconnected.

III. FLAWS IN THE EXISTING SYSTEM:

The main problems of the existing solid waste collection

process and management system are as follows:

- **More complications in the processing.**
- **many controlling units linked with each other**
- **higher implementation cost**

IV. PROPOSED SYSTEM:

Smart netbin a normal dustbin elevated using a microcontroller-based platform Arduino Uno board interfaced with Load sensor and Wi-Fi module.it consists of 2 main modules the mechanical designed components and the electric components. The mechanical components consist of shredder and the load sensing plate while the electric components consist of various components that are the Arduino

Loadcell, LCD Display screen, IR Sensor, Amplifier, Relay module, Wi-Fi Router.

When the user dumps the trash into the dustbin the trash will be first crashed within the shredder and the shredded trash will the get collected onto the load sensing plate present in the dustbin. The load sensor us been attached to the load sensing plate this

sensor will measure the weight of the trash been dumped in the bin. once the set limit of weight is been satisfied the password of the router will get displayed on the LCD screen, although the router is still off .after the password has been displayed the user have to pull this plate outside so that the trash which has been collected on the plate falls down in the dustbin. This motion of the falling trash is captured by the IR sensor and once the IR sensor sense the falling motion

Advantages of proposed system over the existing:

- **Low implementation cost**
- **Simple module**
- **Easy functionality**

V. SYSTEM ARCHITECTURE:

A. The system is composed of following components:

1. The dustbin:

A normal dustbin made of plastic or metal which can hold up all the components installed in it the mechanical shredder installed on the top side and the load sensing plate at the

mediocre level all the IOT components will be installed at the bottom side. Thus, it should be of average size (height_600-700 mm dia_)

2. Sensors:

The sensing unit will mainly consist of 2 sensors i.e. the load sensor and the IR sensor the load sensor used for measuring the weight of trash being dumped into the dustbin and this is attached to the bottom side of load sensing plate, the IR sensor will detect the downward motion of trash once the load sensing plate s pulled out and the trash falls down in the bin

3. Load cell:

During a measurement, weight acts on the load cell's metal spring element and causes elastic deformation. This strain (positive or negative) is converted into an electrical signal by a strain gauge (SG) that is installed on the spring element.

Product Name: Load Cell

Load: 10Kg /22lb

Rated Output: 1+/-0.15mV/V

Recommend Excitation Voltage: DC 5V; Max Excitation

Voltage: DC 10V

4. IR sensor:

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion.

Operating Voltage Range

3.6~5 VDC

Average Current Consumption (mA)

0.06

Detection Angle

35 Â°

Distance Measuring Range

2 ~ 30cm

5. Wi-Fi module

It consists of the router which will provide the internet facilities to the user for dumping the trash into the bin

6. Microcontroller:

Arduino will be the processing unit for the embedded system at the bins. This will be used for controlling sensors and send information.

The other components include:

7. HX711 amplifier:

Differential input voltage: ±40mV (Full-scale differential input voltage is ± 40mV)

Operating Voltage: 2.7V to 5VDC

Operating current: <10 mA

8. LCD display:

Operating Voltage is 4.7V to 5.3V

Current consumption is 1mA without backlight

9. Power supply

The Power supply will provide electrical power for the

microcontroller, the shredder, and the router which are the most important part of the system.

10. Shredder:

A mechanical horizontal two shaft shredder is a machine used for reducing the size of all kind of material.it consist of shredding blade, loading box, box bracket, power system, the blade used is of steel. The specifications:

Voltage 200-300V

Power 4-15 kw

Capacity 80-800

11. Load sensing plate

The load sensing plate is a specifically designed plate according to the dustbin dimensions.it can be made of plastic wood metal it is used to collect the waste dumped into the bin and as the load sensor is attached to its bottom it measures the weight of the trash dumped in. it consist of holes so that the sand soil mud flows down through this holes and their weight is not been considered also the holes reduces the overall weight of the

plate.it is installed at the 1/4th height from the top of the dustbin

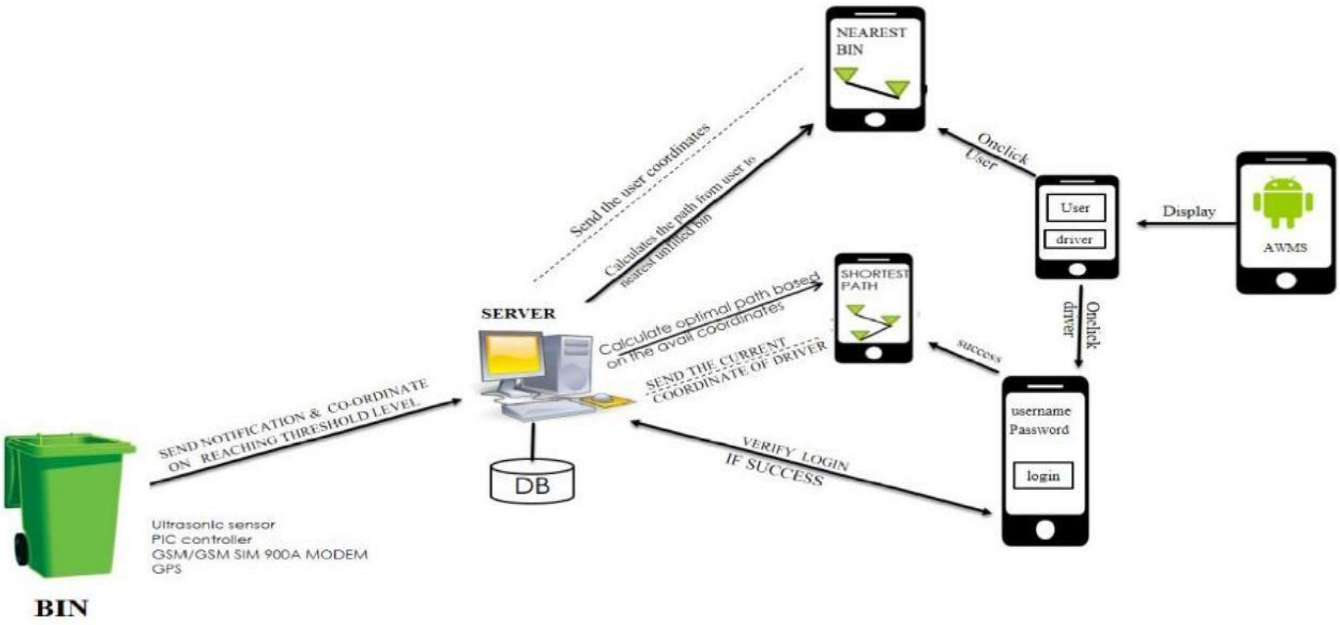
SOLUTIONS:

Design a smart waste collection system that allows citizens to segregate the various types of solid waste they want to dispose and the municipal authorities to efficiently collect the same. The system should be mobile app (Android) based.

Smart waste management is about using technology and data to create a more efficient waste collection methods. Based on IoT (Internet of Things) technology, smart waste management aims to optimize resource allocation, reduce running costs, and increase the sustainability of waste services.

WORKING OF THE MODEL :

The bin with ultrasonic sensor, PIC controller, GSM and GPS will notify the coordinate and bin status to the database. Here GSM is user to communicate with the server, which will contain the SIM with the basic speed internet. The ultrasonic sensor which uses ultrasonic waves will check the bin status. The server will maintain the details of the unfilled bins, filled bins and authority registration. The information to the normal user is about the nearest unfilled bin and authorised person will be given the coordinated of the filled bins. The user end will contain the android app which works on android compatible phone. The user will notify the unfilled nearest bin with path and authorised person will be notified by the filled bins with path. The working is as follows, User inserts trash into the bin, Bin checks for threshold level, Bin sends the status and coordinates to the Control centre on reaching the appropriate level, Control centre uses the coordinates sent by multiple Bins and provides an optimal path to the garbage vehicle, The bin if emptied by the vehicle, a notification is sent by it to Control centre. This helps in easy monitoring.



Smart waste management is a idea where we can control lots of problems which disturbs the society in pollution and diseases.The Smart waste management is compatible mainly with concept of smart cities. The main objectives of our proposed system are as follows:

1. **Monitoring the waste management.**
2. **Providing a smart technology for waste system.**
3. **Avoiding human intervention.**
4. **Reducing human time and effort**

5. Resulting in healthy and waste ridden environment. This project falls under the category of embedded systems and android applications.

VIII. FUTURE WORKS:

The moisture sensor can be implemented hand in hand with the other sensors and the compartments for segregating the dry and wet waste can be created which will solve the issues related to waste segregation.

IX. CONCLUSION:

Improper disposal and improper maintainance of domestic waste create issues in public health and environment pollution thus this paper attempts to provide practical solution towards managing the waste collaborating it with the use of IOT i.e. providing free internet facilities for a specific time once the trash is dumped into the bin. the proposed system will definitely help to overcome all the serious issues related to waste and keep the environment clean

X. REFERENCES:

[1] P. Suresh, Vijay. Daniel, R.H. Aswathy, Dr. V. Parthasarathy, "A State-of-the-Art review on Internet of Things" International Conference on Science Engineering and Management Research (ICSEMR), IEEE, DOI: 10.1109/ICSEMR.2014.7043637 19 February 2015.

[2] Parkash, Prabu V "IoT Based Waste Management for Smart City"

International Journal of Innovative Research in Computer and Communication Engineering, Vol. 4, Issue 2, DOI: 10.15680/IJIRCCE.2016. 0402029, February 2016.

[3] Evaluation on the Performance of Urban Domestic Sewage Treatment Plants in China - 2011 Dongmei Han; Guojun Song

[4] Teemu Nuortioa, Jari Kyto ¨ jokib, Harri Niskaa, Olli Bra ¨ ysyb "Improved route planning and scheduling of waste collection and transport", Expert Systems with Applications 30 (2006) 223 – 232, Elsevier

[5] M. Arebey, M. Hannan, H. Basri, and H. Abdullah, "Solid waste

monitoring and management using RFID, GIS and GSM", The IEEE Student Conference on Research and Development (SCOReD), 16-18 November 2009, UPM Serdang, Malaysia, 2009

3.IDEATION & PROPOSED SOLUTION :

3.1EMPATHY MAP CANVAS :

SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

What do they THINK AND FEEL?

what really counts
major preoccupations
worries & aspirations

Accumulated waste lead to environmental degradation

Is there any way to get rid of waste accumulation ?

Dilemma in choosing a suitable method

How can we be free of contamination ?

What do they HEAR?

what friends say
what boss say
what influencers say

Jeopardize health of the people

Unattended waste results in untidy streets smells foul

In the second place factors such as Wind & Rain further increase contamination

It is a menace to society

Gives an insight of the task

Route optimization

Increase the sustainability of waste services

Indication about the levels of the bins

What do they SEE?

environment
friends
what the market offers

What do they SAY AND DO?

attitude in public
appearance
behavior towards others

Preventing waste will save you money

By consuming less you will handle less waste

Pollution free environment make people feel more refreshing

Forecasting on how often bins need to be emptied

PAIN

fears
frustrations
obstacles

System requires more number of Waste bins

Reduces man power resulting in unemployment

GAIN

"wants" / needs
measures of success
obstacles

No missed pickups & Ultimately saves time

Co2 Emission reduction

Training has to be provided to the people involved

Sensor nodes have limited Memory size

Wireless technologies in the system may be affected by metal objects

Reduced overflows & Waste generation analysis

Reduction in collection cost

Minimize extraction of resource

3.2 BRAINSTROMING

Template

Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

10 minutes to prepare
1 hour to collaborate
2-8 people recommended

Share template feedback

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

Team gathering
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

Set the goal
Think about the problem you'll be focusing on solving in the brainstorming session.

Learn how to use the facilitation tools
Use the Facilitation Superpowers to run a happy and productive session.

Open article

1 Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

PROBLEM

How might we [your problem statement]?

With the existing methods of collecting and disposal it is near impossible to manage such amount of waste in the future as around 30% of waste end up on the roads and public places due to ineffective disposing and collecting methods.

Key rules of brainstorming

To run an smooth and productive session

- Stay in topic.
- Encourage wild ideas.
- Defer judgment.
- Listen to others.
- Go for volume.
- If possible, be visual.

2 Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

Antony krijesh

Rajapandi

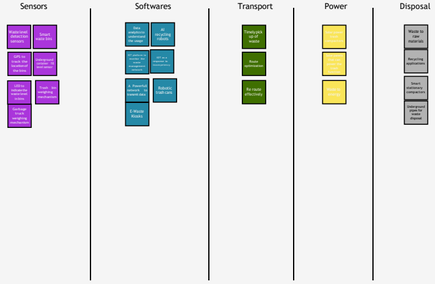
Ponraj

Vilvanathan

3 Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

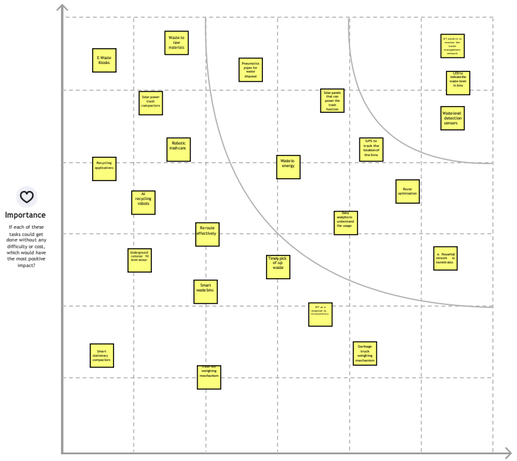
20 minutes



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



After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

Share the mural
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.

Export the mural
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

Strategy blueprint
Define the components of a new idea or strategy.
Open the template

Customer experience journey map
Understand customer needs, motivations, and obstacles for an experience.
Open the template

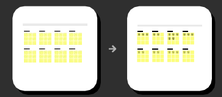
Strengths, weaknesses, opportunities & threats
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
Open the template

Share template feedback

Need some inspiration?

See a finished version of this template to kickstart your work.

Open example



3.3Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	With the existing methods of collecting and disposal it is near impossible to manage such amount of waste in the future as around 30% of waste end up on the roads and public places due to ineffective disposing and collecting methods.
2.	Idea / Solution description	Using IOT based smart sensors we can utilise the smart bin sensor technology and can • Track the location with real time data • Get the levels of the bin using ultrasonic sensor • Get instant alerts incase of emergency
3.	Novelty / Uniqueness	❖ The proposed solution maintains the hygeine of the surrounding places and maintains sanity . ❖ It saves time and very effective in waste disposal
4.	Social Impact / Customer Satisfaction	1. Healthy life 2. Decrease in pollution 3. Decrease in Soil contamination and Water contamination 4. Decrease in Air contamination
5.	Business Model (Revenue Model)	It reduces the expense on fuel and labour cost ,hence minimising the total expenditure than the usual
6.	Scalability of the Solution	The proposed solution can be implemented in most of the metropolitan cities with minimum constraints

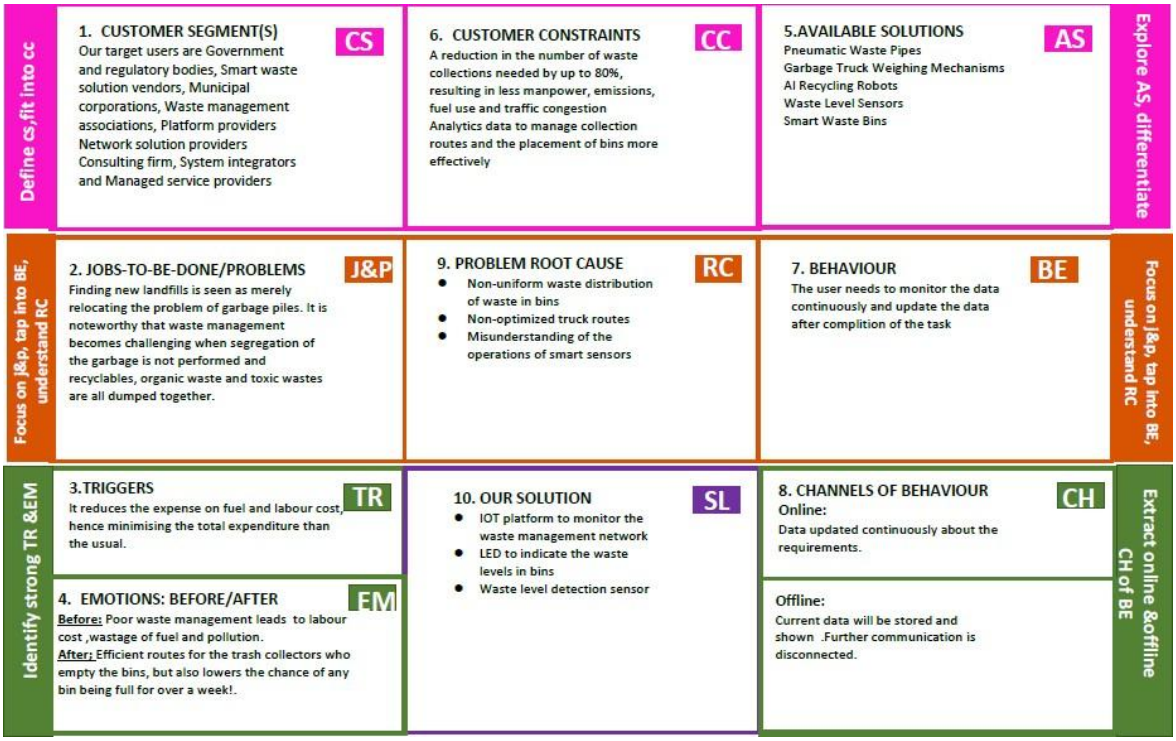
3.4 Problem – Solution Fit

Problem – Solution Fit :

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem. It helps entrepreneurs, marketers and corporate innovators identify behavioral patterns and recognize what would work and why

Purpose:

- ❑ Solve complex problems in a way that fits the state of your customers.
- ❑ Succeed faster and increase your solution adoption by tapping into existing mediums and channels of behavior.
- ❑ Sharpen your communication and marketing strategy with the right triggers and messaging.
- ❑ Increase touch-points with your company by finding the right problem-behavior fit and building trust by solving frequent annoyances, or urgent or costly problems.
- ❑ **Understand the existing situation in order to improve it for your target group.**



4.Solution Requirements (Functional & Non-functional)

Date	13 October 2022
Team ID	PNT2022TMID48397
Project Name	Project - Smart Waste Management System
Maximum Marks	4 Marks

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Expensive bins	As we are making up bins with sensors and other costly devices , this is somewhat expensive architecture to built. And so this requires more security settings as it requires more cost if we need to rebuilt it.
FR-2	Implementing proper monitoring system	All bins can be seen on the map, and you can visit them at any time via the Street View feature from Google. Bins are visible on the map as green, orange or red circles. You can see bin details in the Dashboard capacity, waste type, last measurement, GPS location and collection schedule or pick recognition.
FR-3	**Planning waste collection routes**	As well as planning is important where we need to set locations to particularize routes where bins are collected once it got filled. So, clear mapping of routes where the bin collecting truck need to travel. If we allset with clear plan, there is no need of wasting time and fuel by searching locations.
FR-4	**Separation of different kind of wastes**	Separation of different kind of wastes involves people responsibility too and so, proper education need to be provided. And bins should be implemented accordingly in each locations. And especially medical wastes should be disposed in a proper manner.

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	To the demolition of waste conducted by recycling and landfilling.To sort digestible and indigestible waste using a convolutional neural network.By exploiting this data, trash collection can be planned as well as truck routes can be optimized.
NFR-2	**Security**	Security ensures the level of assurance in data collection, processing and conveying. As this is totally depend upon cloud service we need to make security more particular without channel crash.A waste can be managed efficiently as it avoids unnecessary lumping of wastes on roadside.
NFR-3	**Reliability**	Smart waste management is also about creating better working conditions for waste collectors.Breeding of insects and mosquitoes can create nuisance around promoting unclean environment. This may even cause dreadful diseases.This system is more reliable at any cost by taking care of garbage bins and monitoring bin activity.
NFR-4	**Performance**	The system consist of sensors to measure the weight of waste and the level of waste inside the bin.Customers are provided with required data-driven and decision making prototypes which would help uses to monitor its performance and encounter their quires.
NFR-5	**Availability**	Availability refers to already available solutions and the new renovative technology that we include in the system which we are building new now.This system have much available solutions for users and this made users to operate easily where we have used sensors, GPS detectors, and so on.
NFR-6	**Scalability**	We have to customize the number of bins in the town/city which we are going to monitor 24/7 a week and collect data.Smart waste management aims to optimize resource allocation, reduce running costs, and increase the sustainability of waste service.Analytics data to manage collection routes and the placement of bins more effectively.

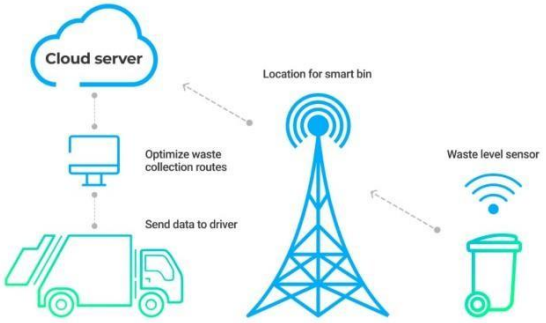
5.Project Design
5.1 Data Flow Diagram & User Stories

Date	13 October 2022
Team ID	PNT2022TMID48397
Project Name	Project – Smart waste management for metropolitan cities.
Maximum Marks	4 Marks

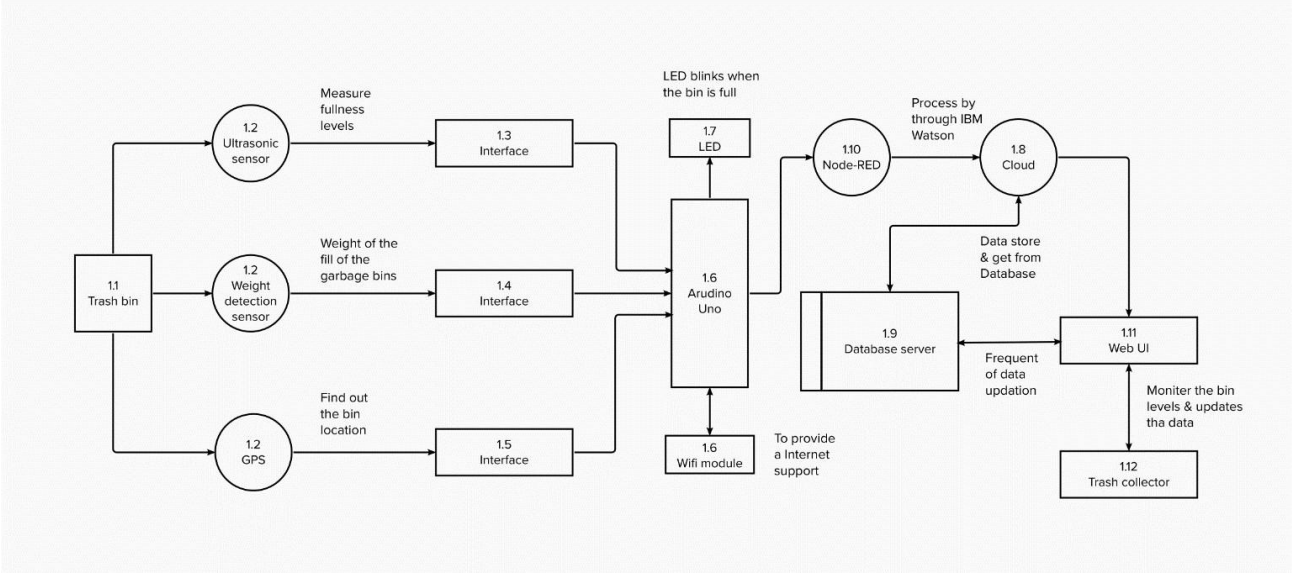
Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

Example: (Simplified)



Example: DFD Level 1 (Industry Standard)



User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Admin (who manage web server)	Web server login	USN-1	As a admin, I have my user name and password foe every worker and co-workers to manage them.	I can manage web account and direct workers.	High	Sprint-1
Co-admin	Login	USN-2	As a co-admin, I'll manage other monitoring activities like garbage level monitoring, location accuracy, garbage separation and removal of waste within a scheduled time.	I can monitor garbage bins activities.	High	Sprint-2
Customer (Web user)	User	USN-3	Here comes the customer, he/she will have access to mobile apps or login webpages to view progress of bins and to report if any query found.	He/ she has the right to make a query if any.	High	Sprint-3
Customer Care Executive	Worker	USN-4	The customer care executive, will try to rectify the queries from customers by contacting co-admin. If case of any critical/ emergency situation query can be conveyed to higher authority.	I can attend calls and respond people by rectifying the problem.	High	Sprint-4
Truck driver	Worker	USN-5	Here, truck driver is a worker who has particular assignments that he has to report when and where the garbage has been picked according to the daily schedule. And should update the happenings in the given website (Webpage login).	I can update my activities on site when the given task has been completed.	Moderate	Sprint-5

5.2 Technology Stack (Architecture & Stack)

Date	13 October 2022
Team ID	PNT2022TMID48397
Project Name	Smart Waste Management for Metropolitan Cities
Maximum Marks	4 Marks

Technical Architecture:

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2

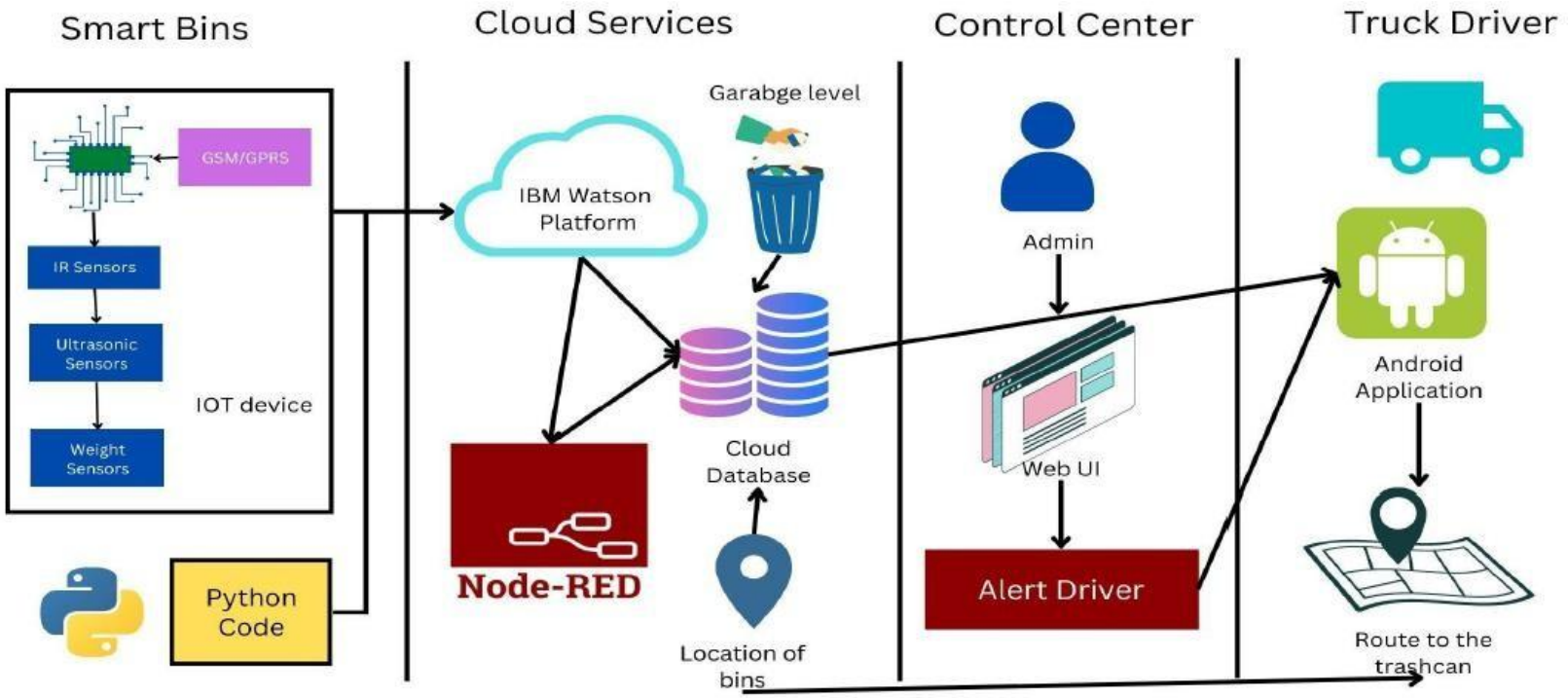


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	Application	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Ultrasonic Sensor	An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves.	a transducer to send and receive ultrasonic pulses
3.	Weight detection Sensor	Weight sensors are a device used to measure force and load. They convert weight into an electrical signal which can be processed and used within various applications.	A load cell is essentially a force transducer or force sensor.
4.	GPS Sensor	GPS sensors are receivers with antennas that use a satellite-based navigation system with a network of 24 satellites in orbit around the earth to provide position, velocity, and timing information.	GPS uses the satellites in space and the GPS receiver on the ground.
5.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloud etc.
6.	LED	LED, in full light-emitting diode, in electronics, a semiconductor device that emits infrared or visible light when charged with an electric current	Electroluminescence
7.	Solar Panel	A solar panel is actually a collection of solar (or photovoltaic) cells, which can be used to generate electricity through photovoltaic effect.	photovoltaics (PV) and concentrating solar-thermal power (CSP).
8.	Lithium Ion Battery	A lithium-ion (Li-ion) battery is an advanced battery technology that uses lithium ions as a key component of its electrochemistry.	the positive to the negative electrode
9.	Wifi Module	The ESP8266 WiFi Module is a selfcontained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network.	IEEE 802 protocol

10.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Template for software development that is designed by a social network of software developers. These frameworks are free for public use	Python, Embedded C.
2.	Security Implementations	provides the technical security policies, requirements, and implementation details for eliminating the security weaknesses	GSM/GPRS.
3.	Scalable Architecture	scalable architecture supports higher workloads without any fundamental changes to it.	Node Red.
4.	Availability	The quality or state of being available trying to improve the availability of affordable housing.	Cloud, DB.
5.	Performance	The execution of an action	IBM Waston IoT Platform.

5,3 USER STORIES

Template

Customer experience journey map

Use this framework to better understand customer needs, motivations, and obstacles by illustrating a key scenario or process from start to finish. When possible, use this map to document and summarize interviews and observations with real people rather than relying on your hunches or assumptions.

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SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES

SCENARIO

Browsing, booking, attending, and rating a local city tour

	Entice How does someone initially become aware of this process?	Enter What do people experience as they begin the process?	Engage In the core moments in the process, what happens?	Exit What do people typically experience as the process finishes?	Extend What happens after the experience is over?
Steps What does the person (or group) typically experience?	Frustration waste collector gets fed up because of constantly checking the bins	Dilema The employer grows uneasy due to increase in expense because of scouting	Confrontation after arrival at the location the collector has to deal with the spilled waste	Negligence recklessness and unthoughtful actions and not dealing with situation	Outcome undealt waste ultimately leads to conatamination
Interactions What interactions do they have at each step along the way? ■ **People:** Who do they see or talk to? ■ **Places:** Where are they? ■ **Things:** What digital touchpoints or physical objects would they use?	Surveillance → continuous monitoring of the levels of bins by means of mobile application	Alerts → gets timely alerts upon the overflow of data	Route Optimzation → provides with best possible routes towards destination	Forecasting → provides an insight means of database	Scheduling → provides a routine or timely pickup
Goals & motivations At each step, what is a person's primary goal or motivation? ("Help me..." or "Help me avoid...")	Reaching out to someone to take care of fills	requesting assistance in the timely pickup	efforts to minimise the expenditure		refreshing atmospheric conditions to public
Positive moments What steps does a typical person find enjoyable, productive, fun, motivating, delightful, or exciting?	Its easy to collect the wasteC	Time and fuel is saved	No need of continuous manual monitoring	Economically beneficial	Cleanliness of streets
Negative moments What steps does a typical person find frustrating, confusing, angering, costly, or time-consuming?	Inabtity to access	Lack of training to the personal	Temporary server down	Incompetence to use the technology	Startup cost
Areas of opportunity How might we make each step better? What ideas do we have? What have others suggested?	Stability considerations	Better physical model	compactability	Network issues due to disconnectivity	maintanence problem scenario

Need some inspiration?

See a finished version of this template to kickstart your work.

Open example →

6.Project Planning Phase

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Use the below template to create product backlog and sprint schedule

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 entering my email,password,and confirming my password.	5	High	rajapandi
Sprint-1	Login	USN-2	As a user, I will receive confirmation email once I have registered for the application.	3	High	Antony krijeshi
Sprint-2	Dashboard	USN-4	As a user, I'll control the waste level by monitoring them via real time web portal.	5	High	Ponraj
Sprint-2	Notification	USN-4	As a user, once the bin gets filled, I'll notify trash truck with location of bin with bin ID.	5	High	Vilvanathan
Sprint-3	Dashboard	USN-5	As a user , I'll gather all the waste from the garbage bin and load it onto a truck..	8	Medium	Rajapandi
Sprint-3	Dashboard	USN-6	As a user, I can specify the location to be monitored and to reach the landfills in optimized routes to save time .	8	Medium	Antony krijesh
Sprint-4	Dashboard	USN-7	As a user, I'll make sure everything is proceeding as planned and without any problems.	13	High	ponraj

Project Tracker, Velocity & Burndown Chart: (4 Marks)

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	8	6 Days	24 Oct 2022	29 Oct 2022	8	29 Oct 2022
Sprint-2	10	6 Days	31 Oct 2022	05 Nov 2022	10	05 Nov 2022
Sprint-3	16	6 Days	07 Nov 2022	12 Nov 2022	16	12 Nov 2022
Sprint-4	13	6 Days	14 Nov 2022	19 Nov 2022	13	19 Nov 2022

Velocity:

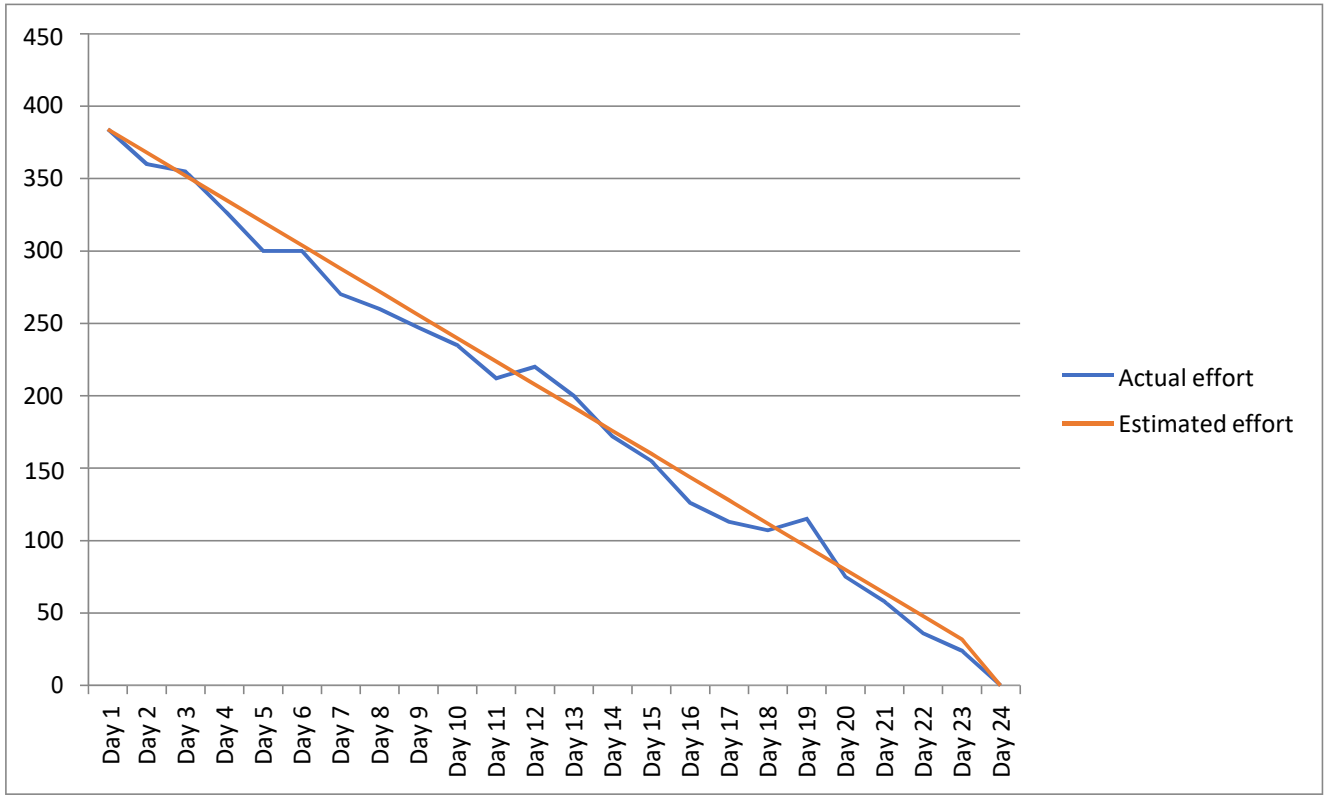
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

sprint	total story points	duration	average velocity
sprint-1	8	6 days	1.33
sprint-2	16	6 days	2.67
sprint-3	10	6 days	1.67
sprint-4	13	6 days	2.17
total	47	24 days	1.95

Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



7.CODING & SOLUTIONING
DEVELOP A PYTHON SCRIPT

TEAM ID :	PNT2022TMID48397
PROJECT :	SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES
MAXIMUM MARKS :	4 MARKS

CODE :

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "i1kqwd"
deviceType = "abcd"
deviceId = "12345"
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")
   elif status == "lightoff":
      print ("led is off")
   else :
      print ("please send proper command")

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

    dist =random.randint(30,100)
```

```
        weight =random.randint(10,50)

        data = { 'distance' : dist, 'Weight': weight}
        #print data
        def myOnPublishCallback():
           print ("Published Distance = %s cm" % dist, "Weight = %s kg " % weight, "to IBM Watson")

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
        if not success:
           print("Not connected to IoTF")
        time.sleep(10)

        deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

8. TESING

8.1 TEST CASES :

Test case ID	Feature Type	Component	Test Scenario
TC_OO1	Functional	IBM cloud	Create the IBM Cloud services which are being used in this project.
TC_OO2	Functional	IBM Cloud	Configure the IBM Cloud services which are being used in completing this project.
TC_OO3	Functional	IBM Watson IoT Platform	IBM Watson IoT platform acts as the mediator to connect the web application to IoT devices, so create the IBM Watson IoT platform.
TC_OO4	Functional	IBM Watson	In order to connect the IoT device to the IBM cloud, create a device in the IBM Watson IoT platform and get the device credentials.
TC_OO5	Functional	IBM Cloud(Node Red)	Configure the connection security and create API keys that are used in the Node-RED service for accessing the IBM IoT Platform.

TC_OO6	Functional	Node Red	Create a Node-RED service.
TC_OO7	Functional	Python 3.7.0	Develop a python script to publish random sensor data such as load cell ,IR sensor and GSM/GPS to the IBM IoT platform
TC_OO8	Functional	Python 3.7.0	After developing python code, commands are received just print the statements which represent the control of the devices.
TC_OO9	Functional	M Cloudant D	Publish Data to The IBM Cloud
TC_O10	Web UI	Node Red & MIT Inventor	Create Web UI in Node- Red
TC_O11	Functional	IBM Cloudant DB	Configure the Node-RED flow to receive data from the IBM IoT platform and also use Cloudant DB nodes to store the received sensor data in the cloudant DB

8.2 USER ACCEPTANCE TESTING :

Pre-Requisite	Steps To Execute	Test Data
IBM Cloud Login ID & Password	1.Go to IBM Cloud signup page 2.Enter e-mail id and other credentials 3.Enter a password	https://cloud.ibm.com/login
IBM Cloud Login ID & Password	1. Go to Cloud login 2. Enter user ID & Password 3.Verify login by the popup display	https://cloud.ibm.com/login
IBM Watson IoT Platform Login ID & Password	1.Login to IBM Cloud 2.Click Catalog 3.Search IoT and click create 4.Go to resource list and search Internet of Things platform 5.Press Launch and click Sign in IBM Watson Platform	https://internetofthings.ibmcloud.com/
IBM Watson IoT Platform Login ID & Password	1. Login to IBM Watson Platform 2. Click Add Device 3. Enter the details and click Finish. Create Device ID & Device type 4.Turn on Device Simulator and click simulation running. Enter the values of loadcell,IR sensor and GSM/GPS 5.Click Send & Save. Verify the displayed result of the levels	Load cell,IR Sensor and GPS/GSM values are generated randomly in simulation
Node Red Installation	1. Install node red and open node red in command prompt 2. Select IBM input in IoT	https://cloud.ibm.com/developer/appservice/create-app?starterKit=59c9d5bd-4d31-3611-897a-f94eea80dc9f&defaultLanguage=undefined

Node Red Installation	1. Select IBM IoT input in Node. In IBM IoT Watson Platform, go to apps and click on generate API keys. 2. Copy & paste generated API key and token in the IBM IoT input. After entering all details, click the done button. 3. Add debug to the IBM IoT and rename as Msg.payload and click on done. Click gauge from the dashboard and fill the details & add functions to the gauge. Check the generated values from the debug message. 4. Edit function node, connect them, add another gauge and functions, name them as "loadcell,IR sensor & GSM/GPS" 5. Finally add light ON/OFF buttons to the IBM IoT and debug. Verify the output from NODE RED using Local host link	Values of sensors and button for light ON/OFF is displayed
Python 3.7.0(64 bit) installation	1.Download and install Python 3.7.0 2.Develop python code	https://www.python.org/downloads/release/python-370/
Python 3.7.0(64 bit) installation	1.Download and install Python 3.7.0 2.After python code	Get the output from the code
IBM Cloud Login ID & Password	1. Run the python code 2. Verify the displayed output	Publishment of python code
MIT Inventor Login ID & password	1. Go to Node Red. Select http in & http response. Add functions and select another http in and http response. Connect them to IBM IoT output and function.Print the command statements such as light ON/OFF and sensor 2. Go to MIT app inventor and create frontend using buttons,horizontal arrangement, text bar, etc. Add blocks and so on to create back end. Verify the output	Sensors values and command values can be seen in the mobile application
IBM Cloud Login ID & Password	1. Go to IBM cloud, search Cloudant in Catalog, Add new dashboard, go to Node Red 2. Connect to cloudant and verify the results	Cloudant is connected by NODE RED

Expected Result	Actual Result	Status	Comments
User should sign up IBM cloud and details should be verified	Working as expected	Pass	Results verified
User login to IBM Cloud and should be navigated to IBM Cloud dashboard page	Working as expected	Pass	Results verified
User should be navigated to IBM IoT Watson Platform	Working as expected	Pass	Results verified
Load cell,IR Sensor and GSM/GPS values should be randomly generated	Working as expected	Pass	Results verified
User should be able to see the Node Red page	Working as expected	Pass	Results verified

Values of sensors and button for light ON/OFF should be displayed	Working as expected	Pass	Results verified
User should be able to develop a python code	Working as expected	Pass	Results verified
User should be able to get the results from the developed code	Working as expected	Pass	Results verified
User should be able to publish the code	Working as expected	Pass	Results verified
Sensors values and command values should be seen in the mobile application	Working as expected	Pass	Results verified
User should be able to connect the Cloudant and Node Red	Working as expected	Pass	Results verified

TC for Automation(Y/N)	BUG ID	Executed By
No		AKILA S
No		ASHWIN BHARATHI A
No		DHARSHINI K
No		SRINIVASAN S
No		AKILA S

No		ASHWIN BHARATHI A
No		DHARSHINI K
No		SRINIVASAN S
No		AKILA S
No		ASHWIN BHARATHI A
No		DHARSHINI K

Test Scenarios

Verify user is able to see login page
Verify user is able to loginto application or not?
Verify user is able to navigate to create your account page?
Verify user is able to recovery password
Veriify login page elements

Search

Verify user is able to search by entering keywords in search box
Verify user is able to see suggestions based on keyword entered in search box
Verify user is able to see related auto suggestions displaying based on keyword entered in search box
Verify user is able to see no matches found message when no results are matching with entered keyword
Verify user is able to see seach detailed page when nothing entered in textbox

Acceptance Testing
UAT Execution & Report Submission

Date	19 November 2022
Team ID	PNT2022TMID48397
Project Name	Project – SMART WASTE MANAGEMENT SYSTEM
Maximum Marks	4 Marks

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	2	3	19
Duplicate	1	0	4	0	5
External	2	3	0	1	6
Fixed	11	3	4	20	38
Not Reproduced	0	0	2	0	2
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	15	15	26	80

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	6	0	0	6
Client Application	45	0	0	45
Security	2	0	0	2

Outsource Shipping	6	0	0	6
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

10.ADVANTAGES :

- Improve Productivity and Performance.
- Increase Profitability.
- Boost Sustainability.
- Superior Customer Engagement.
- Become a Smart City.
- Enhance Safety.

DISADVANTAGES :

- Misunderstanding of the operations of smart sensors: Because this is a new and emerging technology, there is a general misunderstanding of its operations. ...
- Setting up the smart sensor: ...
- Non-optimized truck routes: ...
- Recycling: ...
- Non-uniform waste distribution of waste in bins

12.CONCLUSION :

The behaviour of generating garbage is too dangerous not only for today's generation, but also for future generations. **It is critical to educate people and encourage them to practise Recycle, Reuse, and Reduce instead of producing waste**. Waste disposal should be a priority for municipalities and governments.

12. FUTURE SCOPE :

Total of approximately 143,449 MT of municipal waste is generated daily. However, only 35,062 tons of waste is treated. A report from MNRE says that **waste generation is expected to reach 300 million tons annually by the year 2047**.

GITHUB LINK : https://github.com/IBM-EPBL/IBM-Project-43431-1660716860

DEMO LINK: https://drive.google.com/file/d/1-1u49cri6krf1PC-Qjpo-fe8R9sxDURI/view?usp=drivesdk