Smart for waste management system in metropolitan cities

Project name	Smart for waste management system in metropolitan cities
Team id	PNT2022TMID26079
Team members	1.Sooriya E 2.Sathish Kumar M 3.Subikshan S 4.Sudharsan M

Abstract:-

A big challenge in the urban cities is that of waste management as there is a rapid growth in the rate of urbanization and thus there is a need of sustainable urban development plans. As the concept of smart cities is very much trending these days and the smart cities cannot be complete without smart waste management system. There needs to be system that gives prior information of the filling of the bin that alerts the municipality so that they can clean the bin on time and safeguard the environment. To avoid all such situations we intend to propose a solution for this problem "Smart Garbage Bin", which will alarm and inform the authorized person when the garbage bin is about to fill. Then message will be send to the authorized person to collect the garbage from the particular area. The authorized person will sends the message from his web application to the garbage collectors by sending a SMS .This system maintain a dry waste and a wet waste separately. This will help to reduce the overflow of the garbage bin and thus keeping environment clean

INTRODUCTION:

 Internet of Things is nothing but the applications performing with the help of internet access.. IoT Communication over the internet has grown from user - user interaction to device – device interactions these days. The IoT concepts were proposed years back but still it's in the initial stage of commercial deployment. Home automation industry and transportation industries are seeing rapid growth with IoT. The basic project idea is to design a smart waste detection system which would automatically notify the officials about the current status of various garbage bins in the city, would have real-time monitoring capabilities, which would be remotely controlled using IOT techniques.

 This paper introduces you to the use of IoT on one such area, that is, Garbage Detection in smart ways using IoT and see how this can also be a major part of developing a city into a smart city

EXISTING WORKS:

 In the existing system garbage is collected by corporation by weekly once or by 2 days once. Though the garbage shrinks and overflows the garbage bin and spread over the roads and pollutes the environment. The smell will be heavy and produces air pollution and spreads disease. The street dogs and animals eat the waste food and spreads over the area and creates dirty environment to avoid such situation we are planning to design IOT Based Garbage Management For Smart Cities.

Disadvantages of existing system

➢ Time consuming and less effective: trucks go and empty containers whether theyare full or not.

➢ High costs.

➢ Unhygienic Environment and look of the city.

➢ Bad smell spreads and may cause illness to human beings.

➢ More traffic and Noise

PROPOSED SYSTEM :

In this proposed system there are multiple dustbins located through the city or the campus, these dustbins are provided with low cost embedded device which helps in tracking the level of the garbage bins and an unique ID will be provided for every dustbin in the city so that it is easy to identify which garbage bin is fill. When the level reaches the threshold limit, the device will transmit the level along with the unique ID provided. These details can be accessed by the concern authorities from their place with the help of internet and an immediate action can be made to clean the dustbins.

LITERATURE SURVEY:

The idea of smart garbage bins and systems have been in discussion for quite a long time. The technologies used at disposal to develop this smart system have also evolved, Internet of Things (IoT). Each idea seems to be similar but is slightly different at its core and our proposed work is no exception from the same. After the IoT field, finding its hold in our lives, this is our original plan for designing a smart garbage collection system which has provision for citizen participation and analysis of data for better decision

making. At hardware level, the smart system is a garbage bin with ultrasonic sensor, a micro-controller and Wi-Fi module for transmission of data

The worldwide implementation of Internet of Things is possible with a Cloud centric vision. This work exploits the future possibilities, key technologies and application that are likely to drive IoT research. But a strong foundation to our work is provided, where the basics and applications of Arduino board is explained . It is quite interesting as it implements a GAYT (Get As You Throw) system concept as a way to encourage recycling among citizens. As we would discuss further, the citizen participation part of our system is quite influenced by their work.
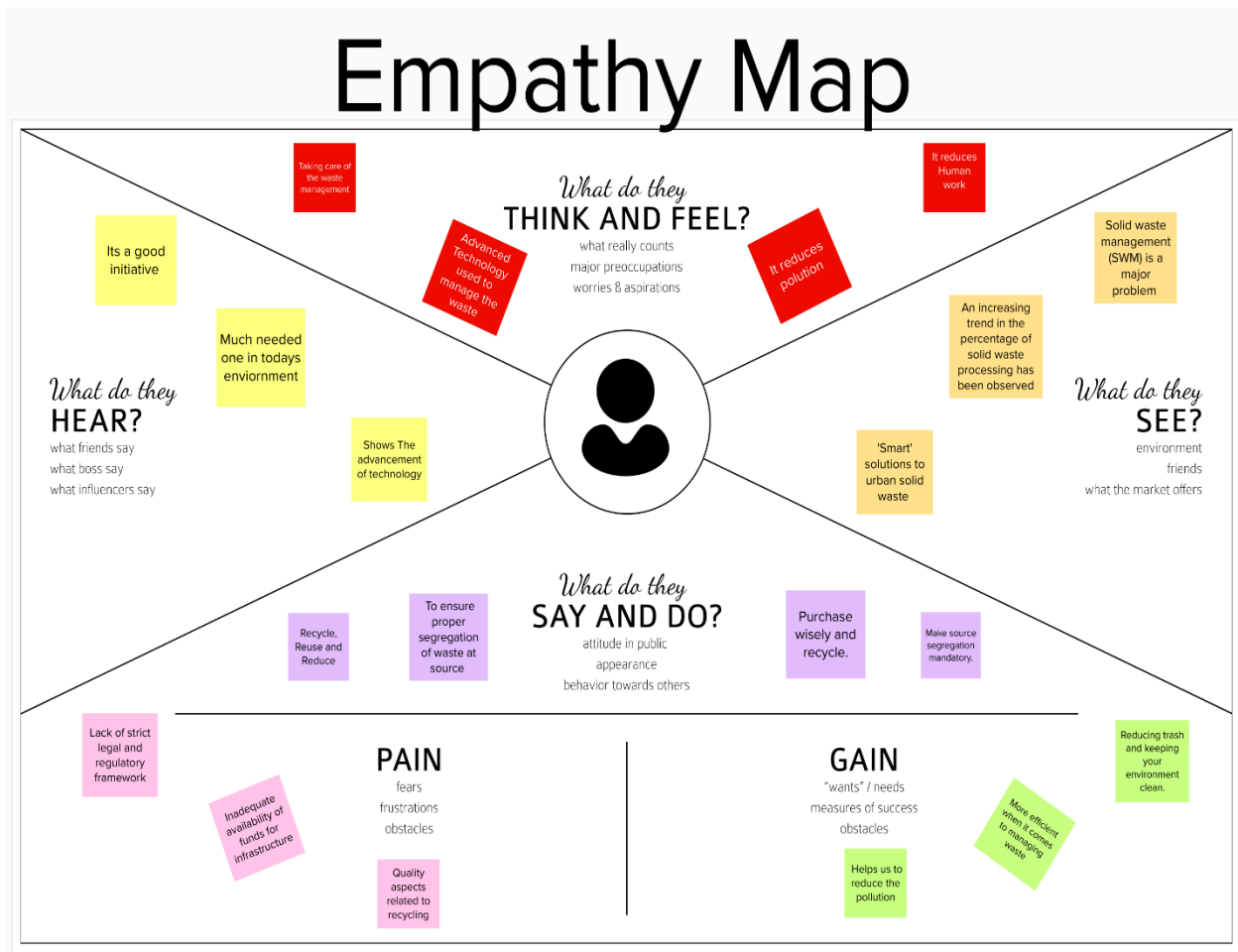
PROPOSED WORK :

The main objective of our project involves applying IoT technology (electronics and applications) to the current urban waste management scenario and enables a two way communication between the infrastructures deployed in the city and the operators/administrators. A centralized system for real-time monitoring is our goal to achieve. In this way both the municipal and citizens benefit from an optimized system which results in major cost savings and less urban pollution.
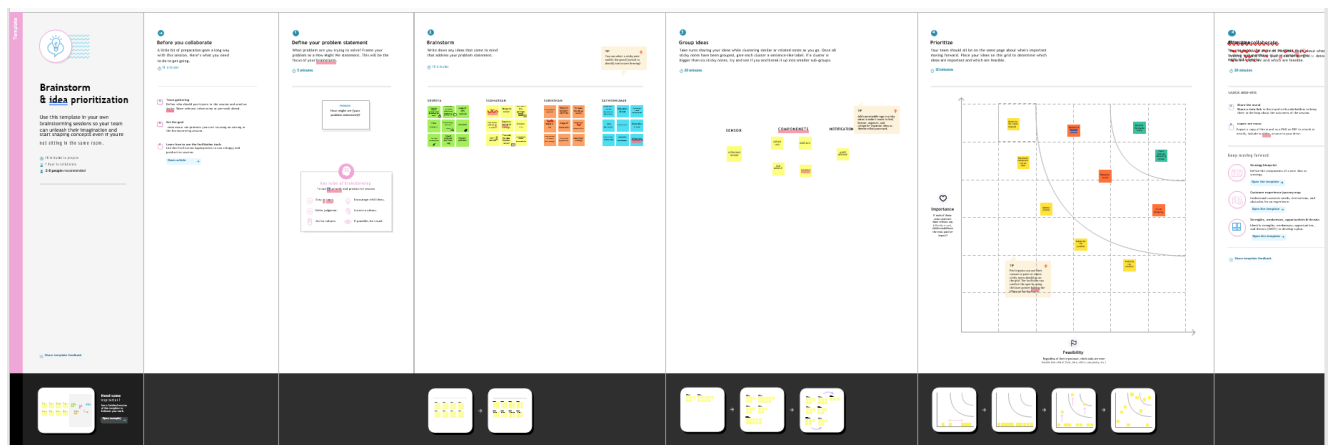
PROBLEM STATEMENT :

Empathy Map Canvas:

IDEATION & BRAINSTORMING:

PROPOSED SOLUTION:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	A historical backlog of waste services for, especially, urban informal areas, tribal areas and rural formal areas. Although 61%10 of all South African households had access to kerbside domestic waste collection services in 2007, this access remains highly skewed in favour of more affluent and urban communities. Inadequate waste services lead to unpleasant living conditions and a polluted, unhealthy environment
2.	Idea / Solution description	The Proposed system consists of main subsystems namely Smart Trash System(STS) and Smart Monitoring and Controlling Hut(SMCH). In the proposed system, whenever the waste bin gets filled this is acknowledged by placing the circuit at the waste bin, which transmits it to the receiver at the desired place in the area or spot.
3.	Novelty / Uniqueness	In mega cities due to comparatively more population along with the rapid urbanization the collection of garbage is becoming a big task. Waste management is a matter of concern, equal involvement of the Government and the citizens is a must to manage and overcome waste management issues.

4.	Social Impact / Customer Satisfaction	Public and social health are paramount not only to individual governments in the world, but the United Nations (UN) as well. The world body, in a bid to achieve the Millennium Development Goals (MDGs), encourages governments to implement social intervention programs that lead to improvement in basic services for health, education, water and sanitation. In September 2015, Heads of State and Governments adopted the 2030 Agenda for Sustainable Development which includes the 17 Sustainable Development Goals (SDGs). The SDGs builds on the success of the MDGs. The Goal 6 of the SDGs is to ensure availability and sustainable management of water and sanitation.
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	Sensoneo's smart waste management solution empowers cities to manage and battle evergrowing volumes of urban and municipal waste. The growing volumes of waste are largely caused by two factors: large-scale urbanization and industry growth. The modern lifestyle around the globe produces much more waste per citizen than only a decade ago. The United Nations projects 66% of the world´s population will live in cities by 2050. To sustain all these factors, problems and challenges, cities need a sophisticated and efficient tool to manage waste, monitor bins with sensors, and optimize capacity and collection routes.

PROPOSED SOLUTION FIT:

1. CUSTOMER SEGMENT(S) **CS**	6. CUSTOMER CONSTRAINTS **CC**	5. AVAILABLE SOLUTIONS **AS**
. workers who are working in corporation . automatic sensor based operation with zero manual invention	. recycling might be inexpensive .insufficient data collection	. Based on IOT technology smart waste management aims to optimize resource allocation, reduce running costs, and increases the sustainability of waste services.

2. JOBS-TO-BE-DONE / PROBLEMS **J&P**	9. PROBLEM ROOT CAUSE **RC**	7. BEHAVIOUR **BE**
. Due to lack of proper collections of waste and garbage ends up in polluting the environment	. The greatest problem regarding waste management in developing countries begins at the very starting point of the process	. AI based smart waste bin, designed for public places enabling them to monitor and manage

3. TRIGGERS	10. YOUR SOLUTION	8. CHANNELS of BEHAVIOUR **CH**
. AI recycling robots & solar-power trash compactor Digitally improvement cities . smart waste bins **TR**	. The garbage bins are build with a sensor module(Ultrasonic sensor)which continuously monitors the garbage level inside the garbage bin and sends an alert message to the garbage collector. **SL**	8.1 ONLINE . Garbage collector can monitor the level of the dustbin using the sensor 8.2 OFFLINE . They have to manually check the garbage level each and every day. So that they have to spend for fuel every day

4. EMOTIONS: BEFORE / AFTER		
. If the garbage bin is full in it may pollute the city and when we inhale such kind of hazardous smell that will lead to breathing problems . So when we collect the garbage properly there won't be any such kind of issues **EM**		

REQUIREMENT ANALYSIS:

Functional Requirements:

| FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User verification	The user should receive a verification e-mail which they have to confirm to complete the registration.
FR-4	Authentication	The data inside the device is need to be authenticated to ensure the privacy of the users.
FR-5	Legal Requirements	Proper Medical Certificate is produced to ensure the integrity of the users.
FR-6	Database	Information of the location area will be stored in the database.

Non-functional Requirements:

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	It can be widely used in metropolitan cities with time management.
NFR-2	Security	stored We are using login for the admin and the information will be in IBM cloud
NFR-3	Reliability	It will be reliable that it can update with very time period so that the accuracy will be good
NFR-4	Performance	It will be perform fast and secure even at the lower bandwidth.
NFR-5	Availability	Smart Waste Management System will be available in every Metropolitan Cities
NFR-6	Scalability	It is scalable that we are going to use data in kb so that the quite amount of storage is satisfied.

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.
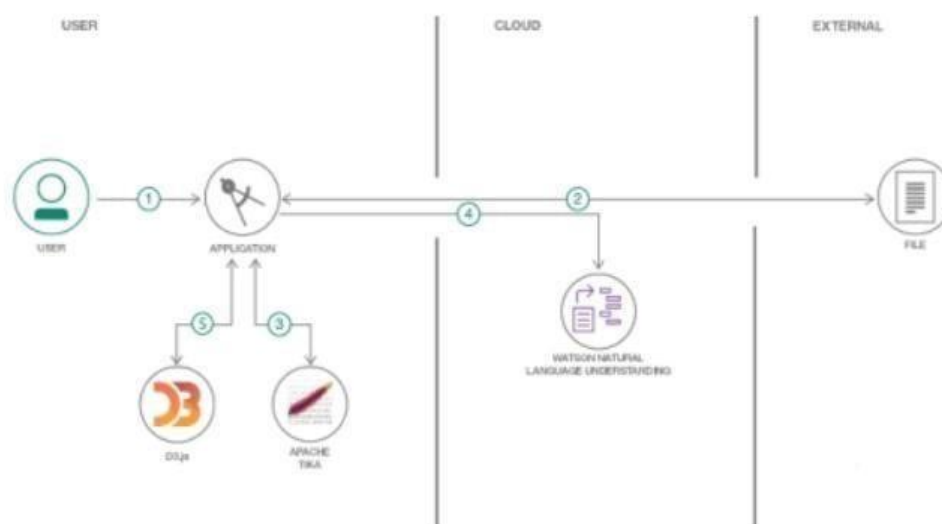

1. User configures credentials for the Watson Natural Language Understanding service and starts the app.
2. User selects data file to process and load.
3. Apache Tika extracts text from the data file.
4. Extracted text is passed to Watson NLU for enrichment.
5. Enriched data is visualized in the UI using the D3.js library.

Solution Architecture:

Solution architecture: A complicated with numerous sub-processes, – solution architecture connects technological remedy to business issue. Its objectives are to

• Find the best tech solution to solve existing business problems.

• Explain to project stakeholders the structure, traits, behaviour, and other features of the software.

• Specify the project's features, development stages, and solution needs.

• Offer the requirements by which the solution is created, handled, and given to the clients.
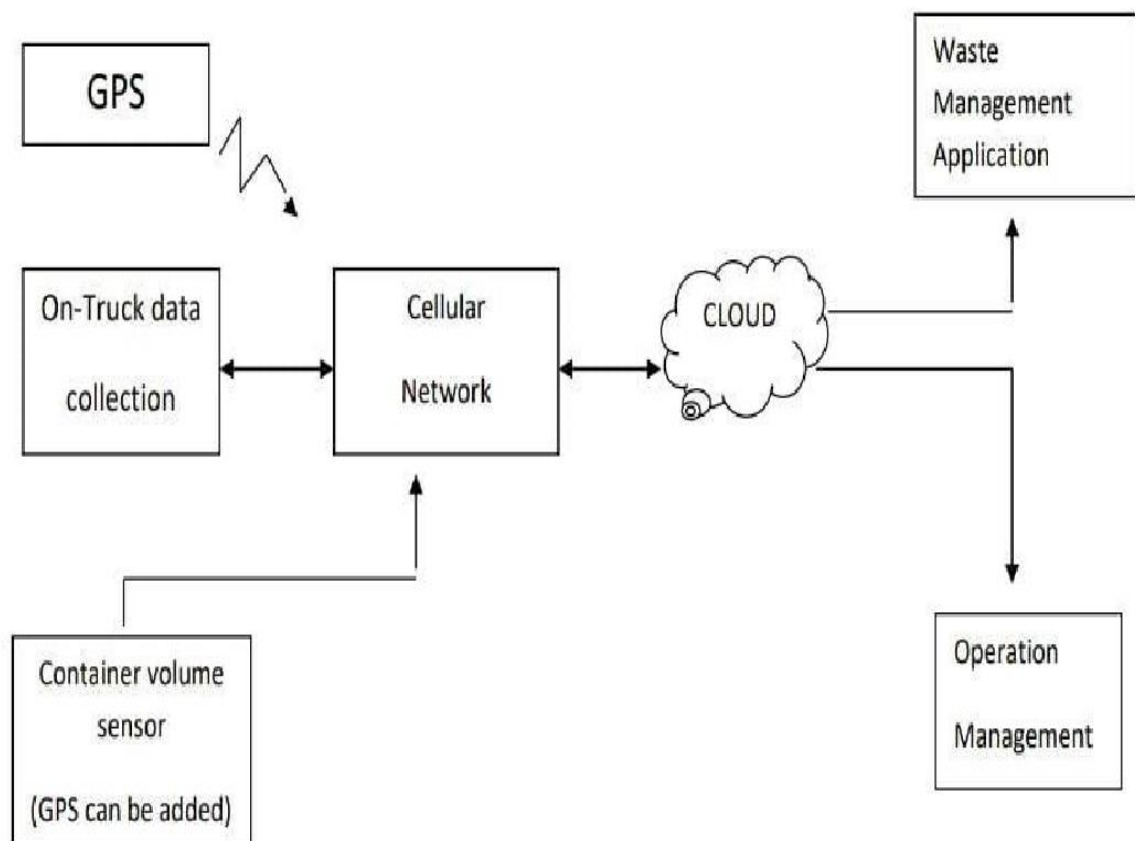
User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
Customer (Web user)		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
Customer Care Executive		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
Administrator	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1

PROJECT PLANNING AND SHEDULING :

Sprint Planning :

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 and pass code for ever workers over there in municipality.	10	High	Sooriya E
Sprint-1	Login	USN-2	As a Co-Admin, I'll control the waste level by monitoring them vai real time web portal. Once the filling happens, I'llnotify trash truck with location of bin with bin ID.	10	High	Sudharsan M
Sprint-2	Dashboard	USN-3	As a Truck Driver, I'll follow Co-Admin's Instruction to reachthe filling bin in short roots and save time.	20	Low	Subikshan S
Sprint-3	Dashboard	USN-4	As a Local Garbage Collector,I'll gather all the waste from the garbage, load it onto a garbage truck, and deliver it to Landfills.	20	Medium	Sathish Kumar M

Sprint Delivery shedule :

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

CODING & SOLUTIONING

NODE RED FUNCTION

DUSTBIN -1

```
return{

  id : 1,

  name: "Dustbin 1",

  lat: "13.122786615093027",

  lon: "80.14753945031933",

   capacity : Math.floor(Math.random()*100)+1

}
```

DUSTBIN -2

```
return{

  id : 2 ,

  name: "Dustbin 2",

  lat : "13.122535847116538",

  long: "80.14650948204708",

  capacity : Math.floor(Math.random()*100)+1

}
```

DUSTBIN -3

```
return{

    id : 3,

    name: "Dustbin 3",

    lat : "13.124233750291825",

    long: "80.14666505017155",

    capacity : Math.floor(Math.random()*100)+1

}
```

DUSTBIN -4

```
return{

    id : 4,

    name: "Dustbin 4",

    lat : "13.123695646862918",

    long: "80.14885373275004",

    capacity : Math.floor(Math.random()*100)+1

}
```

CONDITION:

```
const{capacity,id}=msg;



if(capacity>=80){

   return{

      payload: {

         ...msg,

         icon: 'fa-trash',

         iconcolour: 'red',

         popped:true,

         when: new Date().toISOString()

      }

   }

}
```

MAP FUNCTION:

```
const datas={ ...msg.payload}


let cleanedData=[];


for(let key in datas){

   datas[key]['popped']=true

   datas[key]['icon']="fa-trash"

   datas[key]['iconColour'] = datas[key]['capacity']>=80?"red":"green"

   datas[key]['when']=new Date().toISOString()

   delete datas[key]['_msgid']

   cleanedData.push(datas[key])

}


return{

   payload: cleanedData

}
```

TESTING:

TEST CASE:-

IoT testing is the practice of executing QA tests that validate the performance, functionality and security of an IoT device. Because every IoT device transmits data from one object to another over the Internet, it's crucial to verify that your IoT devices can transmit sensitive information wirelessly before market launch. That's why many successful IoT businesses rely on IoT automation, penetration, and performance testing tools so that any defect is detected before it reaches consumers.These days, IoT devices come in all shapes and forms, from smart TVs and smart appliances to commercial security systems and traffic monitoring technologies. In short, if your device is "smart" then it's an IoT device that requires testing.

Security Testing
IoT penetration testing tools can verify that IoT devices are free from any threats, vulnerabilities or risks. Your security testing process should have your IoT automation testing tools search for any and all possible weaknesses or loopholes within the IoT product. Is transmitted data always protected and encrypted? How strongly does password protection prevent malicious attacks?

Connectivity Testing
Connectivity is what makes IoT devices so appealing. IoT testing tools should review the strength of communication between the device and the user as well as between two or more IoT devices. How well does the device connect to the network? Once connected, can the device successfully transmit requested and relevant data? How does the device perform when offline?

Performance Testing

IoT performance testing tools are designed to ensure the expected performance of the IoT device under normal circumstances. The goal of performance testing for IoT applications is to eliminate any performance blocks or glitches that prevent the IoT device from running at optimal levels. IoT performance testing tools can gather information on the device's response time and reliability of product features. Does the IoT software maintain speed and stability during normal conditions? What is the IoT device's load capacity before it malfunctions or crashes?

Functional Testing

With the assistance of IoT testing tools, your team should validate the IoT software system against functional requirements and specifications. From API testing your IoT device to standard regression testing, your functional test cases should test each function within the IoT device by providing appropriate input and verifying the output against your functional requirements. Whether performed manually or with IoT automation testing tools, functional testing checks the User Interface, APIs, database and client/server communication.

Compatibility Testing

Because of the complexity attached to IoT technology, compatibility testing must be included in every QA process. Execute test cases through your IoT automation testing tools that examine the compatibility of your IoT device across any user experience, from hardware and operating systems to software and network speeds. Is the IoT device compatible with all operating systems and browser types? Does the IoT device perform as expected across generations of devices of versions of browsers?

USER ACCEPTANCE TESTING :-

User Acceptance Testing (UAT) is a type of testing performed by the end user or the client to verify/accept the software system before moving the software application to the production environment. UAT is done in the final phase of testing after functional, integration and system is done.User Acceptance Testing (UAT) is a process to check whether the system accepts a user's requirements. It's performed at a time when actual users use the system. This testing comes after - Unit Test--->Integration Test, --->System Test, --->Acceptance Test in the process. Its testing process related to another analogy, such as manufacturing pens. While production of a ballpoint pen, the cap, the body, the tail, the clip, the ink cartridge, with the help of things mentioned above, a full ballpoint pen manufactured after that single pen was produced with a combination of every single item.Each component specified above was tested to ensure that each component will make the pen in a working condition. When a complete pen is integrated, System Test is performed. Once it is over, perform the Acceptance test to confirm that each ball pen is in working condition and ready for customers. You can also explore more about Integration Test in this insight.Evaluate your app's usability, functionality, and design by having real users try it and verify whether it is user-friendly and can handle tasks in real-world conditions.

Usually, it is done by the client and the end-user to validate the requirements were both accurately communicated and executed.

- Client – The Stakeholders of the software carry out this
- End-users – It is carried out by the end-users of the software
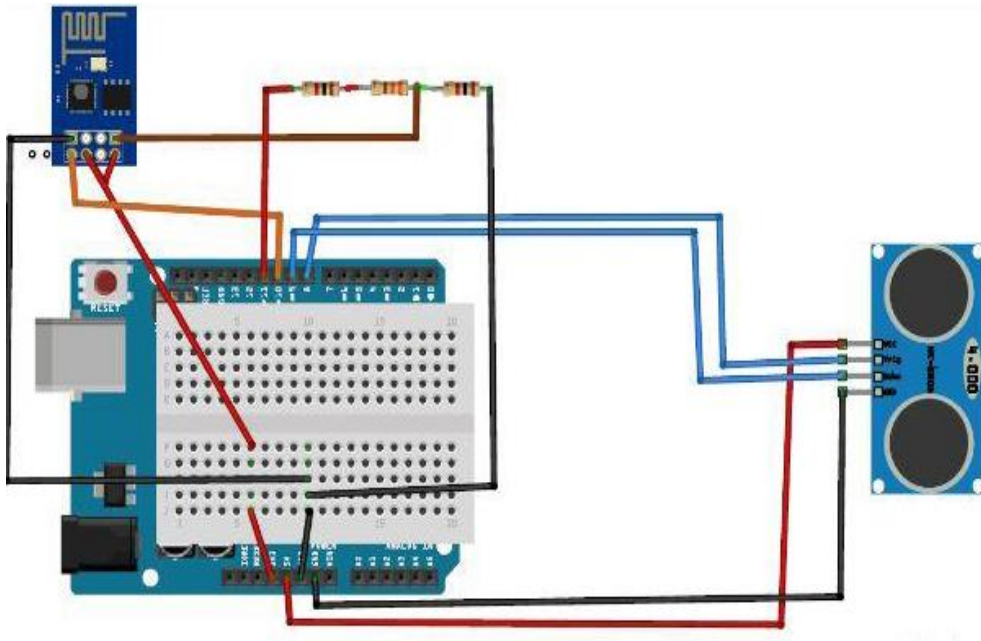
The user is the person who uses the application, if no longer daily, a minimum of often. So, it's essential to shape customers in a phase of the complete excellent approach within the software development lifecycle.

RESULT:

IoT Enabled Smart Waste Management

IoT Platform

Location Of Smart Bin

Optimized Trash Collection Route

Embedded Sensor

Send to Driver in Cellular Connected Truck

BLOCK DIAGRAM:

ADVANTAGE & DISADVANTAGE:

As mentioned above, waste management involves the collection and disposal of both hazardous and non-hazardous wastes from all the sectors of society. We shall now look in detail the advantages of waste management or the benefits of proper garbage disposal.

ADVANTAGE:

1.This practice is highly lucrative
2.Keeps the environment clean and fresh
3.Saves the earth and conserves earth
4.Reduce environmental pollution
5.Waste management will help you earn money
6.Creates employement

DISADVANTAGE:

1.The process is not always cost effective,
2.The resultamt product has short life
3.The sites are often dangerous
4.The practice are not done uniformly
5.Waste management can cause more problems

PROPOSED APPLICATIONS :

1. Waste Level detection inside the garbage bins. Transmission of the information wirelessly to concerned officials .
2. System can be accessed anytime and from anywhere
3. Real-time data transmission and access
4. Avoids the overflows of garbage bins.
5. This project can only be used by municipal authorities or other private firms to tackle the current problem of urban waste collection.
6.Improves Environment quality-Fewer smells-Cleaner cities
7. This system has no individual use, but can be used by a city, state or a country.
8. Using this system, waste collection would become efficient and also reduction

in transportation costs can be witnessed.

COMPONENTS AND COMPATIBILITY :

For small scale simulation purposes we need the following components –
Wi-Fi Module:
802.11b/g/n protocol, Wi-Fi Direct (P2P), soft-AP, Integrated TCP/IP protocol stack.
Wi-Fi Module helps us to send the details of the dustbin at the receiver side.
Arduino Atmega328
Arduino is an open-source prototyping platform based on easy-to-use hardware and software.
Arduino boards are able to read inputs - light on a sensor, anger on a button, or a Twitter message and turn it into an output - activating a motor, turning on an LED, publishing something online.
Resistors
AVR family microcontroller Embedded C language
Arduino software
Ultrasonic sensors

CONCLUSION :

This project work is the implementation of smart garbage management system using IR sensor, microcontroller and Wi-Fi module. This system assures the cleaning of dustbins soon when the garbage level reaches its maximum. If the dustbin is not cleaned in specific time, then the record issent to the higher authority who can take appropriate action against the concerned contractor Therefore, the smart garbage management system makes the garbage collection more efficient. Such systems are vulnerable to plundering of components in the system in different ways which needs to be worked on.

FUTURE ENHANCEMENT :

Smart dustbin helps us to reduce the pollution. Many times garbage dustbin is overflow and many animals like dog or rat enters inside or near the dustbin. This creates a bad scene. Also some birds are also trying to take out garbage from dustbin. This project can avoid such situations. And the message can be sent directly to the cleaning vehicle instead of the contractor's office

REFRENCES:

[1] Ikuo Ihara; Nagaoka University of Technology; Ultrasonic Sensing: Fundamentals and Its Applications to Non-destructive Evaluation.

[2] Arduino, "Available at http://www.arduino.cc," 2010.

[3] M. Batty, "Smart Cities, Big Data," Environment and Planning B: Planning and Design 2012, vol. 39, pp. 191–93.

[4] Xu Li, Student Member, IEEE, Performance Evaluation of Vehicle-Based Mobile Sensor Networks for Traffic Monitoring.

[5] Yusuf Abdullahi Badamasi, The Working Principle Of An Arduino, Electronics, Computer and Computation (ICECCO), 2014 11th International Conference on 29 Sept.-1 Oct. 2014.

[6] Pedro Reis , Rui Pitarma, Celistino Goncalves, Intelligent System for Valorizing Solid Urban Waste, Filipe Caetano Faculty of Engineering UBI University of Beira Interior Covilha, Portugal, 2015.

[7] Adnan Aijaz, Member, IEEE; Cognitive Machine-to-Machine Communications for Internet-of-Things: A Protocol Stack Perspective

[8] IEEE; INTERNET OF THINGS JOURNAL.

[9] Dr. K.G. Srinivasa Head of the Department; Department of Computer Science; M S Ramaiah Institute of Technology

[10] Ni-Bin Chang, Smart and Green Urban Solid Waste Collection Systems: Advances, Challenges, and perspectives

Demo link:

https://drive.google.com/drive/folders/1nBl-nhwBqarYm7VedTTVrDeSEhG5zJm7?usp=share_link