



IBM PROJECT

SMART WASTE MANAGEMENT FOR METEROPOLITIAN CITIES

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1.INTRODUCTION:

1.1Project Overview:

This project helps the environment to be kept clean. Today big cities around the world are facing a common problem, managing the city waste effectively without making city unclean. Today's waste management systems involve a large number of employees being appointed to attend a certain number of dumpsters this is done every day periodically. This leads to a very inefficient and unclean system in which some dumpsters will be overflowing some dumpsters might not be even half full. This is caused by variation in population density in the city or some other random factor this makes it impossible to determine which part needs immediate attention. Here a waste management system is introduced in which each dumpster is embedded in a monitoring system that will notify the corresponding personal if the dumpster is full. In this system, it is also possible to separate wet and dry waste into two separate containers. This system provides an effective solution to the waste management problem.

a. **Purpose**

The purpose of this product is to make the environment friendly and clean. This made the environment tidy and good.

2.LITERATURE SURVEY

2.1.Existing Problem:

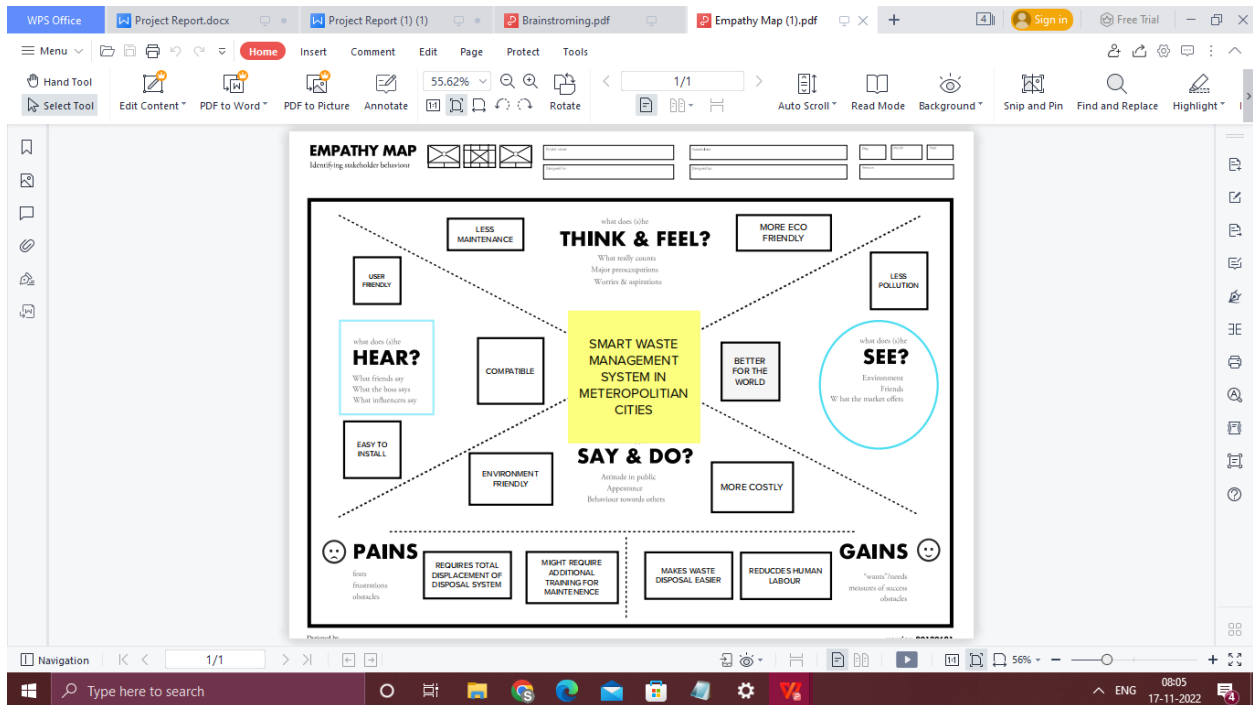
Smart waste management refers to any system that uses technology to make trash collection more efficient, cost-effective and environmentally friendly. Most of these systems are equipped with the Internet of Things (IoT), a monitoring technology that collects and tracks real-time data, to help optimize waste collection and spur future innovation.

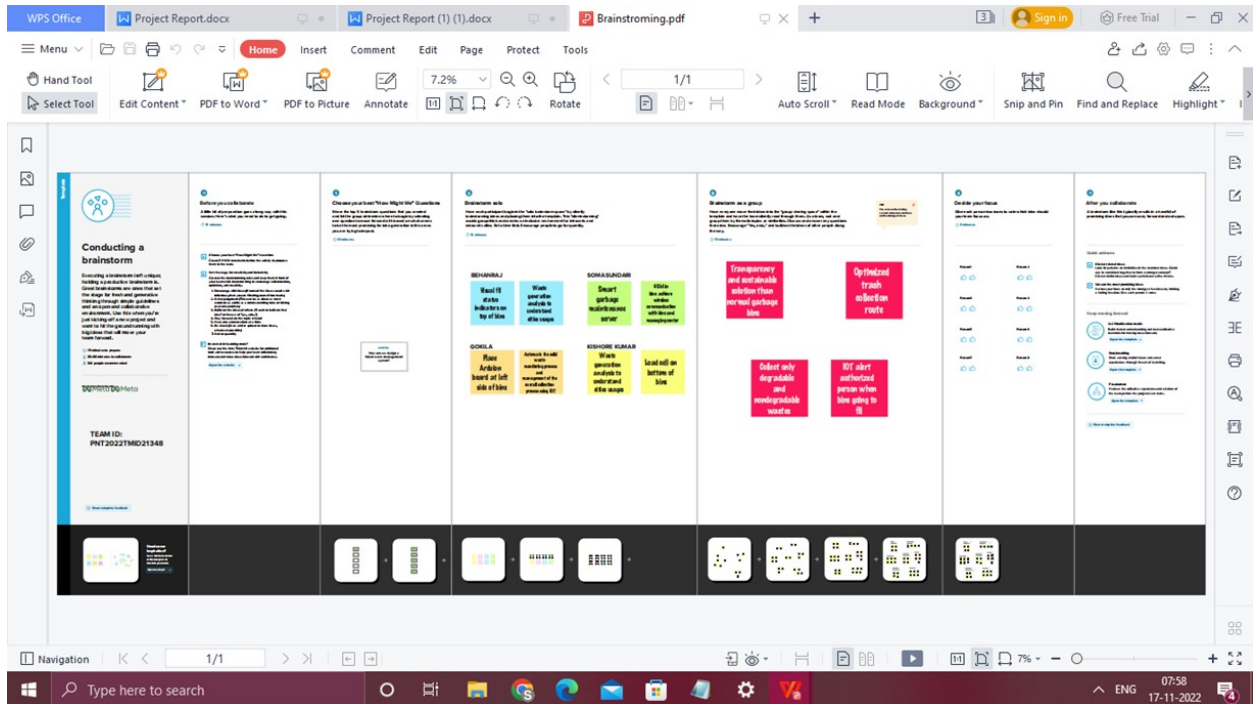
2.2.Problem statement definition:

Sensors are unpredictable. Also the cost price of the products and the complications in installing the systems are high. This makes the customers feel disappointed sometimes

1.IDEATION & PROPOSED SOLUTION

3.1.Empathy Map Canvas:





3.3.Proposed Solutions

S.No.	Parameter	Description
	Problem Statement	<p>The problem of unorganized and non-systematic waste collection is solved by designing an embedded IoT system that will monitor each dumpster individually for the amount of waste deposited. Here an automated system is provided for segregating wet and dry waste. It has been tested and verified properly to make sure all the different parts work together for a smooth function of the whole system. This system allows the authorized person to know the fill level of each garbage bin in a locality or city at all times, to give a cost-effective and time-saving route to the truck drivers.</p>

	Idea / Solution description	<p>The key research objectives are as follows:</p> <ul style="list-style-type: none"> • In the proposed system, the received signal indicates the waste bin status at the monitoring and controlling system. • The proposed system would be able to automate the solid waste monitoring process and management of the overall collection process using IOT (Internet of Things). • In the proposed system, the received signal indicates the waste bin status at the monitoring and controlling system. • The proposed system would be able to automate the solid waste monitoring process and management of the overall collection process using IOT (Internet of Things).
	Novelty / Uniqueness	<p>The data gathered from the dumpsters will help reduce the timely pickup of the waste before they overload. Once the trash bin is ready to overflow, the collection centers are immediately alerted to send the pickup trucks emptying the filled bins. The route optimization helps to schedule the truck near the filled dumpster. This is the most effective way to prevent missing out on any pickup.</p>

	Social Impact/ Customer Satisfaction	<p>Excellent Web world is an experienced IoT software and application company, where we have helped our customers develop many IoT based systems, like smart switches, smart parking, smart helmet, etc.</p> <p>If you are willing to live in a smart city, we would be more than happy to create an IoT based waste management for smart city.</p>
	Business Model(Revenue Model)	<p>. Smart waste management technology improves the management of the city services by using in-built sensors where data analytics and technology together notifies the waste collectors, reduces the odor, and enhances the appearance of the bins in public areas. In addition, it helps improve the quality of life of the people. Solid Waste, comprising the Company's waste collection, transfer, recycling and resource recovery, and disposal services, which are operated and managed locally by the Company's various subsidiaries, which focus on distinct geographic areas and Corporate and Other, comprising the Company's other activities, including its development and operation of landfill gas-to- energy facilities in the INDIA, and its recycling brokerage services, as well as various corporate functions.</p>

	Scalabilityof the Solution	<p>In this regard, smart city design is being increasingly researched and discussed around the world to solve this problem. Following this approach, this paper focused on the citizen's perspective and presented an efficient IoTbased real-time waste management model for improving urban living conditions. The proposed system uses sensors and communication technology, where real-time waste data is collected by smart bins, and 4,444 citizens can access compartments scattered around the city to check availability online. sent to the platform.</p>
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3.4 Problem SolutionFit

Smart Waste Management System

Team ID : PNT2022TMID21348

STEP 1

Problem Solving Cards

-Basic question

#Problem Statement

1. What's most valuable to the customer?
2. What are we the best at?
3. Where are we looking to improve?



STEP 2

Framing Statements

Smart waste management system framing



The greatest problem regarding waste management in developing countries begins at the very starting point of the process. Due to lack of proper systems for disposal and collections, wastes and garbage's end up in the roads and surrounding. According to a report from Google research, the amount of waste generation in 2010 was around 20,000 tons per day, and it is estimated that by 2025 the amount will be no less than around 47000 tons per day. 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. Not only that, there is even no systematic methodology for the collected garbage for treating and recycling thus most of them end up in land filling and river water, making the environment unhealthier. The prime impediment of implementing smart waste management system based on IoT in a developing country is the social and economic infrastructure of the country itself. The initial stage of this system comprises of proper disposal and collection, which is the biggest challenge. In addition, to motivate and influence people to follow proper waste disposal methods is also important.

STEP 3

Ideas

Problem Solution

Example ideas:

AI-based smart waste bin, designed for public places, enabling them to Monitor and Manage

Reduce the number of bins required & DE-cluttering and improving the street scene

Previously there were numerous initiatives on waste management and educating people to dispose waste properly, and as they failed to achieve significant results, we have figured out the scopes that could be develop. To solve this problem, we have designed a process that ensures proper disposal and efficient waste collection. The procedures we designed involves creative initiative that will inspire people to dump in designated area or bins, and innovative method by using Decreasing Time algorithm or DTA for monitoring garbage generation and collection of the garbage's.

4.REQUIREMENT ANALYSIS

4.1Functional Requirement:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Product Installation	Trash bin installation of embedded components such as sensors and Raspberry Pi
FR-2	Pushing data to Database	Database Getting the sensor readings from the ultrasonic sensor and load cell
FR-3	User Interface	Storing the data in cloud for backup When the threshold level is reached, 1. Notifies the user 2. Sends the GPS location

4.2Non-functional Requirements:

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

FR No	Non-Functional	Non-Functional Requirement Description
NFR-1	Usability	The product is simple to use and install.
NFR-2	Security	All communication must use end to end encryption.
NFR-3	Reliability	The sensor data is monitored anytime and from anywhere on all devices.

NFR-4	Performance	The users are notified and get the location of bins in a very efficient way, which reduces human effort.
NFR-5	Availability	The data is monitored via a web app and notified 24/7 whenever the threshold level is reached
NFR-6	Scalability	Capable of incorporating a large number of garbage sensors.

5.PROJECT DESIGN

5.1Data Flow Diagrams:

Visual Template

Visualize data flows and behaviors to explain complex processes

Data Flow Diagram

a template brought to you by your friends at MURAL

INTRODUCTION

Data flow diagrams are typically used by IT and engineering teams to show the flow of information, source of data inputs, and how that data is used. These visual representations of a system can help be used to explain complex processes to lay experts and/or to build out new structures with your team.

Data flow diagrams illustrate relationships between internal and external processes, data stores, and data flows. The diagram shows data flows with both semantic and syntactic behaviors using set-like flow diagram notation.

PEOPLE

13 Icons

THINGS

3 Icons

DIFFERENTLY

Interconnected

TOOL TIPS

Create connections at the speed of thought.

Hold **⇧** and **click** and **drag** to create a connection

Click on the connector points to create new diagram elements

Click on the connector points to modify and new connections and shapes

Change connector styles

Switch between different shapes and styles with a click

Roll with objects of the same type by filtering your selection box

Add labels to components, make links on the flow or change the "to" connection, or even change the process

INSTRUCTIONS

- 1 Define the process you want to visualize, or use a pre-existing one
- 2 Develop the data flow by using the shapes and connectors in the key
- 3 Adjust and fine tune the data flow
- 4 Review the data flow
- 5 Next Steps

BRAINSTORMING AREA

DATA

PROCESS

EXTERNAL ENTITY

NEXT STEPS

DATA

PROCESS

EXTERNAL ENTITY

FLOW KEY

DATA

This small rectangle is used for data that is input, output, or to be produced in the process.

PROCESS

This shape is used for an action or operation, the steps that must be done.

EXTERNAL ENTITY

It is where data comes from or goes to. It is external to the process.

CONNECTOR

Connects elements of the flow.

VISUAL KEY

You can also make your diagrams more engaging by using images and icons!

DATA

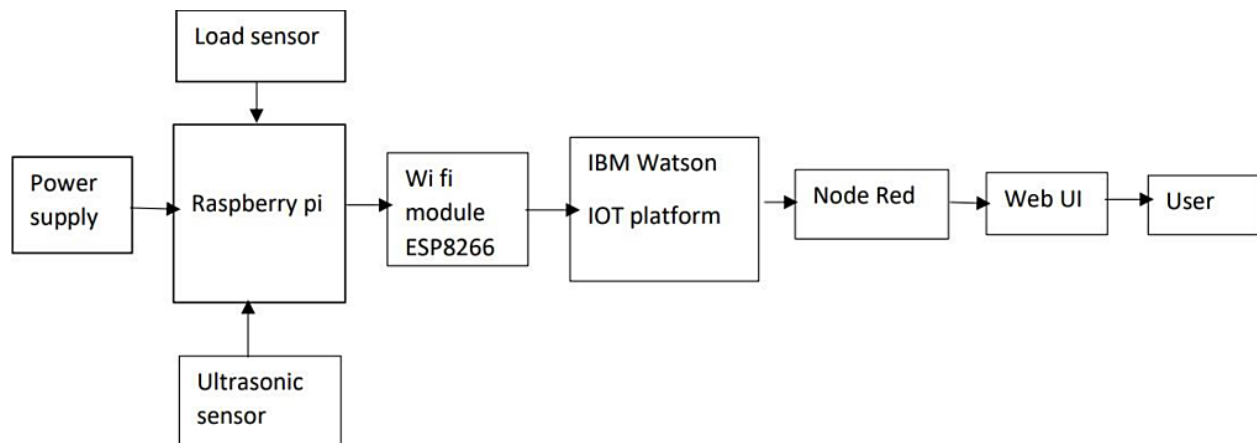
PROCESS

EXTERNAL ENTITY

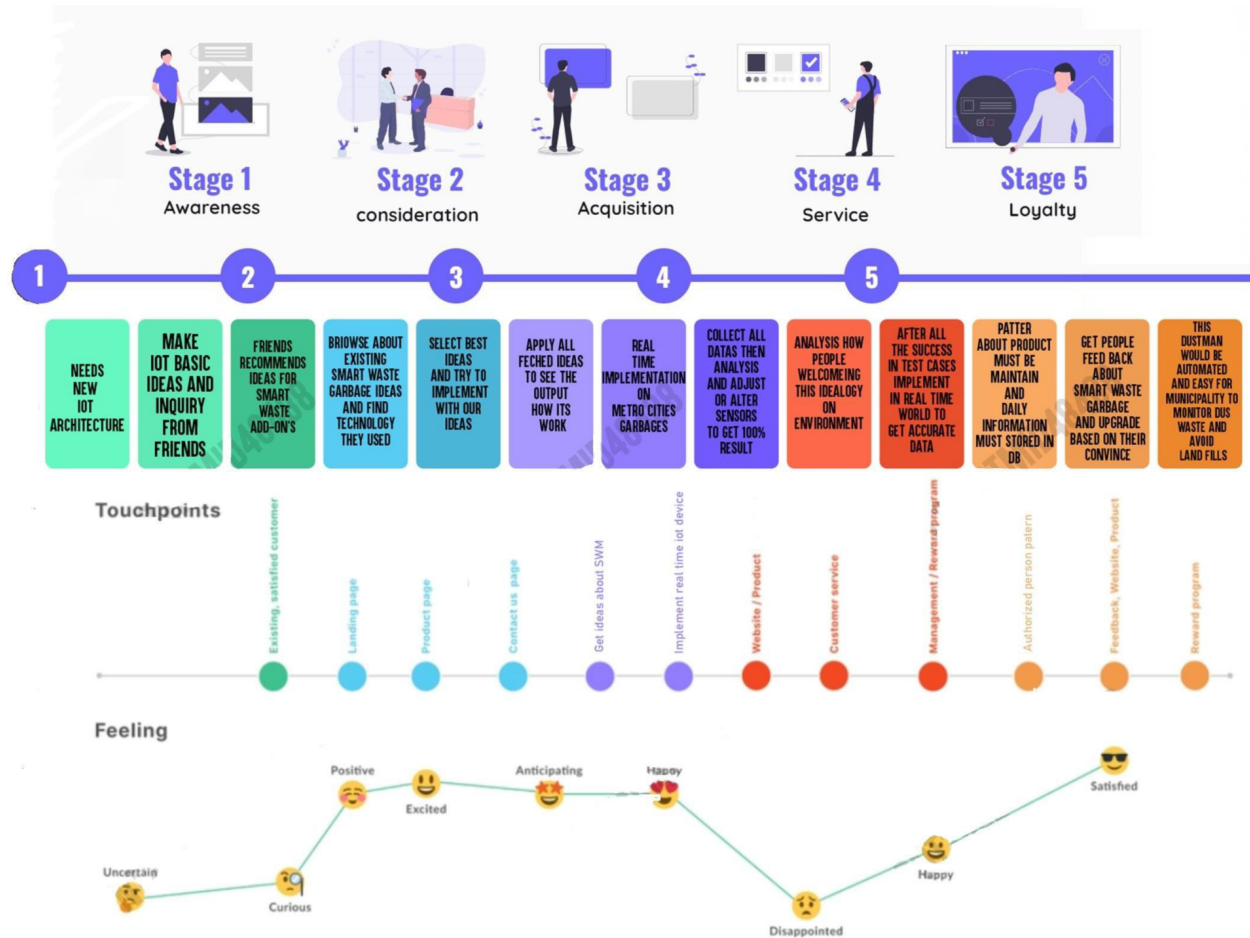
ADD YOUR OWN!

Share your feedback

5.2Solution & TechnicalArchitecture:



5.3 User Stories:



6.PROJECT PLANNINGAND SCHEDULING

6.1Sprint Planning& Estimation:

Sprint	Functional Requirement (Epic)	User Story Number	User Story/Task	Story Points	Priority	Team Members
Sprint-1	Login	USN-1	We will provide user ID and password for all the employees and manage them. Here we complete the work of a user. We will monitor dust bin level. If the dust bins are filled, we will post the location and garbage ID to the trash truck. Here we complete the work of a co-admin.	20	High	somasundrai

Sprint-2	Dashboard	USN-2	We will follow the route sent by co-admin to reach the filled dustbin. Here we complete the work of a truck driver.	20	Low	Kishore kumar
Sprint-3	Dashboard	USN-3	We will collect all the garbage from dust bin and load it into garbage trucks and send it to the landfill. Here we complete the work of a waste collector.	20	Medium	Gokila
Sprint-4	Dashboard	USN-4	We will monitor the process. Here we complete the work of a municipal authority.	20	High	Behanraj

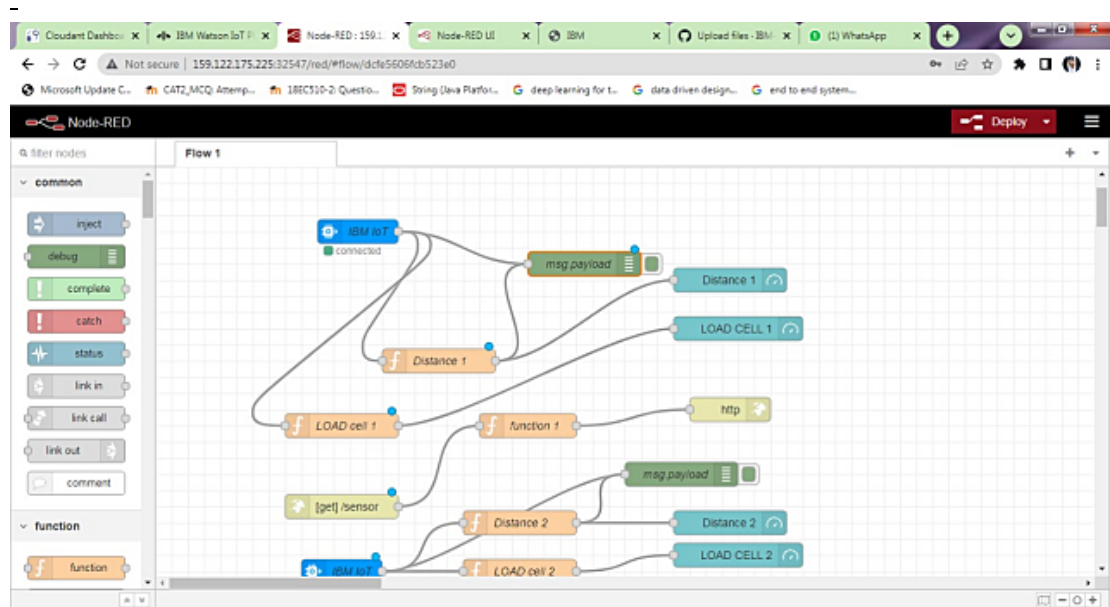
6.2Sprint Delivery Schedule:

Project Tracker, Velocity & Burn down Chart:

Sprint	Total Story Point	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	21 Oct 2022	27 Oct 2022	20	27 Oct 2022
Sprint-2	20	6 Days	28 Oct 2022	04 Nov 2022	20	04 Nov 2022
Sprint-3	20	6 Days	08 Nov 2022	14 Nov 2022	20	14 Nov 2022
Sprint-4	20	6 Days	15 Nov 2022	21 Nov 2022	20	21 Nov 2022

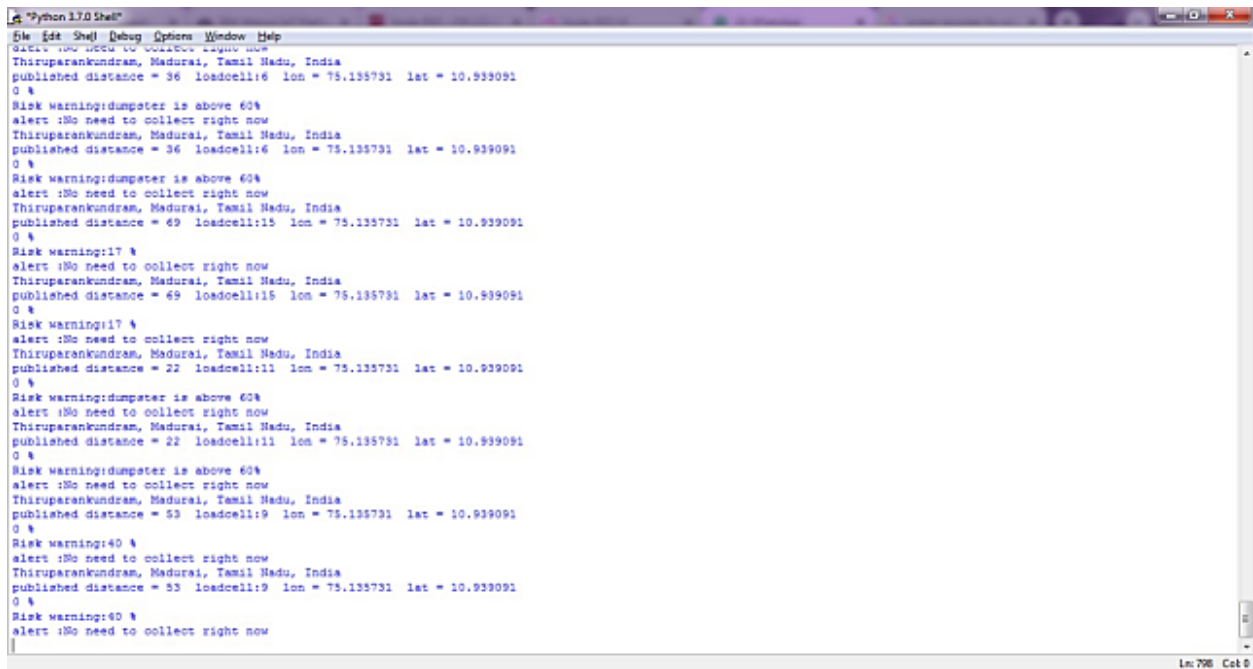
7.CODING AND SOLUTIONING

7.1Feature 1(Node Red Output)



7.2 Feature

Python code is developed and then tested whether the code is generating random sensor data or not



```
Python 3.7.0 Shell
File Edit Shell Debug Options Window Help
ctrl-c: No need to collect right now
Thiruparankundram, Madurai, Tamil Nadu, India
published distance = 36 loadcell:6 lon = 75.135731 lat = 10.939091
0 %
Risk warning:dumpter is above 60%
alert :No need to collect right now
Thiruparankundram, Madurai, Tamil Nadu, India
published distance = 36 loadcell:6 lon = 75.135731 lat = 10.939091
0 %
Risk warning:dumpter is above 60%
alert :No need to collect right now
Thiruparankundram, Madurai, Tamil Nadu, India
published distance = 49 loadcell:15 lon = 75.135731 lat = 10.939091
0 %
Risk warning:17 %
alert :No need to collect right now
Thiruparankundram, Madurai, Tamil Nadu, India
published distance = 49 loadcell:15 lon = 75.135731 lat = 10.939091
0 %
Risk warning:17 %
alert :No need to collect right now
Thiruparankundram, Madurai, Tamil Nadu, India
published distance = 22 loadcell:11 lon = 75.135731 lat = 10.939091
0 %
Risk warning:dumpter is above 60%
alert :No need to collect right now
Thiruparankundram, Madurai, Tamil Nadu, India
published distance = 22 loadcell:11 lon = 75.135731 lat = 10.939091
0 %
Risk warning:dumpter is above 60%
alert :No need to collect right now
Thiruparankundram, Madurai, Tamil Nadu, India
published distance = 53 loadcell:9 lon = 75.135731 lat = 10.939091
0 %
Risk warning:40 %
alert :No need to collect right now
Thiruparankundram, Madurai, Tamil Nadu, India
published distance = 53 loadcell:9 lon = 75.135731 lat = 10.939091
0 %
Risk warning:40 %
alert :No need to collect right now
Ln: 798 Col: 0
```

8.ADVANTAGES AND DISADVANTAGES

Advantages:

- a. Practice is highly lucrative
- b. Keeps the environment clean and fresh
- c. Saves the Earth and conserves energy

- d. Reduces environmental pollution

Disadvantages:

- a. Process is not always cost-effective
- b. The resultant product has a short life
- c. Needs More Global Buy-In
- d. The sites are often dangerous

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9..CONCLUSION

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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. The use of environmental management tools allows institutions to anticipate and to avoid problems in a proactive rather than reactive way. They assist with analysis and reporting of performance and with day-to-day management, which requires timely feedback to make appropriate adjustments. In the past we have seen environmental movements bringing positive changes to the nation. But with the increase in population and demands of the consumers and the main focus of the governments engaging in economic and military development in the country, the environment factor has been largely ignored.

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10.FUTURE SCOPE

Future of Solid Waste Disposal & Management in India

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There are four tiers to waste management to reduce its environmental impact. 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 204: pollution prevention and source reduction; reuse or redistribution of unwanted, surplus materials; treatment, reclamation, and recycling of materials within the waste; and disposal through incineration, treatment, or land burial. Recycling e-waste also helps recover precious metals like gold, silver, cobalt, etc. This is especially useful for India as it has to depend on other countries to meet its metal requirements. And as a bonus, recycled metals are also 2 to 10 times more energy-efficient than metals smelted from virgin ore.