

PROJECT REPORT

PROJECT NAME : Smart waste management system for metropolitan cities

1.INTRODUCTION

Project Overview:

The solid waste is increasing in urban and rural areas as the population is increasing and waste management has become a global concern. In implementing the smart cities the great challenge is how to manage waste with low cost and high performance. Waste has a negative impact on the quality of society which smart cities aim to improve. The process of collecting wastes, separating it, and transporting the containers daily and quickly to avoid any prospect of a spread of diseases is a complex process. The Internet and its applications have become an integral part of today's human lifestyle. It has become an essential tool in every aspect. Due to the tremendous demand and necessity, researchers went beyond connecting just computers into the web. With the help of IOT, garbage in the cities can be collected on monitoring the bin level, to prevent overflow of the garbage which negatively impacts the environment and to avoid or postpone garbage collection schedules in case of low garbage levels.

Purpose:

We amalgamate technology along with waste management in order to effectively create a safe and a hygienic environment. 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. This makes it possible to plan more efficient routes for the trash collectors who empty the bins, but also lowers the chance of any bin being full for over a week. A good level of coordination exists between the garbage collectors and the information supplied via technology. This makes them well aware of the existing garbage level and instigate them whenever the bins reach the threshold level. They are sent with alert messages so that they can collect the garbage on time without littering the surrounding area. The fill patterns of specific containers can be identified by historical data and managed accordingly in the long term. Thus, smart waste management provides us with the most optimal way of managing the waste in an efficient manner using technology.

LITERATURE SURVEY

1. Smart Waste Management System using IOT

[Tejashree Kadus¹, Pawankumar Nirmal², Kartikey Kulkarni³ Department of Mechanical Engineering MIT Academy of Engineering, Pune Savitribai Phule University](#)

The paper is based on the concept of Automation used in waste management system under the domain of Cleanliness and Hygiene. Dumping garbage onto the streets and in public areas is a common synopsis found in all developing countries and this mainly ends up affecting the environment and creating several unhygienic conditions. In order to deal with these problems Smart netbin is an ideology put forward which is a combination of hardware and software technologies

i.e. connecting Wi-Fi system to the normal dustbin in order to provide free internet facilities to the user for a particular period of time. The technology awards the user for keeping the surrounding clean and thus work hand in hand for the proper waste management in a locality. Smart netbin uses multiple technologies firstly the technology for measuring the amount of trash dumped secondly the movement of the waste and lastly sending necessary signals and connecting the user to the Wi-Fi system. The proposed system will function on client server model, a cause that will assure clean environment, good health, and pollution free society

2. IOT based Smart Waste Management

[Prof. Indu Anoop¹, Ayush Jain¹, Shweta Pathak¹, Gauri Yadav¹ Dept of Information Technology, Vidyalkar Institute of Technology, Mumbai, India](#)

Many times, in our city we see that the garbage bins or dustbins placed at public places are overloaded. It

creates unhygienic conditions for people as well as ugliness to that place leaving bad smell. To avoid such situations

the proposed project will be implemented for efficient waste management using IOT. These dustbins are interfaced

with arduino based system having ultrasonic wireless systems along with central system showing current status of

garbage, on mobile web application with Android app by Wi-Fi. Hence the status will be updated

on to the App. Major

part of the proposed project depends upon the working of the Wi-Fimodule; essential for its implementation. The main

aim of this project is to reduce human resources and efforts along with the enhancement of a smart city vision.

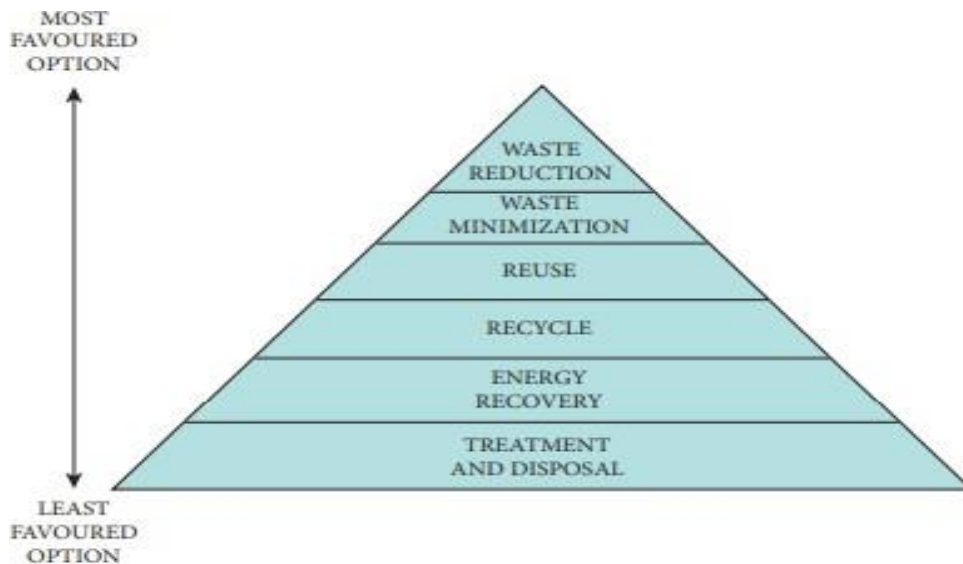
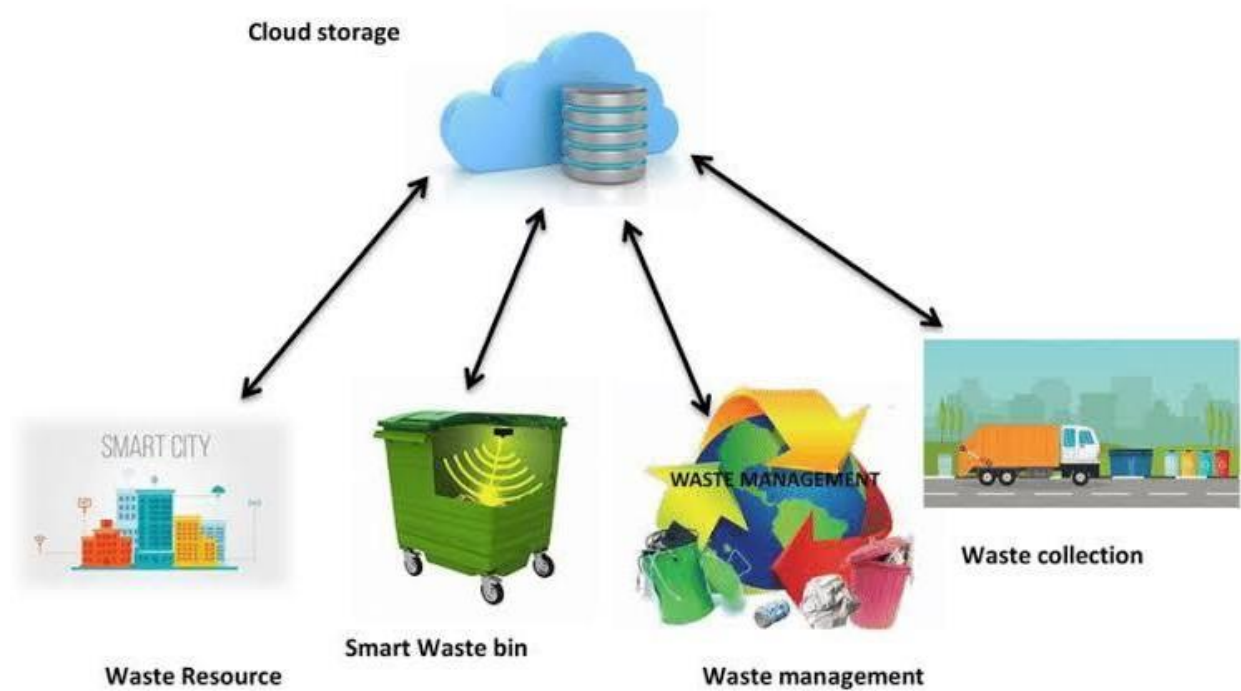


FIGURE 1: Waste management hierarchy.

3. Challenges and Opportunities of Waste Management in IoT-Enabled Smart Cities: A Survey

[Theodoros Anagnostopoulos](#); [Arkady Zaslavsky](#); [Kostas Kolomvatsos](#);
[Alexey Medvedev](#); [Pouria Amirian](#); [Jere](#)

The new era of Web and Internet of Things (IoT) paradigm is being enabled by the proliferation of various devices like RFIDs, sensors, and actuators.

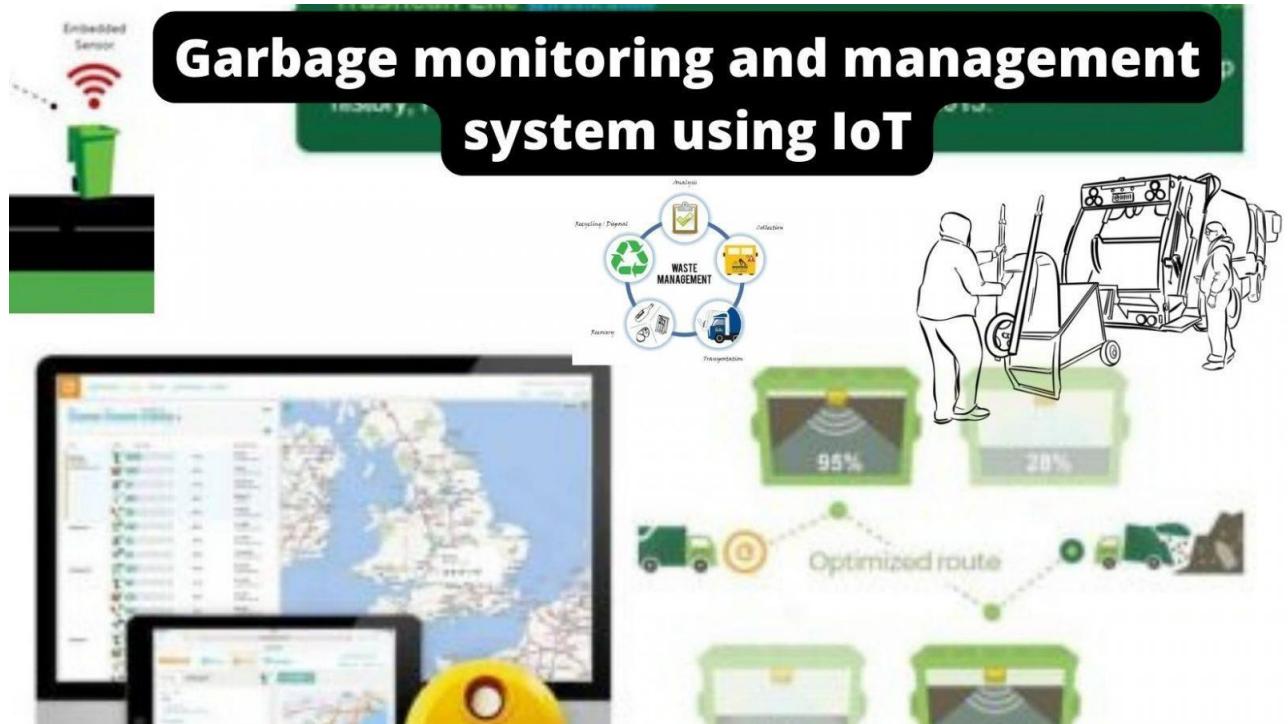


Smart devices (devices having significant computational capabilities, transforming them to 'smart things') are embedded in the environment to monitor and collect ambient information. In a city, this leads to Smart City frameworks. Intelligent services could be offered on top of such information related to any aspect of humans' activities. A typical example of services offered in the framework of Smart Cities is IoT-enabled waste management. Waste management involves not only the collection of the waste in the field but also the transport and disposal to the appropriate locations. In this paper, we present a comprehensive and thorough survey of ICT-enabled waste management models. Specifically, we focus on the adoption of smart devices as a key enabling technology in contemporary waste management. We report on the strengths and weaknesses of various models to reveal their characteristics. This survey sets up the basis for delivering new models in the domain as it reveals the needs for defining novel frameworks for waste management.

4. Garbage Management Using IOT

[Vijaykumar Dangi¹, Pranav Tekale², Swanand Dangare³, Astha Zope⁴, P.V.Ambekar⁵ 1,2,3,4U.G. Student, Department of Computer Engineering, SITS, Narhe, Pune, India⁵ Professor, Department of Computer Engineering, SITS, Narhe, Pune, India](#)

Brilliant Cities are being planned and worked for agreeable human residence. Among administrations that good urban areas can supply is that the naturally friendly waste/junk accumulation and getting ready. In this paper, we tend to inspire and propose a web of Things (IoT) – authorized framework engineering to accomplish dynamic waste accumulation and conveyance to handling plants or exceptional junk tips. Previously,



squander accumulation was dealt with in a fairly static way utilizing traditional operations look into the approach. As planned during this paper, these days, with the multiplication of sensors and actuators, as well as solid and universal portable correspondences, the Web of Things (IoT) empowers dynamic arrangements went for advancing the waste vehicle fleet live, accumulation courses and organized waste get. We propose the best question based dynamic booking model to address the difficulties of close constant planning driven by sensor information streams. An Android application alongside an easy to use GUI is produced and introduced with a specific end goal to demonstrate the practicality and assess a waste gathering situation utilizing trial information. At long last, the planned model's square measure assessed on factory made and real data from the town district of St. Petersburg, Russia. The models illustrate consistency and accuracy.

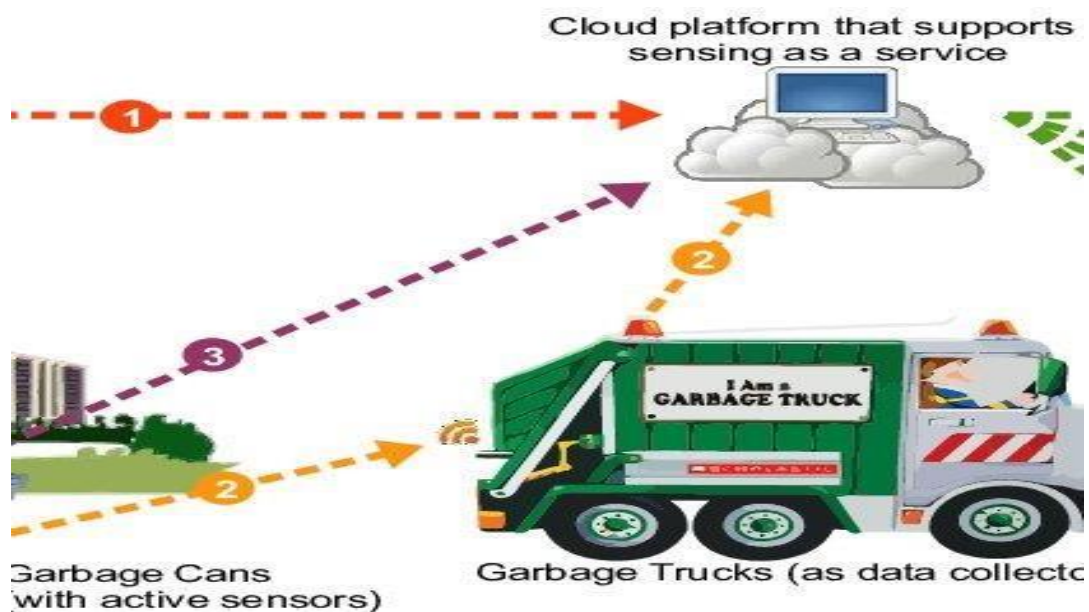
5. Cloud-based smart wastemanagement for smart citie

[Mohammad Aazam](#); [Marc St-Hilaire](#); [Chung-Horng Lung](#); [IoannisLambadaris](#)

With the ever increasing population, urbanization, migration issues, and change in lifestyle, municipal solid waste generation levels are increasingsignificantly. Hence, waste management becomes a challenge faced not only by the developing nations, but also the developed and advanced countries. The overall waste management involves three main types of entities:

- 1) users who generate waste
- 2) waste collectors/city admin
- 3) stakeholders.

Waste management directly effects the lifestyle, healthcare,environment, recycling and disposal, and several other industries. Currentwaste management trends are not sophisticated enough to achieve a robust andefficient waste management mechanism. It is very important tohave a smart way of managing waste.



made aware in timely fashion that what type of waste in what quantity is coming up at what particular time. This will not only help in attracting and identifying stakeholders, but also aids in creating more effective ways of recycling and minimizing waste also making the overall waste management more efficient and environment friendly. Keeping all this in mind, we propose a cloud-based smart waste management mechanism in which the waste bins are equipped with sensors, capable of notifying their waste level status and upload the status to the cloud. The stakeholders are able to access the desired data from the cloud. Moreover, for city administration and waste management, it will be possible to do route optimization and select path for waste collection according to the statuses of waste bins in a metropolis, helping in fuel and time efficiency.

6. Smart Waste Management System using IOT

[Tejashree Kadus¹, Pawankumar Nirmal², Kartikee Kulkarni³ Department of Mechanical Engineering MIT Academy of Engineering, Pune Savitribai Phule University](#)

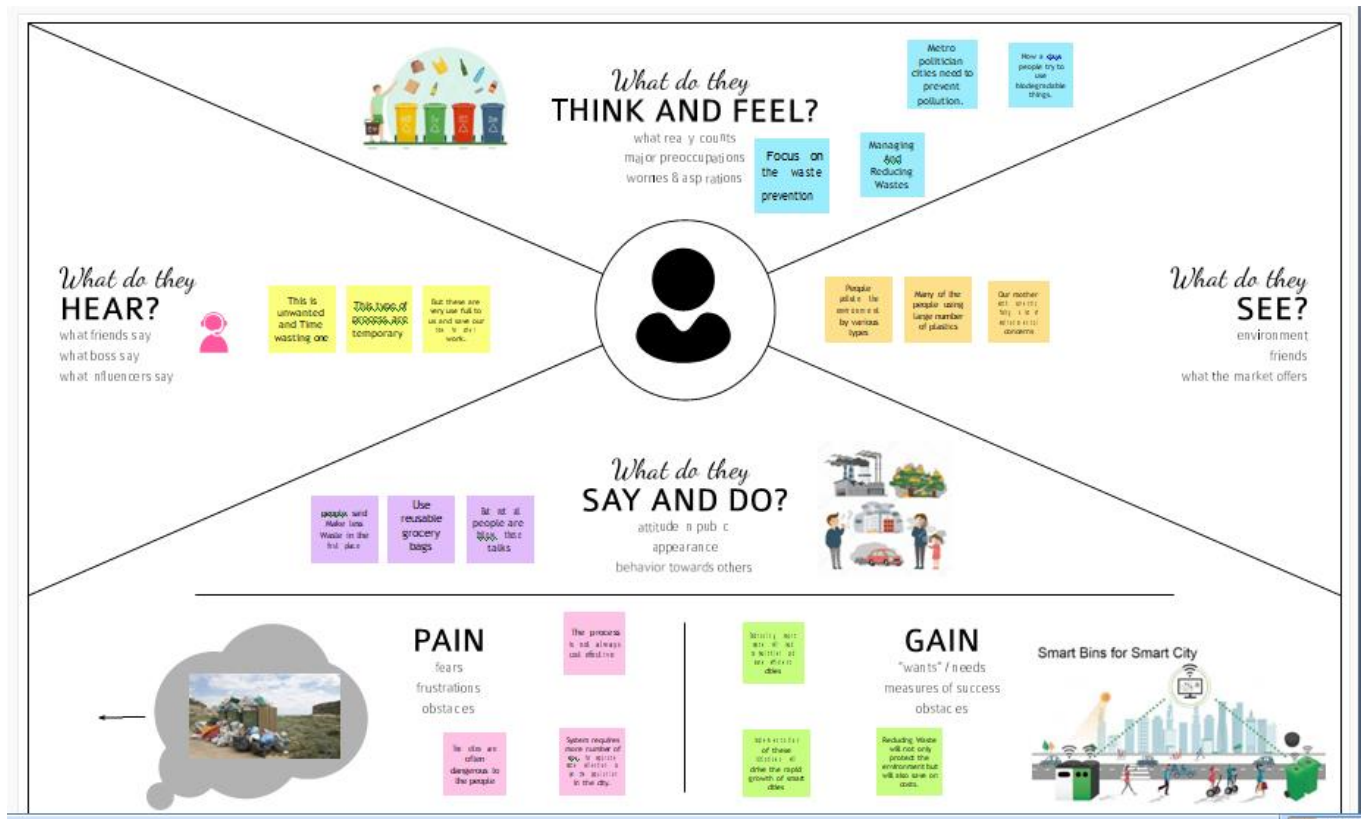
The paper is based on the concept of Automation used in waste management system under the domain of Cleanliness and Hygiene. Dumping garbage onto the streets and in public areas is a common synopsis found in all developing countries and this mainly ends up affecting the environment and creating several unhygienic conditions. In order to deal with these problems Smart netbin is an ideology put forward which is a combination of hardware and software technologies i.e. connecting Wi-Fi system to the normal dustbin in order to provide free internet facilities to the user for a particular period of time. The technology awards the user for keeping the surrounding clean and thus work hand in hand for the proper waste management in a locality. Smart netbin uses multiple technologies firstly the technology for measuring the amount of trash dumped secondly the movement of the waste and lastly sending necessary signals and connecting the user to the Wi-Fi system. The proposed system will function on client server model, a cause that will assure clean environment, good health, and pollution free society

PROBLEM STATEMENT DEFINITION:

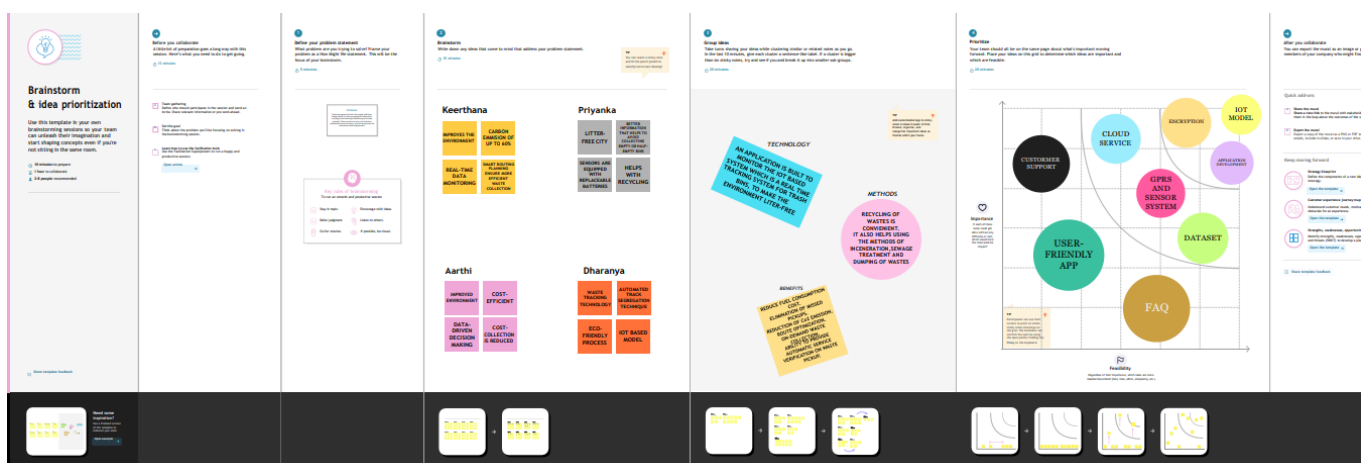
Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Municipal corporation authority	Get notified when the trash cans are full and be made aware of where the full cans are located.	Don't have the facilities at the moment	There is no tool available to determine the level of bins.	Frustrated
PS-2	Individual working for a private limited corporation	Get rid of the example of a surplus of waste	The trash cans are always filled	I occupy a metropolitan city which is invariably crowded	Worried

2.IDEATION & PROPOSED SOLUTION

Empathy Map Canvas



3.IDEATION & BRAINSTORMING



Proposed Solution

1. IDEA/SOLUTION DESCRIPTION

In this case, the user can use the dustbin Indoors and Outdoors.

1. Garbage level detection in bins.
2. Getting the weight of the garbage in the bin.
3. Alerts the authorized person to empty the bin whenever the bins are full.
4. Garbage level of the bins can be monitored through a web
5. We can view the location of every bin in the web application by sending GPS location from the device.



PROBLEM STATEMENT

The dumping of waste in the surroundings leads to serious health issues and there is no proper method to manage the waste generated.

2. NOVELTY/UNIQUENESS

Our automated waste collection system powers smart and sustainable cities around the world. Automated Waste Collection improves hygiene and minimises use of garbage trucks.

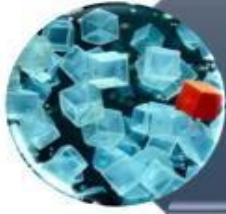


SOLUTION DESCRIPTION

A smart way to manage the waste generated and thereby providing an alert message to the authority.

SOCIAL IMPACT/CUSTOMER SATISFACTION

There is no contact between the hands of the user and dustbin. It is an effective way of reducing trash and keeps the environment clean and more hygienic. It also saves the time of the user. It is more convenient and efficient. This is ideal for busy location. This can store in all kind of renewable and non renewable materials.



NOVELTY

Once the level of the waste reaches a threshold level, an immediate message is given to the authority. so that the dustbin is replaced before it gets filled completely thereby preventing the overflow of waste in the surroundings

3. BUSINESS 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.



CUSTOMER SATISFACTION

There is no need for manual monitoring, the time is saved, prevents from several health issues.

4. SCALABILITY OF SOLUTION

Our solution that we provide based on IOT like Smart dustbin using Battery and Arduino UNO. So, here the solution scalability is about how the battery level runs how long the Smart dustbin response to the user.



FINANCIAL BENEFIT

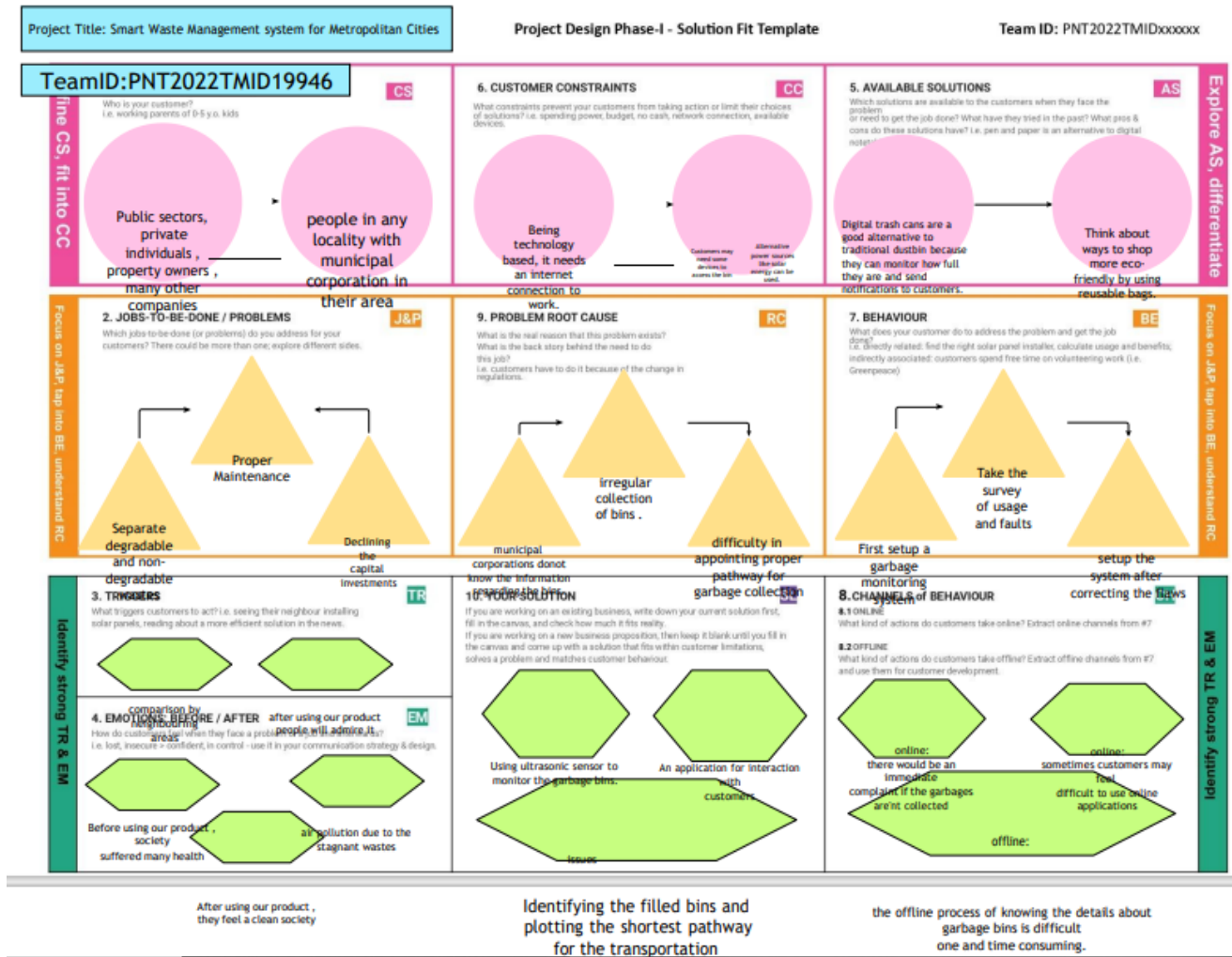
It is userfriendly. It is beneficiary for all kinds of people.



SCALABILITY OF SOLUTION

It is possible to implement in any surroundings and it can withstand any kind of temperature and pressure

PROBLEM SOLUTION FIT:



4.REQUIREMENT ANALYSIS:

FUNCTIONAL REQUIREMENTS :

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Detailed bin inventory.	All monitored bins and stands can be seen on the map, and you can visit them at any time via the Street View feature from Google. Bins or stands 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-2	Real time bin monitoring.	The Dashboard displays real-time data on fill-levels of bins monitored by smart sensors. In addition to the % of fill-level, based on the historical data, the tool predicts when the bin will become full, one of the functionalities that are not included even in the best waste management software.. Sensors recognize picks as well;so you can check when the bin was last collected. With real-time data and predictions, you can eliminate the overflowing bins and stop collecting half-empty ones.
FR-3	Expensive bins.	We help you identify bins that drive up your collection costs. The tool calculates a rating for each bin in terms of collection costs. The tool considers the average distance depo-bin discharge in the area. The tool assignsbin a rating (1-10) and calculates distance from depo- bin discharge.
FR-4	Adjust bin distribution.	Ensure the most optimal distribution of bins. Identifyareas with either dense or sparse bin distribution. Make sure all trash types are represented within a stand. Based on the historical data, you can adjust bincapacity or location where necessary.

NON FUNCTIONAL REQUIREMENTS

Following are the non-functional requirements of proposed solution

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	IoT device verifies that usability is a special and important perspective to analyze user requirements, which can further improve the design quality. In the design process with user experience as the core, the analysis of users' product usability can indeed help designers better understand users' potential needs in waste management, behavior and experience.
NFR-2	Security	Use a reusable bottles Use reusable grocery bags Purchase wisely and recycle Avoid single use food and drink containers.

NFR-3	Reliability	Smart waste management is also about creating better working conditions for waste collectors and drivers. Instead of driving the same collection routes and servicing empty bins, waste collectors will spend their time more efficiently, taking care of bins that need servicing.
NFR-4	Performance	<p>The Smart Sensors use ultrasound technology to measure the fill levels (along with other data) in bins several times a day. Using a variety of IoT networks ((NB-IoT,GPRS), the sensors send the data to Sensoneo's Smart Waste Management Software System, a powerful cloud-based platform, for data driven daily operations, available also as a waste management app.</p> <p>Customers are hence provided data-driven decision making, and optimization of waste collection routes, frequencies, and vehicle loads resulting in route reduction by at least 30%.</p>
NFR-5	Availability	By developing & deploying resilient hardware and beautiful software we empower cities, businesses, and countries to manage waste smarter.
NFR-6	Scalability	Using smart waste bins reduce the number of bins inside town , cities coz we able to monitor the garbage 24/7 more cost effect and scalability when we moves to smarter.

5.PROJECT DESIGN

Data Flow Diagrams

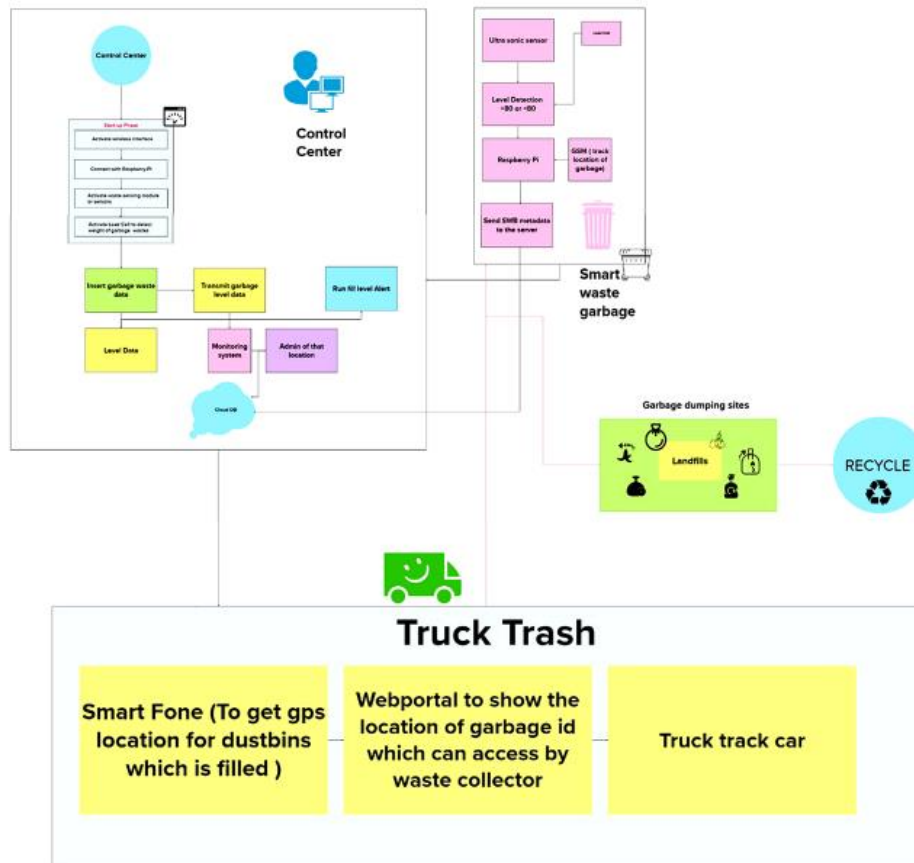
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically.

It shows how data enters and leaves the system, what changes the information, and where data is stored.

A smart waste management platform uses analytic to translate the data gather in your

bins into actionable insights to help you improve your waste services.You can receive data on metric such as:

- The first test conducted is the situation where the garbage bin is empty or itsgarbage level is very low
- Then, the bin is filled with more garbage until its level has surpassed the firstthreshold
value, which is set to 80% then the first warning SMS is being sent, as depicted
- The first notification SMS sent by the system, once the waste reaches the level of85% full
- The second notification SMS sent by the system, indicating that bin is at least95% full and
the garbage needs to be collected immediately
- Locations prone to overflow
- The number of bins needed to avoid overflowing waste
- The number of collection services that could be saved
- The amount of fuel that could be saved
- The driving distance that could be saved



SOLUTION & TECHNICAL ARCHITECTURE:

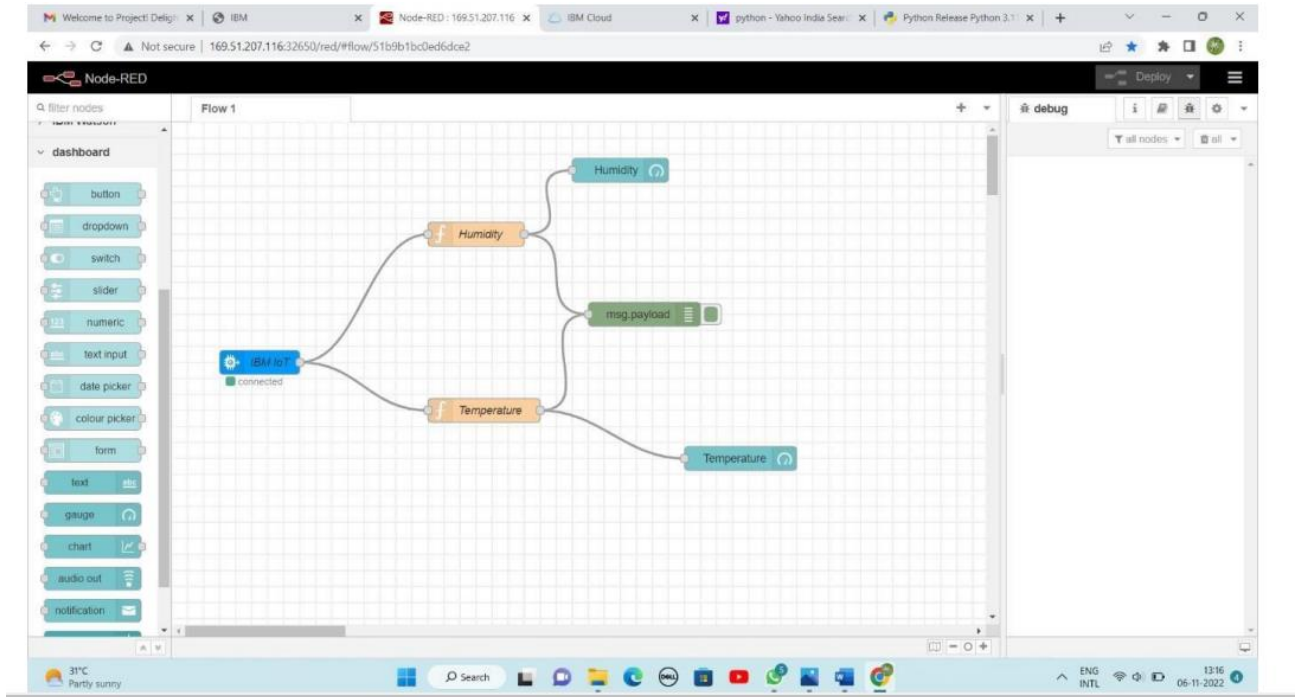


6.PROJECT PLANNING AND SCHEDULING

Sprint Planning and Estimation



CODING & SOLUTIONING (Explain the features added in the project along with code)



7.ADVANTAGES &

DISADVANTAGES

ADVANTAGES:

1.Reduction in

Collection Cost

2.No Missed

Pickups 3.Reduced

Overflows

4.Waste

Generation

Analysis5.CO2

Emission

Reduction

DISADVANTAGES

:

System requires a greater number of waste bins for separate waste collection as per population in the city. This results in high initial cost due to expensive smart dustbins compare to other methods.

Sensor nodes used in the dustbins have limited memory size.

10. CONCLUSION

A Smart Waste Management system that is more effective than the one in use now is achievable by using sensors to monitor the filling of bins. Our conception of a "smart waste management system" focuses on monitoring waste management, offering intelligent technology for waste systems, eliminating human intervention, minimizing human time and effort, and producing a healthy and trash-free environment. The suggested approach can be implemented in smart cities where residents have busy schedules that provide little time for garbage management. If desired, the bins might be put into place in a metropolis where a sizable container would be able to hold enough solid trash for a single unit. The price might be high.

11. FUTURE SCOPE

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

1. Change the system of user authentication and atomic lock of bins, which would aid in protecting the bin from damage or theft.
2. The concept of green points would encourage the involvement of residents or end users, making the idea successful and aiding in the achievement of collaborative waste management efforts, thus fulfilling the idea of Swachh Bharath.
3. Having case study or data analytics on the type and times waste is collected on different days or seasons, making bin filling predictable and removing the reliance on electronic components, and fixing the coordinates.
4. Improving the Server's and Android's graphical interfaces

