Project Report

Team ID	**PNT2022TMID14345**
Project Name	**Smart waste management system for metropolitan cities**

1. INTRODUCTION

1.1 Project Overview:

Our continual increase in trash production has led to an international rubbish issue. Despite our efforts to make the world more sustainable and environmentally friendly, we continue to have problems with garbage generation and management. The ideal solution to this issue is to combine technological support with a vision of social, economic, and environmental sustainability. This is how it is carried out. To operate effectively, the smart bin system goes through a complete system check and battery level monitoring. If the battery level is low, it needs to be recharged right away before moving on to the next stage. Multiple sensors linked to the bin indicate the threshold level levels. A warning message is delivered to the garbage collectors and the municipality or local authority if the level of waste is exceeded. Through the GSM system, messages containing the location of the overflowing rubbish area are sent to the appropriate garbage collectors. An information update is provided to the municipality and the server is updated after the trash bin has been emptied. This is how technology may be used to effectively handle and manage bin garbage.

1.2 Purpose:

To efficiently establish a secure and sanitary workplace, we combine waste management with technology. Utilizing data and technology to make the trash business more effective is known as smart waste management. Smart trash management, which is based on Internet of Things (IoT) technology, aims to maximise resource allocation, lower operating costs, and improve the sustainability of waste services. This reduces the likelihood that any bin would be full for longer than a week while also enabling the trash collectors who empty the bins to plan more effective routes. The coordination between the trash haulers and the information provided by technology is good. This keeps them informed about the level of waste currently there and prompts them if the dumpsters exceed the threshold level. So that they can collect the trash on time and avoid cluttering the neighbourhood, they are issued with alert messages. Historical data can be used to identify certain container fill trends, which can then be controlled long-term accordingly. Mobile applications are utilised to address issues with the conventional waste management system in addition to hardware fixes, such as tracking drivers while they are out in the field.

2.LITERATURE SURVEY:

2.1 Existing problem:

In local towns and cities all around the world, waste management has grown to be a serious problem. Municipalities frequently have overflowing local dumpsters without being aware of it. This has a variety of effects on the locals, from the unpleasant odour to the hazardous and unclean environment. Poor waste management, which includes everything from nonexistent collection infrastructure to inefficient disposal, contaminates the air, water, and land. Open and unclean environments can infect people, spread diseases, and lead to the contamination of drinking water. As they accumulate throughout the food chain, toxic substances like persistent organic pollutants (POPs) pose particularly serious dangers to both human health and the ecosystem. Animals who consume polluted plants receive larger dosages of pollutants than those who are exposed to them directly. Hazardous elements from landfills, agricultural areas, feedlots, etc. will be absorbed by precipitation or surface water seeping through garbage and carried into surface and groundwater. Because it is frequently utilised for drinking, bathing, pleasure, as well as in agricultural and industrial processes, contaminated groundwater also offers a serious health danger. Various pests (insects, rodents, gulls, etc.) that seek out food in waste might be drawn to landfills and waste transfer terminals. These pests pose a threat to human health because they can transmit viruses and bacteria (such as salmonella and e-coli) that cause diseases.

2.2 References:

PAPER 1:

TITLE: IoT Based Waste Management for Smart City

AUTHOR NAME: Parkash Tambare, Prabu Venkatachalam

PUBLICATION YEAR: 2016

DESCRIPTION:

The amount of waste created each day is increasing, and as a result, we frequently see that the trash cans or dust cans that are placed in public areas of cities are overflowing. We intend to build "IoT Based Waste Management for Smart Cities" to avoid this because it leads to unhygienic living conditions for people and offensive odours in the neighbourhood. The suggested system includes a large number of trash cans that are dispersed throughout the city or on the campus. Each garbage can has a low-cost integrated gadget that monitors its level as well as a unique ID that makes it possible to track and identify it.

PAPER 2:

AUTHOR NAME:

Mohammad Aazam, Marc St-Hilaire, Chung-Horng Lung, Ioannis Lambadaris

PUBLICATION YEAR: 2016

DESCRIPTION:

The sensors in each bin of the Cloud SWAM system proposed by Mohammad Aazam et al can determine how much waste is there inside. For organic, plastic/paper/bottle/glass, and metal garbage, separate bins are available. In this manner, each type of waste is already separated, and the status makes it clear how much and what kind of waste is collected. The accessibility of cloud-stored data may be advantageous to various organisations and stakeholders in various ways. As soon as the trash is picked up, analysis and planning can start, and they can continue throughout recycling and import/export-related activities. The Cloud SWAM system offers prompt garbage pickup. The health, hygiene, and disposal conditions are improved by a timely and efficient garbage collection procedure.

PAPER 3:

TITLE: Arduino Microcontroller Based Smart Dustbins for Smart Cities

AUTHOR NAME: K. Suresh, S. Bhuvanesh and B. Krishna Devan

PUBLICATION YEAR: 2019

DESCRIPTION:

This essay describes a method for cleaning up our atmosphere and surroundings. The waste collection and disposal system needs to be upgraded for the Indian government's smart city plan to make these communities even smarter than they presently are. Self-Monitoring Automated Route Trash (SMART) dustbins are designed to be used in smart buildings, including among others bus stations, hospitals, and institutions. In this project, we used the Servomotor to open the dustbin lid, the PIR and Ultrasonic sensors to detect human presence, and the Ultrasonic sensor to determine the amount of trash. A communication module is used to relay signals between two garbage cans, and the GSM module communicates the message to the operator.

PAPER 4:

AUTHOR NAME: Mohd Helmy Abd Wahab, Aeslina Abdul Kadir, Mohd Razali Tomari and Mohamad Hairol Jabbar

PUBLICATION YEAR: 2014

DESCRIPTION:

proposed a smart recycle container that could manage the recycling of aluminium cans, plastic bottles, glass, and paper. After automatically calculating the worth of the garbage that was thrown away, a 3R card is generated. By putting rubbish in specified recycle bins, you can earn points under the recycling system. Such a system encourages recycling activities by allowing the points to be exchanged for goods or services. The system records details about disposal methods, materials disposed of, user identification, and points accumulated by the user. The user must tap his card to the designated RFID reader in order to access the recycle bin. Opening the recycling bin doors, garbage is placed one by one within.

PAPER 5:

TITLE: Waste Management Initiatives in India For Human Wellbeing

AUTHOR NAME: Dr. Raveesh Agarwal, Mona Chaudhary and Jayveer Singh

PUBLICATION YEAR: 2015

DESCRIPTION:

This essay's goal is to look at the current waste management practises employed in India to benefit the country's populace. The second objective is to provide suggestions for improving Indian municipal rubbish disposal methods. The foundation of this work is secondary research. The system is improved by taking a close look at the waste management reports that have already been published and the suggestions for improvement made by planners, NGOs, consultants, government accountability organizations, and significant business leaders. It offers a thorough grasp of the various waste management initiatives in India and indicates potential areas for waste management improvement. The purpose of the essay is to help readers understand the significant role that the government-run waste management industry in our country plays in the waste management process.

PAPER 6:

AUTHOR NAME: Fachmin F olianto, Yong Sheng Low and Wai Leong Yeow

PUBLICATION YEAR: 2015

DESCRIPTION:

The smart bin system is proposed with a three-tiered structure. Every Smartbin has an ultrasonic sensor that measures bin fullness, logs readings, and tracks sensor statuses. Every sensor cluster includes a gateway nod, which accepts and delivers sensor readings. The data is sent across to the backend server. The analytics module of the back end server looks over the data that the bin subsystem has gathered. In order to create events when a threshold is exceeded, the analytics module analyses fullness readings, compares them to predetermined standards, and so on. The workstation receives data from the bin sub-system and presents it to users via a graphical user interface.

PAPER 7:

TITLE: Design and Development of Smart Waste Management System: A Mobile App for Connecting and Monitoring Dustbin Using IoT

AUTHOR NAME: Na Jong Shen, Azham Hussain and Yuhanis Yusof

PUBLICATION YEAR: 2020

DESCRIPTION:

A very innovative system that will assist the creation of the smart city is the smart waste management method. We constantly see that the trash cans positioned in public spaces of our city are always crammed full. As a result, the city is filthy, and Malaysia's current waste management system is not designed to deal with the problem. Additionally, the outdated practise of manually inspecting the trash in trash cans is a challenging task that demands a lot more human labour and is expensive. To avoid any such occurrences, a programme called the Smart Waste Management System is implemented. This solution was developed to make it possible for mobile applications to communicate with trash cans that are Internet of Things (IoT)-based. This project was developed using an approach called adaptive software development.

PAPER 8:

AUTHOR NAME: Keerthana b et al.

PUBLICATION YEAR: 2017

DESCRIPTION:

India's waste management system was designed as an internet of bins. The smart TRASH management system, which employs sensor, microcontroller, and other modules, ensures that the trash cans are correctly emptied when the rubbish level reaches its peak. An alarm message is sent to the truck that collects the trash if the waste quantity exceeds one of the two thresholds set for the bins. The device allows people to keep putting trash bags in the bins until they reach the threshold limit. It transmits the message repeatedly until the bin is close to the threshold limit, at which point the bin is locked, and then it waits for the vehicle to acknowledge it before emptying the bin. The notice "Overloaded" is displayed when the bin locks. The trash can will then be watched for a predetermined period of time, and if it isn't empty within that time, a notice will be sent to a higher authority so they may take the necessary action.

PAPER 9:

TITLE: IoT based smart garbage collection system

AUTHOR NAME: Rahul Kumar Borah, Sahana Shetty, Rahul Patidar, Anisha Raniwala and Kratee Jain

PUBLICATION YEAR: 2018

DESCRIPTION:

The smart trash can is essential to developing a dynamic and efficient waste management system. The management of trash from its creation to transfer is one of the biggest difficulties facing municipal organisations worldwide. Dustbins placed throughout finished urban areas and placed in open areas are overflowing as a result of the daily growth in garbage, creating unsanitary conditions for the residents. For smart urban groups, we have presented a remote strong waste management prototype to preserve a critical barrier from such a predicament. By increasing the time and cost involved, this prototype enables common groups to commercially maintain clean metropolitan areas by remotely monitoring the status of garbage cans and full web servers.

PAPER 10:

TITLE: Smart City Waste Management System using IoT and Cloud Computing.

AUTHOR NAME: Aderemi A. Atayero, Segun I. Popoola, Rotimi Williams, Joke A. Badejo and Sanjay Misra

PUBLICATION YEAR: 2021

DESCRIPTION:

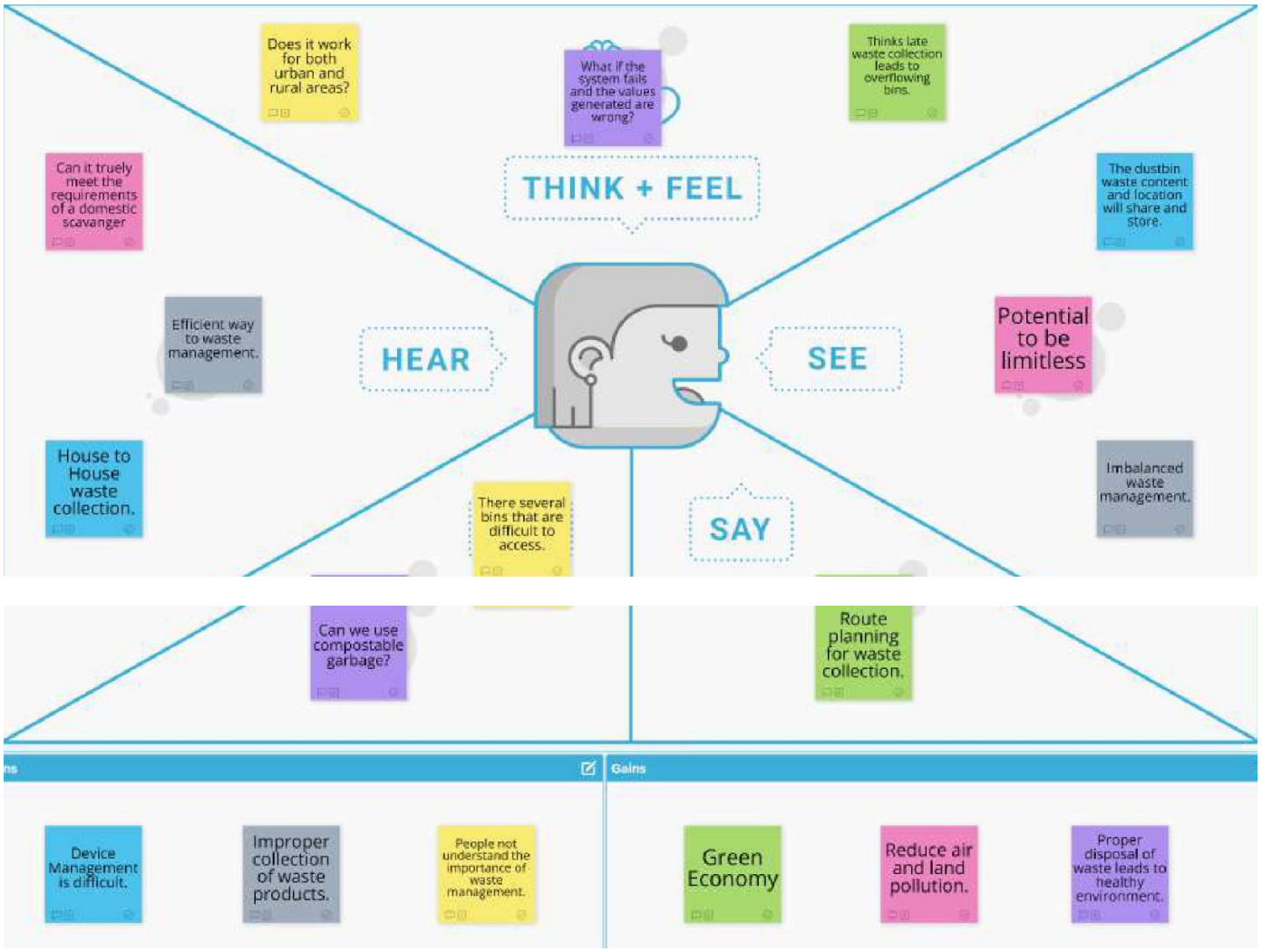
In the urban regions of the majority of developing countries, there is a huge issue with the careless disposal of solid waste, which gravely jeopardises the ability of the population to lead healthy lives. The public will gain by having access to reliable information about the state of solid trash at various locations throughout the city. In this work, an intelligent solid waste monitoring system is developed using Internet of Things (IoT) and cloud computing technologies. The solid waste fill levels in each of the containers, which are strategically positioned across the community, are measured by ultrasonic sensors. The sensor data is transmitted to the Thing Speak IoT cloud platform via a Wireless Fidelity (Wi-Fi) communication channel.

2.3 Problem Statement Definition:

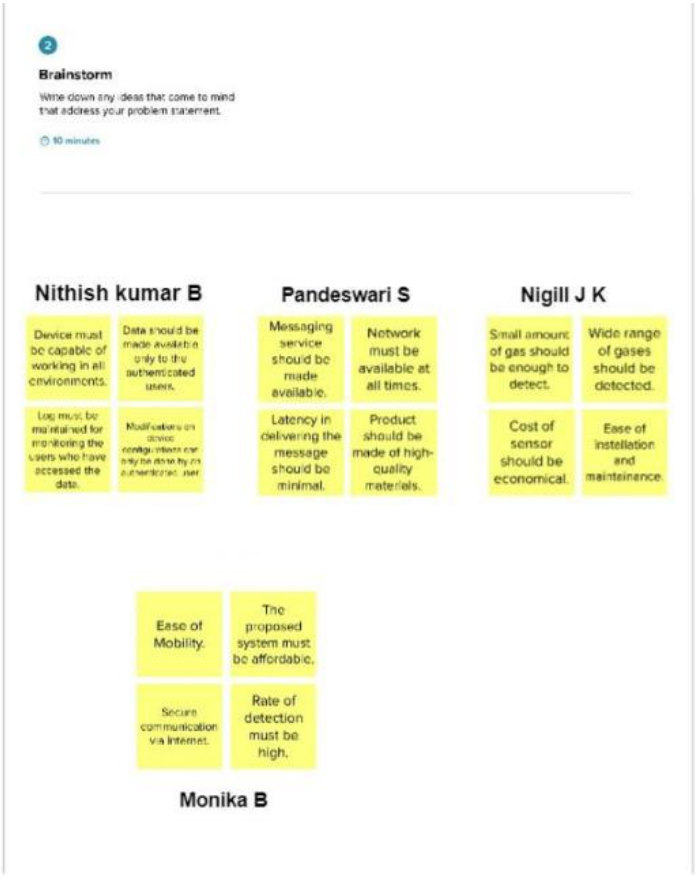
Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Municipal corporation authority	Get notified when the trash cans are full and be made aware of where the full cans are located.	Don't have the facilities at the moment	There is no tool available to determine the 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 where there is a city is invariably crowd.	Worried

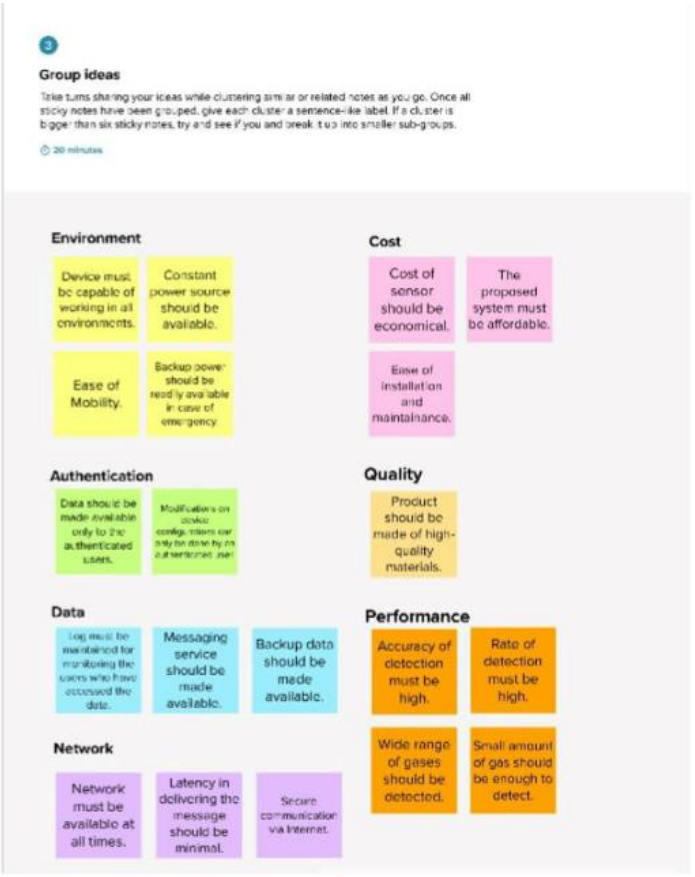
3.IDEATION & PROPOSED SOLUTION

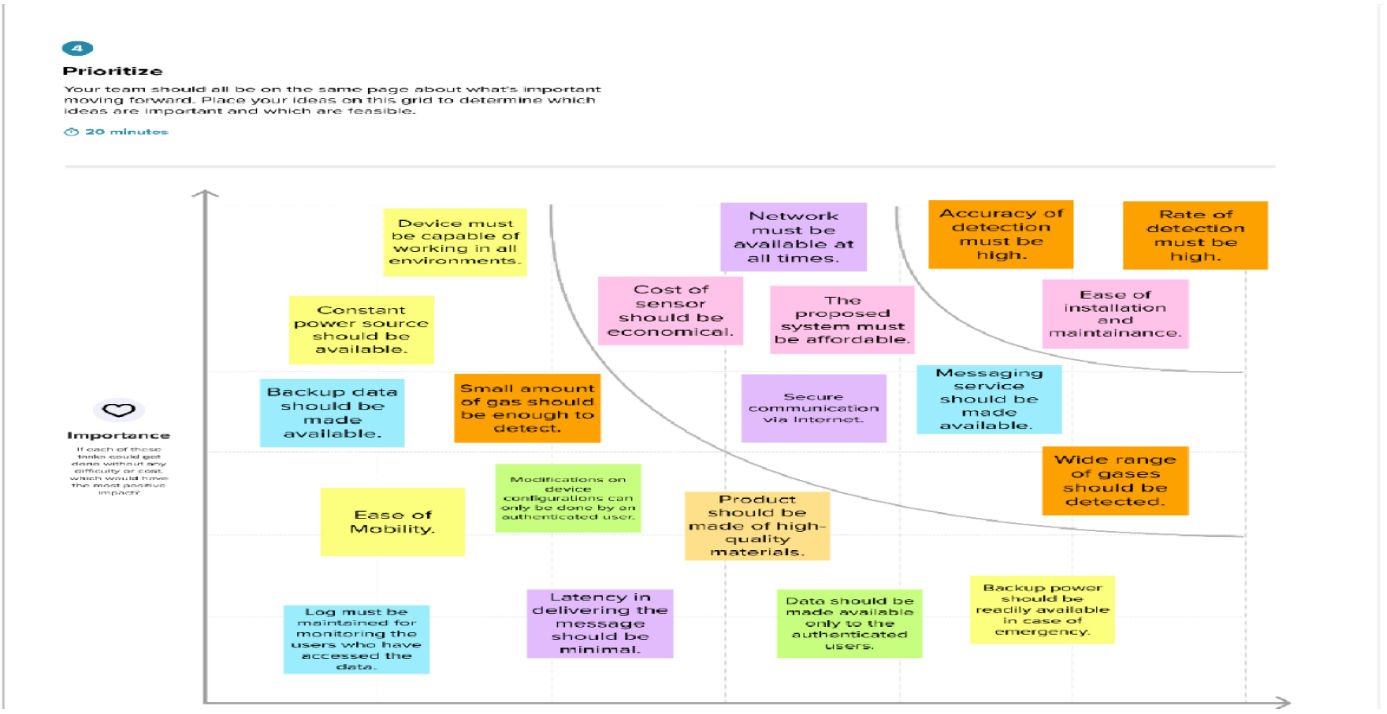
3.1Empathy Map Canvas



3.2Ideation & Brainstorming







3.3Proposed Solution

S. No	Parameter	Description
1.	Problem Statement (Problem to be solved)	The manual monitoring of wastes in trash cans is a laborious operation that requires additional time, money, and human labor Unsafe trash disposal is generating problems for people. Bad odor all around the place from uncollected trash or rubbish.
2.	Idea / Solution description	This procedure uses a cloud connection and non-bio degradable wastes and an ultrasonic sensor to determine the level of a rubbish container By developing an app, the company of a certain neighborhood inside a large metropolis will be able to check the trash cans to see if they are full or not.
3.	Novelty / Uniqueness	In contrast to the traditional ways for collecting trash cans, this strategy instructs us to utilize the transportation only when necessary. Keeping an eye on the trash cans easier and less labor-intensive for humans.
4.	Social Impact / Customer Satisfaction	People can experience a clean atmosphere. Reduces the amount of labor required from humans for waste disposal. For a municipal corporation to monitor the cleanliness of different areas of the city, this proposal will be quite helpful.
5.	Business Model (Revenue Model)	By cutting back on unneeded transportation costs to pointless locations, this lowers a significant amount of fuel costs for city businesses. This initiative intends to assist municipal corporation. Provide a sanitary atmosphere.

3.4 Problem Solution Fit

1.CUSTOMER SEGMENTS

- ✓ The global smart waste management market is segmented on the basis of waste type, method source, and region
- ✓ By waste type, it is divided into solid waste, special waste, and e-waste.

6. CUSTOMER CONTRAINTS

- ✓ Waste management in cities is often times the most expensive item of investment as it involves both the collection of waste and its transportation for appropriate disposal

5. AVAILABLE SOLUTIONS

- ✓ We can significantly reduce the amount of solid waste by following some basic principles of reducing the amount of waste that is created, reusing materials that would otherwise be discarded, by recycling materials and by using recycled materials.

2.JOBS-TO-BE-DONE / PROBLEMS

- ✓ Consult with interested stakeholders.
- ✓ Identify potential waste streams.
- ✓ Evaluate the reuse and recycling program.
- ✓ Consider waste collection strategies.

9. PROBLEM ROOT CAUSE

- ✓ 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

7. BEHAVIOUR

- ✓ Get a full overview of the world of smart waste management in the ultimate guide. Learn how smart sensors can optimize your waste collection.

3.TRIGGERS

- ✓ It triggers an alarm system that will alert the people to dispose of the trash properly.

4.EMOTIONS:Before/After

- ✓ Before the action is taken the user feels deceived and cheated.
- ✓ After the problem is resolved user feels the sincerity of the developer

10. YOUR SOLUTION

- ✓ Shop eco-friendly with reusable bags.
- ✓ Ditch disposables in the kitchen.
- ✓ Reduce food waste
- ✓ Installing more bins for collecting recyclables like paper,glass,plastics.

8. CHANNELS OF BEHAVIOUR

ONLINE

- ✓ Global industry is undergoing major transformations with the genesis of a new paradigm known as the Internet of Things (IoT) with its underlying technologies.

OFFLINE

- ✓ 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

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	Real time bin monitoring.	The Dashboard shows statistics on the amount of fill in bins as it is being tracked by smart sensors. The application also forecasts when the bin will fill up based on past data in addition to the percentage of fill level, which is one of the features that even the finest waste management software lacks. As picks are also recognized by the sensors, you can determine when the bin was last emptied. You can get rid of the overflowing bins and cease collecting half-empty ones using real-time data and forecasts.
FR-2	Eliminate inefficient picks.	Get rid of the collection of half-empty trash cans. Picks are recognized by sensors. We can demonstrate to you how full the bins you collect are using real-time data on fill-levels and pick recognition.
FR-3	Plan waste collection routes.	Route planning for rubbish pickup is semiautomated using the tool. You are prepared to act and arrange for garbage collection based on the levels of bin fill that are now present and forecasts of approaching capacity. To find any discrepancies, compare the planned and actual paths.
FR-4	Adjust bin distribution.	Ensure the best possible bin distribution. Determine which regions have a dense or sparse distribution of bins. Ensure that each form of waste has a representative stand. You can make any required adjustments to bin position or capacity based on past data.
FR-5	Expensive bins.	We assist you in locating containers that increase collection prices. The tool determines a collection cost rating for each bin. The tool takes local average depo-bin discharge into account. The tool determines the distance from depo-bin discharge and rates bins (1–10).
FR-6	Detailed bin inventory.	On the map, you can see every monitored bin and stand, and you can use Google Street View at any time to visit them. On the map, bins or stands appear as green, orange, or red circles. The Dashboard displays information about each bin, including its capacity, trash

		kind, most recent measurement, GPS position, and pick-up schedule.

4.2 Non-Functional requirements

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

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability is a unique and significant perspective to examine user needs, which may further enhance the design quality, according to IoT devices. Analyzing how well people interact with a product may help designers better understand customers' prospective demands for waste management, behavior, and experience in the design process when user experience is at the Centre.
NFR-2	**Security**	Utilize recyclable bottles. Utilize reusable shopping bags. Spend responsibly and recycle Eat and drink in limited-use containers.
NFR-3	**Reliability**	Creating improved working conditions for garbage collectors and drivers is another aspect of smart waste management. Waste collectors will use their time more effectively by attending to bins that require service rather than travelling the same collection routes and servicing empty bins.
NFR-4	**Performance**	The Smart Sensors assess the fill levels in bins (along with other data) numerous times each day using ultrasonic technology. The sensors feed data to Senone's Smart Waste Management Software System, a robust cloud-based platform with datadriven daily operations and a waste management app, using a variety of IoT networks (NB-IoT, GPRS). As a consequence, customers receive data-driven decision-making services, and garbage collection routes, frequency, and truck loads are optimized, resulting in at least a 30% decrease in route length.
NFR-5	**Availability**	By creating and implementing robust hardware and gorgeous software, we enable cities, companies, and nations to manage garbage more intelligently.
NFR-6	**Scalability**	Using smart trash bins allows us to scale up and monitor the rubbish more efficiently while also reducing the number of bins needed in towns and cities.

5.PROJECT DESIGN

5.1 Data Flow Diagrams

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system.

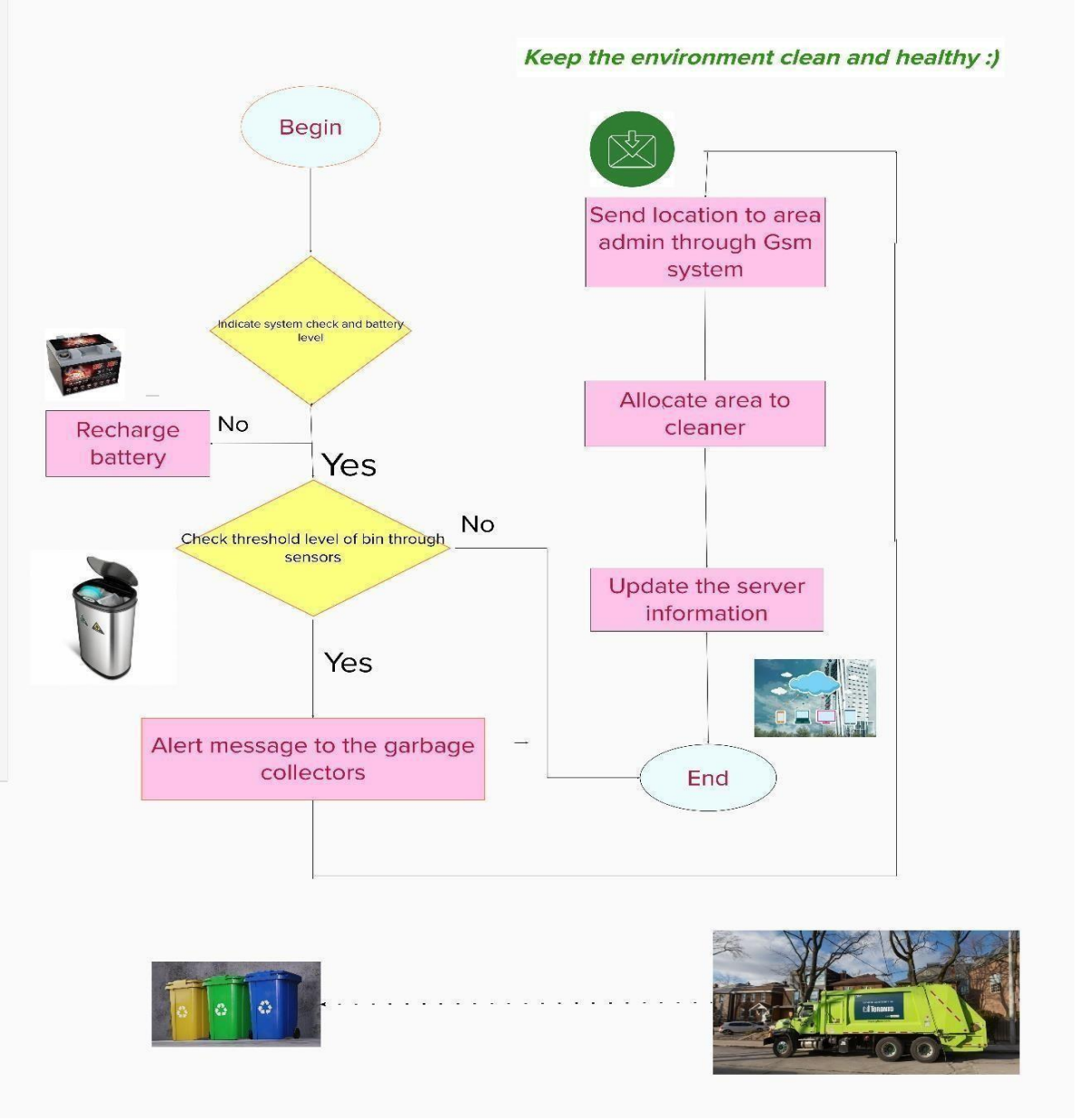
A neat and clear DFD can depict the right amount of the system requirement graphically.

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

A smart waste management platform uses analytics 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 its garbage level is very low
- Then, the bin is filled with more garbage until its level has surpassed the first threshold **value, which isset 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 of 85% full
- The second notification SMS sent by the system, indicating that bin is at least 95% full and **the garbageneeds 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

Data flow diagram:



5.2 Solution & Technical Architecture:

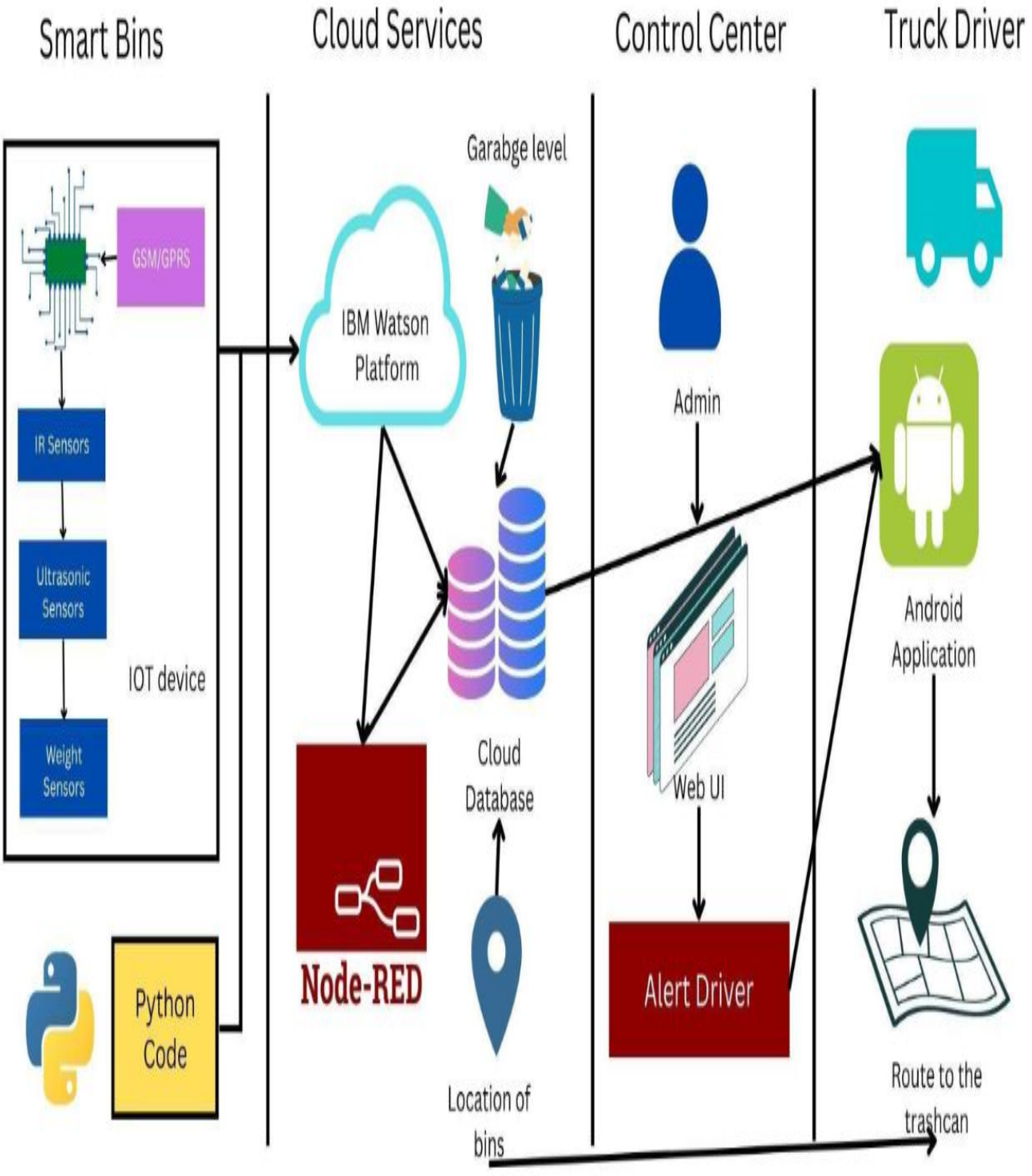


Table-1: Components & Technologies:

S.no	Component	Description	Technology
1.	Arduino Uno	The Arduino Uno is an open-source microcontroller board based on the Microchip Atmega328P microcontroller	C++
2.	Application Logic-1	Logic for IR sensor data	C++/Python
3.	Application Logic-2	Logic for Ultrasonic sensor data	C++/Python
4.	Application Logic-3	Logic for Weight sensor data	C++/Python
5.	GPRS/GSM	The Arduino GSM shield allows an Arduino board to connect to the internet,send and receive SMS,and make voice calls using the GSM library	C++/Python
6.	Cloud Server	Application Deployment on Local System/Cloud	IBM Watson Iot Platform,Node Red
7.	Cloud Database	Database Service on Cloud	IBM Watson Iot Platform,Cloudant DB
8.	User Interrface	How user interacts with application to alert the truck driver	HTML,CSS,Java Script,Python
9.	External API-1	Purpose of External API used in the application to locate the trashcans	Google Maps Geolocation API

Table-2: Application Characteristics:

S.no	Characteristics	Description	Technology
1.	Open-Source Microcontroller	Ardunio Uno is used to make the Iot device	C++/Python
2.	Security	Encryption/Decrypti on used for security purpose	GSM/GPRS,Python
3.	Scalable Architecture	New features can be added	Node Red
4.	Availability	Web application can be accessed from anywhere	IBM Watson IoT Platform HTML,CSS,Java Script
5.	Performance	All truck drivers can access the application at same time	Cloudant DB, IBM Watson IoT Platform

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5.1 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	Login	USN-1	As an administrator, I assigned user names and passwords to each employee and managed them.	I can control my online account and dashboard.	Medium	Sprint-1
Co-Admin	Login	USN-2	As a Co-Admin, I'll control the waste level monitor. If a garbage filling alert occurs, I will notify the trash truck of the location and rubbish ID.	I can handle the waste collection.	High	Sprint-1
Truck Driver	Login	USN-3	As a Truck Driver, I'll follow Co Admin's instruction to reach the filled garbage.	I can take the shortest path to reach the waste filled route specified.	Medium	Sprint-2
Local Garbage Collector	Login	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	I can collect the trach, pull it to the truck, and send it out.	Medium	Sprint-3
Municipality officer	Login	USN-5	As a Municipality officer, I'll make sure everything is proceeding as planned and without any problems.	All of these processes are under my control.	High	Sprint-4

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6.PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information byreferring the, technical papers, research publications etc.	1 October 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	1 October 2022
Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	1 October 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	10 October 2022
Problem Solution Fit	Prepare problem - solution fitdocument.	10 October 2022

Solution Architecture	Prepare solution architecturedocument.	10 October 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences withthe application (entry to exit).	13 October 2022
Functional Requirement	Prepare the functional requirementdocument.	13 October 2022
Data Flow Diagrams	Draw the data flow diagramsand submit for review.	15 October 2022
Technology Architecture	Prepare the technology architecture diagram.	15 October 2022
Prepare Milestone & Activity List	Prepare the milestones & activitylist of the project.	26 October 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developedcode by testing it.	IN PROGRESS..

6.2 Sprint Delivery Schedule

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	Login	USN-1	As a Administrator, I need to give user id and passcode for ever workers over there in municipality	10	High	Nithish kumar, Monika,
Sprint-1	Login	USN-2	As a Co-Admin, I'll control the waste level by monitoring them via real time web portal. Oncethe filling happens, I'll notify trash truck with location of bin with bin ID	10	High	Nigill, Pandes wari
Sprint-2	Dashboard	USN-3	As a Truck Driver, I'll follow Co-Admin's Instruction to reach the filling bin in short roots and save time	20	Low	Pandes wari, Monika
Sprint-3	Dashboard	USN-4	As a Local Garbage Collector, I'II gather all the waste from the garbage, load it onto a garbage truck, and deliver it to Landfills	20	Medium	Nithish kumar, Nigill,
Sprint-4	Dashboard	USN-5	As a Municipality officer, I'll make sure everything is proceeding as planned and without any problems	20	High	Nithish kumar, Nigill,Monika

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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	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

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)

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

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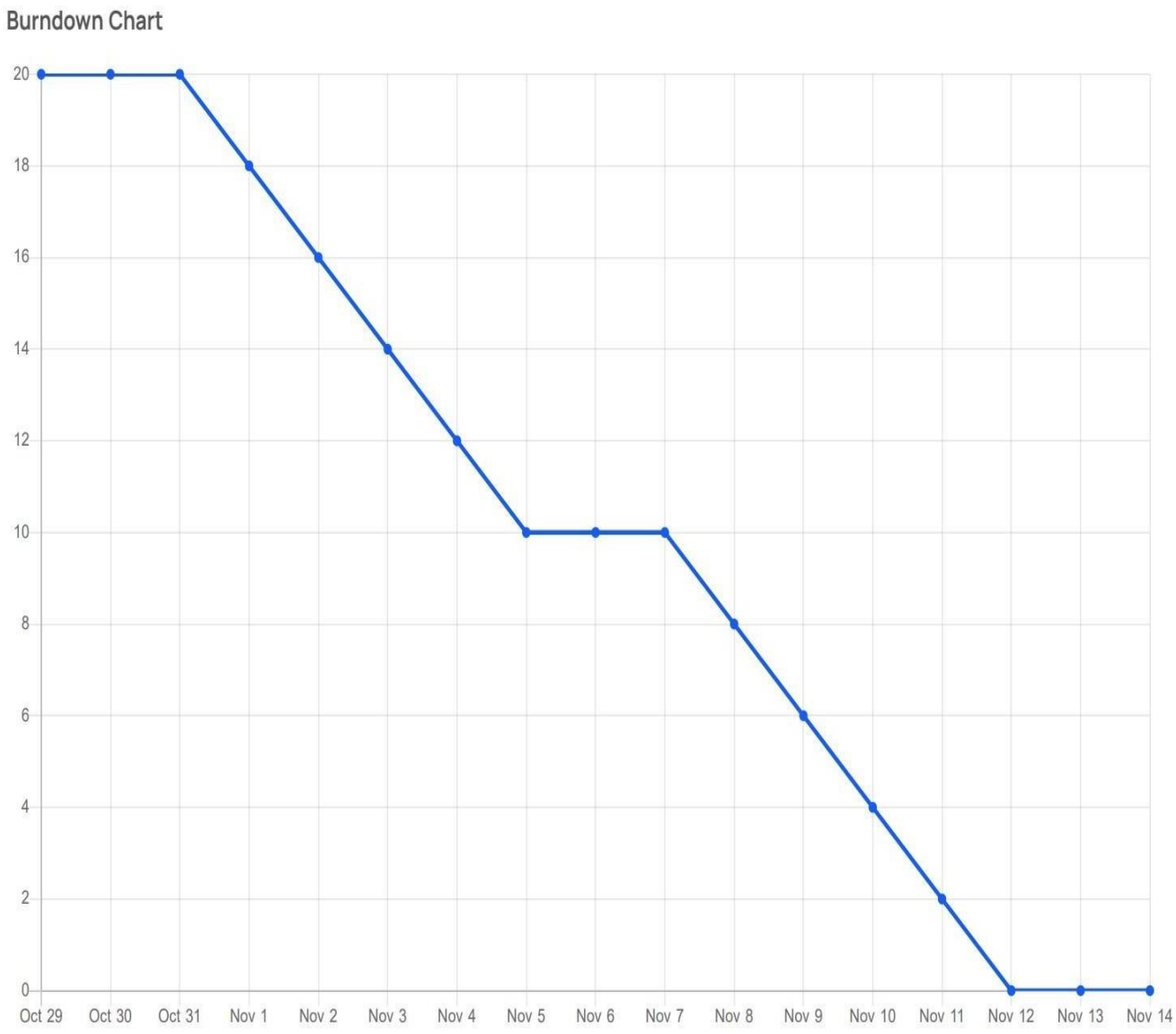
10/22/22, 11:16 PM Burndown Chart - Generated by https://easyretro.io



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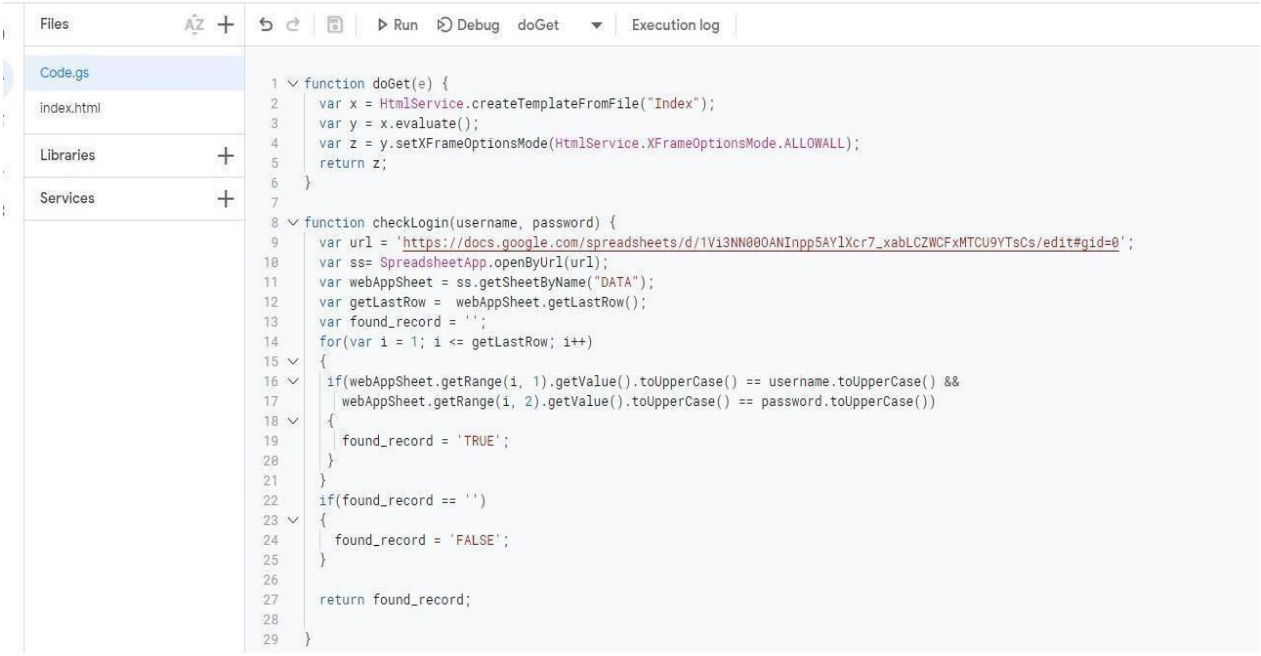
7.CODING & SOLUTIONING (Explain the features added in the project along with code)

CODE FOR REGISTRATION AND LOGIN CREDENTIALS:

Code.gs:

```
function doGet(e) {
  var x =
  HtmlService.createTemplateFromFile("Inde
  x");var y =x.evaluate();
  var  z  =  y.setXFrameOptionsMode(HtmlService.XFrameOptionsMode.ALLOWALL);return  z;
}

function checkLogin(username, password) {
  var  url  =
  'https://docs.google.com/spreadsheets/d/1Vi3NN00OANInpp5AYlXcr7_xabLCZWCFxMTCU
  9YTsCs/edit#gid=0'; var ss= SpreadsheetApp.openByUrl(url);
  var webAppSheet =
  ss.getSheetByName("DATA");var
  getLastRow =
  webAppSheet.getLastRow(); var
  found_record = '';
  for(var i = 1; i <= getLastRow; i++)
  {
   if(webAppSheet.getRange(i, 1).getValue().toUpperCase() ==
      username.toUpperCase() &&webAppSheet.getRange(i,
      2).getValue().toUpperCase() == password.toUpperCase())
   {
      found_record = 'TRUE';
   }
  }
  if(found_record == '')
  {
    found_record = 'FALSE';
  }

  return found_record;
```

```
}

function AddRecord(usernamee, passwordd, email, phone) {
  var url =
  'https://docs.google.com/spreadsheets/d/1Vi3NN00OANInpp5AYlXcr7_xabLCZWCFxMTCU
  9YTsCs/edit#gid=0'; var ss= SpreadsheetApp.openByUrl(url);
  var webAppSheet = ss.getSheetByName("DATA");
  webAppSheet.appendRow([usernamee,passwordd,email,phone]);
  }
```



index.html:

```
<!DOCTYPE html>
<html>
  <head>
    <style>
      body{
        background-
        image:url('background.jpg');backgroun
        d- repeat: no-repeat; background-
        attachment: fixed; background-
        size:100% 100%;
      }
    </style>
    <base target="_top">
    <script>
      function AddRow()
    {
```

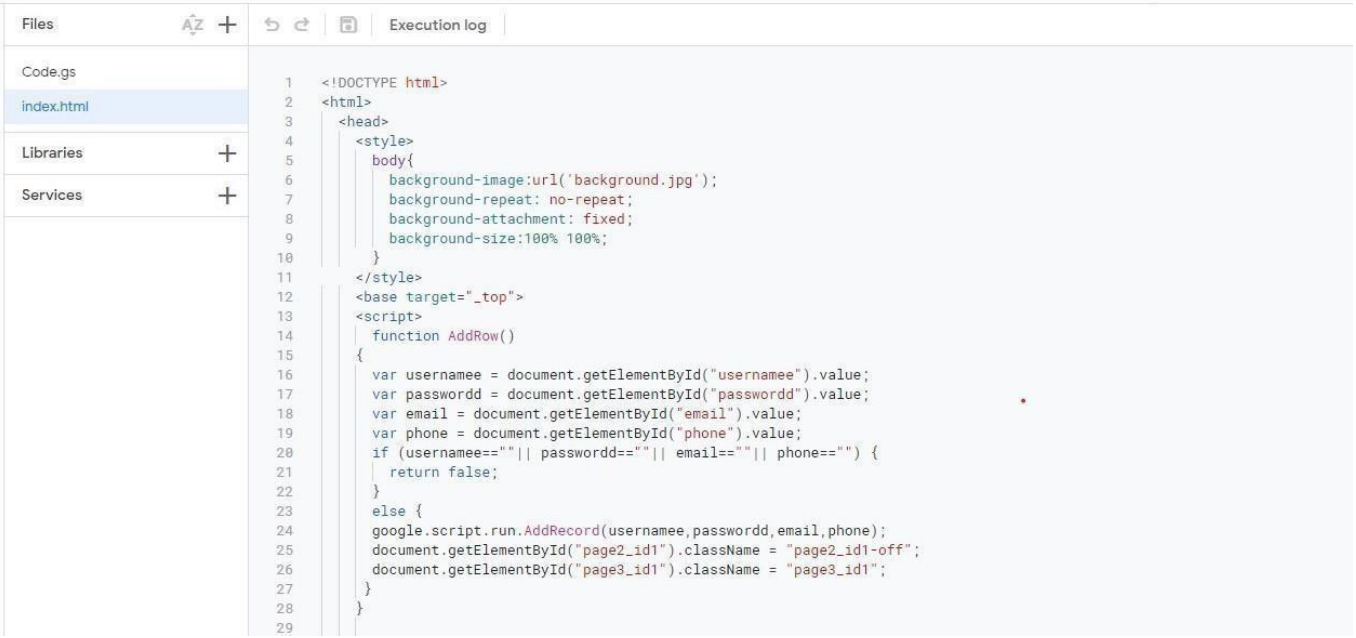
```
    var usernamee = document.getElementById("usernamee").value; var passwordd
    =     document.getElementById("passwordd").value;
          var                                          email =
    document.getElementById("email").value;
    var phone = document.getElementById("phone").value;
    if (usernamee==""|| passwordd==""|| email==""|| phone=="") {return false;
    }
    else { google.script.run.AddRecord(usernamee,passwordd,email,phone);

    document.getElementById("page2_id1").classNam
    e = "page2_id1-off";
    document.getElementById("page3_id1").classNa
    me = "page3_id1";
   }
  }

   function LoginUser()
  {
  var username =
  document.getElementById("username").value;var
  password =
  document.getElementById("password").value;
  google.script.run.withSuccessHandler(function(output)
  {
    if(output == 'TRUE')
    {
        var url1 ='https://node-red-jrfhu-2022-10-06.eu-
gb.mybluemix.net/ui/#!/0?socketid=kVaDwxl44Sp25mOZAAAX';
        var winRef = window.open(url1);
        winRef ? google.script.host.close() :
        window.onload=function(){document.getElementById('url').href = url1;}
    }
    else if(output == 'FALSE')
    {
      document.getElementById("errorMessage").innerHTML = "Invalid data";
    }
  }).checkLogin(username, password);
  }

function function1(){
  document.getElementById("page1_id1").className
```

```
      = "page1_class1-off";
      document.getElementById("page2_id1").className
      = "page2_id1";
}

function function3(){
   document.getElementById("page3_id1").className =
   "page3_id1-

         off";document.getElementById("page1_id1").className =

"page1_id1";
}

   </script>
   <style>

/*page1*/
.page1_class1-off{
      display: none;
   }


/*page2*/
.page2_class1{
      display:none;
   }

.page2_id1-off{
      display:none;
}

/*page3*/
.page3_class1{
      display:none;


}
.page3_id1-off{
      display:none;
}

input[type=text]:hover{
```

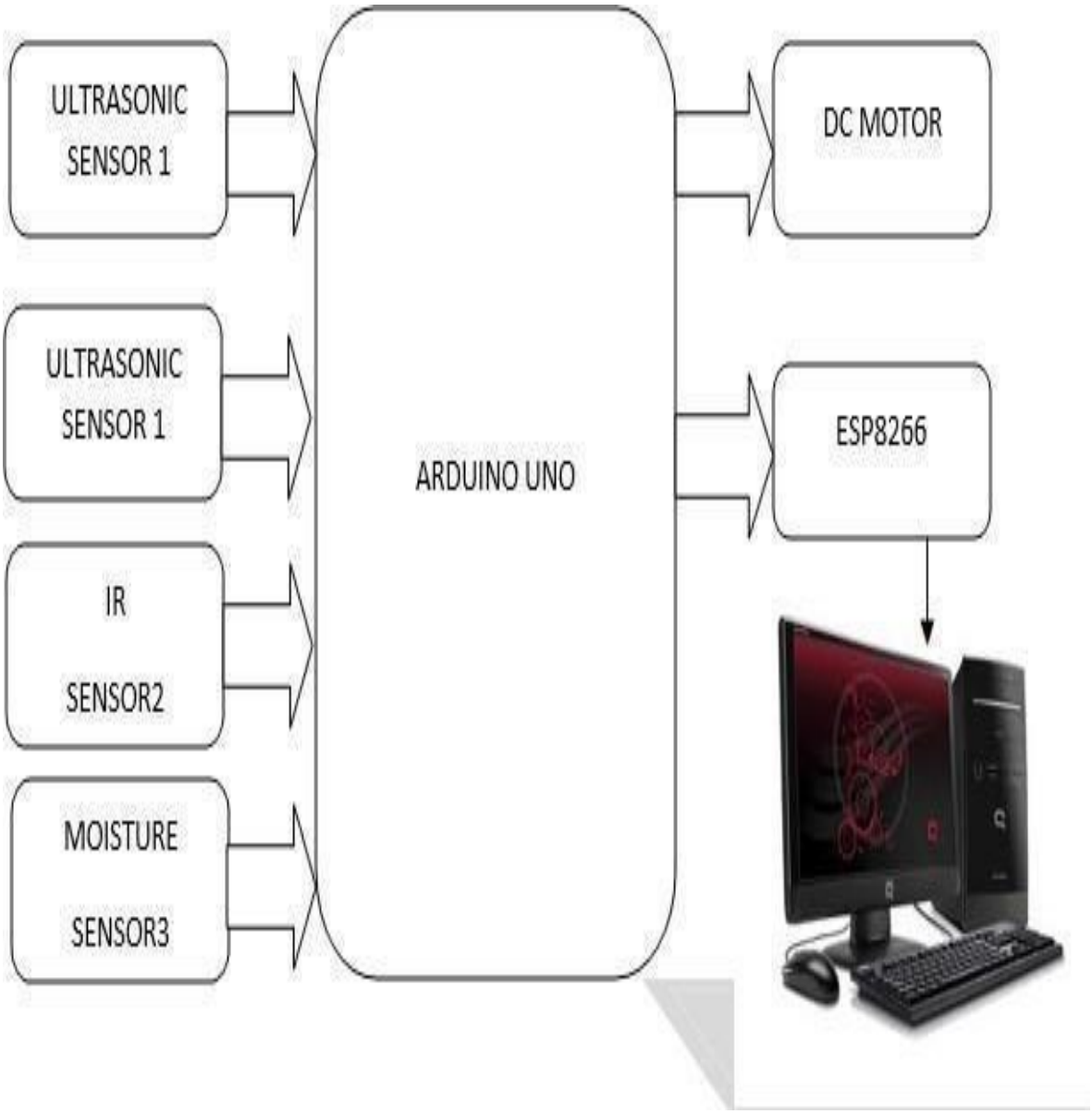
```
        border-bottom:2px solid black;
      }
input[type=number]:hover{
        border-bottom:2px solid black;
      }
input[type=password]:hover{
        border-bottom:2px solid black;
      }


</style>
<meta name="viewport" content="width=device-width, initial-scale=1.0">
  </head>
  <body>
   <br><br>
<!--page1-->
<center>
 <div class="page1_class1" id="page1_id1" style="background-
color:rgb(135, 207, 235);border:2px solid gray;border-radius: 20px;width:
250px;padding-top: 10px;padding-bottom:20px;padding-left: 20px;padding-right:
20px;">
    <h1>Login Here</h1>
    <br>
    <p>Username</p>
    <input type="text" id="username" placeholder=" Enter Username" style=";outline: none;
    text-align: center;font-size:0.9em
;width: 50%;font-weight:bold;"/><br>
    <br>
    <p>Password</p>
    <input type="password" id="password" placeholder=" Enter Password"
style="border- top: none;border-right:none;border-left: none;outline: none; text-
align: center;font-size:0.9em ;width: 50%;font-weight:bold;"/>
    <br><span id="errorMessage" style="color: red" ></span><br>
    <br>
<input type="submit" value="Login" onclick="LoginUser()" style="float:


    centre;padding-top: 1px;padding-bottom:1px;padding-left: 10px;padding-right:
10px;font-size: 0.9em;font- weight:bold;" /><br>
    <br><br>
    <b>If you don't have an account,</b><input type="button" onClick="function1()"
```

```
    value="Create New" style="margin-top:5px;font-weight:bold;" />
 </div>

<!--page2-->
<div class="page2_class1"  id="page2_id1"  style="background-
color:rgb(135, 207, 235);border:2px solid gray;border-radius: 20px;width:
250px;padding-top: 10px;padding-bottom:20px;padding-left: 20px;padding-right:
20px;">
 <h1>Register Here</h1>
 <p>Name</p>
    <input type="text" id="usernamee" placeholder=" Enter Name" style="border-top:
none;border-right: none;border-left:none;outline: none; text-align: center;font-
size:0.9em ;width: 50%;font-weight:bold;"/><br>

    <br>
 <p>Password</p>
    <input type="password" id="passwordd" placeholder="Create password"
style="border-top: none;border-right:none;border-left: none;outline: none; text-
align: center;font-size: 0.9;width: 50%;font-weight:bold;" /><br>
        <br>
<p>Email</
           p>
    <input type="text" id="email" placeholder=" Enter Email" style="border-top:
none;border-right: none;border-left:none;outline: none; text-align: center;font-
size:0.9em ;width: 50%;font-weight:bold;"/><br>
    <br>
 <p>Phone Number</p>
    <input type="number" id="phone" placeholder="Enter number" style="border-top:
none;border-right: none;border-left:none;outline: none; text-align: center;font-
size:0.9em  ;width:  50%;font-weight:bold;"  /><br><br>
    <br><br>
    <input type="submit" value="Create" onclick="AddRow()" style="float:
centre;padding- top: 1px;padding-bottom:1px;padding-left: 10px;padding-right:
10px;font-size: 0.9em;font-weight:bold;" />
    <br>
</div>
<!--page3-->
 <div class="page3_class1" id="page3_id1" style="background:none;border:2px
solid gray;border-radius: 20px;width:250px;padding-top: 10px;padding-bottom:
20px;padding-left: 20px;padding- right: 20px;"><center>
```

```
    <h2> REGISTRATION SUCCESSFUL! Login to your account</h2>
    <input type="submit"  onClick="function3()"  value="Login" style="font-weight:bold;"><br>
</div>


</center>
 </body>
</html>
```



CIRCUIT DIAGRAM:

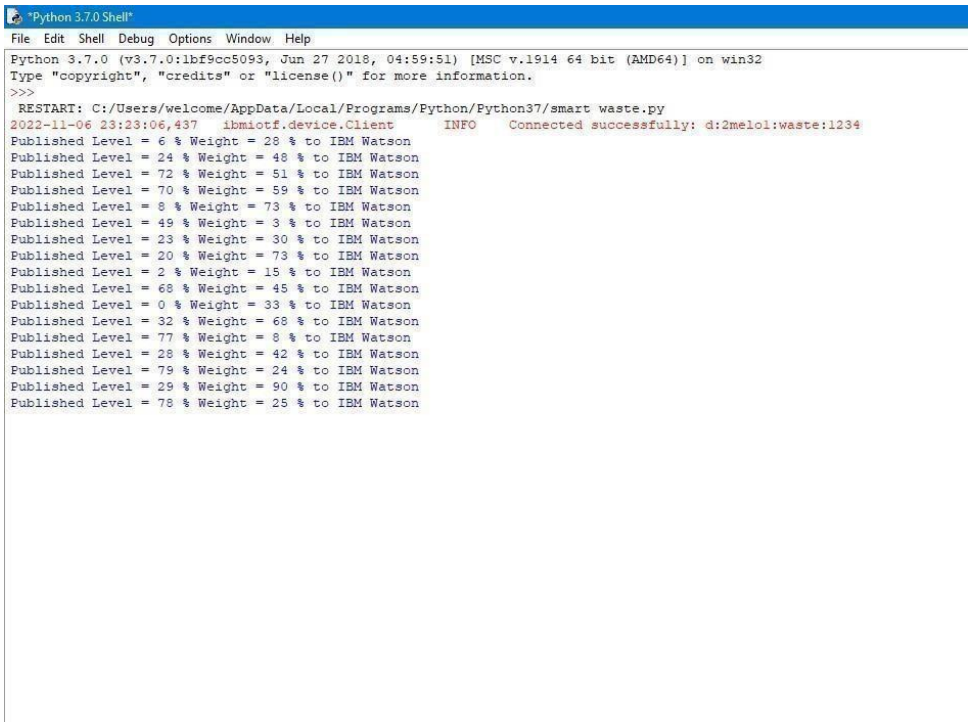


Python Code

```
import time import sys import

ibmiotf.application import

ibmiotf.device importrandom

#Provide your IBM Watson

Device Credentials

organization

= "2melo1" deviceType =

"waste" deviceId = "1234" authMethod =

"token" authToken = "12345678"

# Initialize GPIO

def myCommandCallback(cmd):

print("Commandreceived: %s" %

cmd.data['command'])status=cmd.data['command']

if status=="waste level":

    print ("waste level monitored")

  else :

    print ("weight level monitored")
```

```
#print(cmd)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

    level=random.randint(0,100) weight=random.randint(0,100)



    data = { 'level' : level, 'weight':

    weight }#print data

    def myOnPublishCallback():

      print ("Published Level = %s %%" % level, "Weight = %s %%" % 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(20)


  deviceCli.commandCallback = myCommandCallback


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



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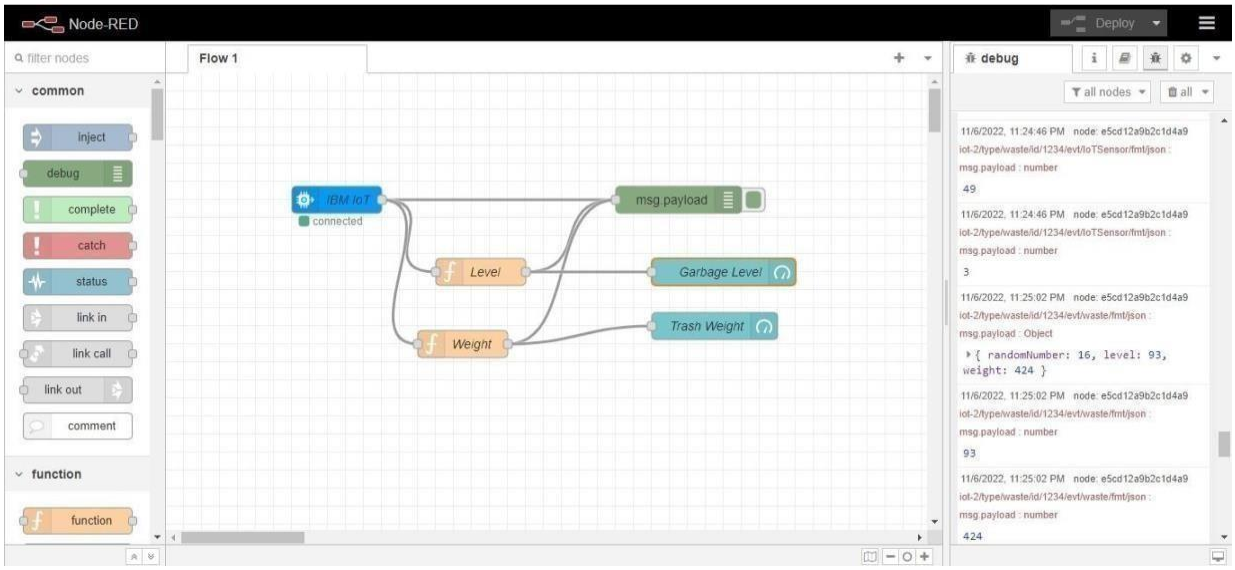
NODE RED INPUT AND OUPUT:



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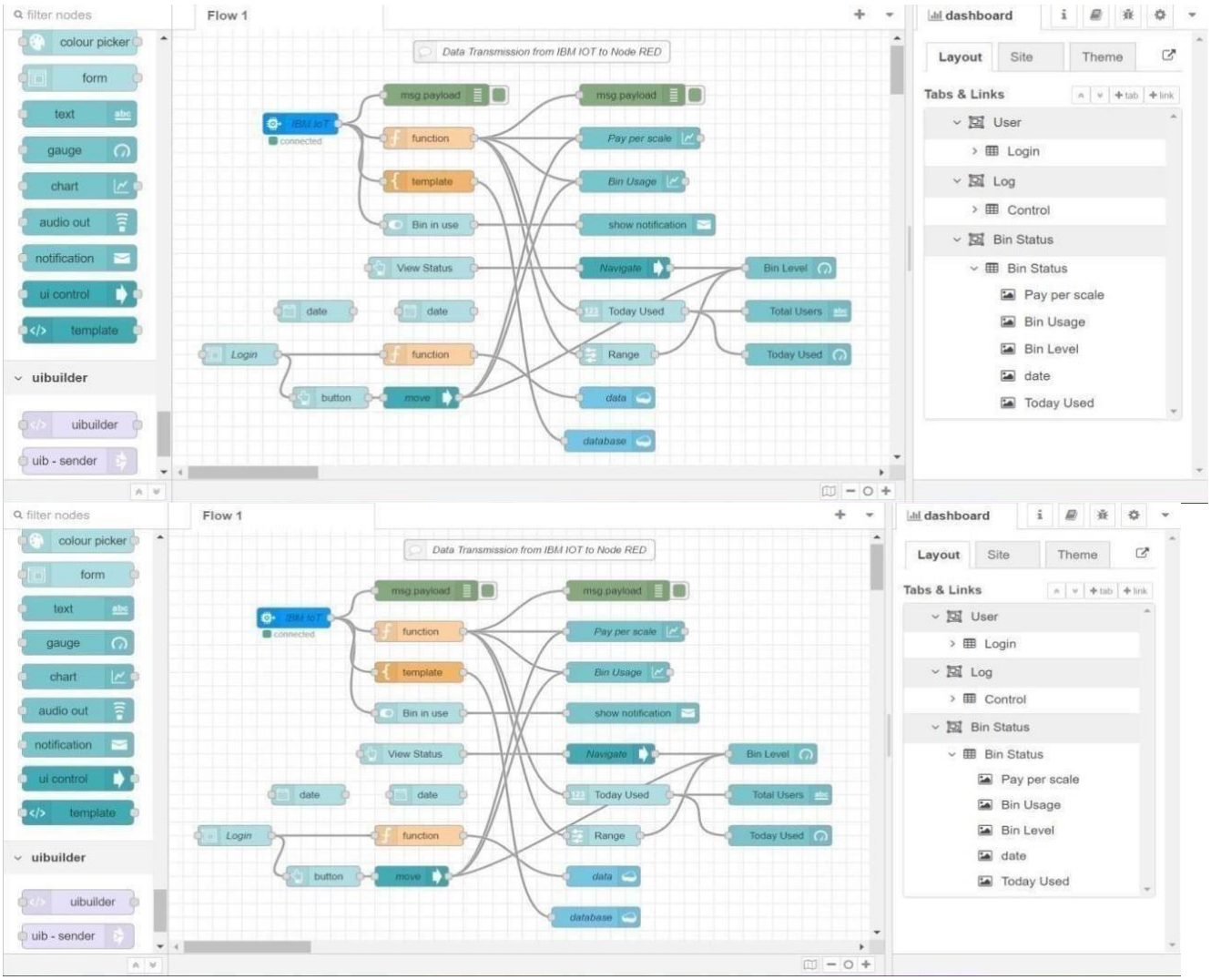
1. Node-RED Connection setup for data transmission from IBM Watson IOT platform to Node-REDdashboard.



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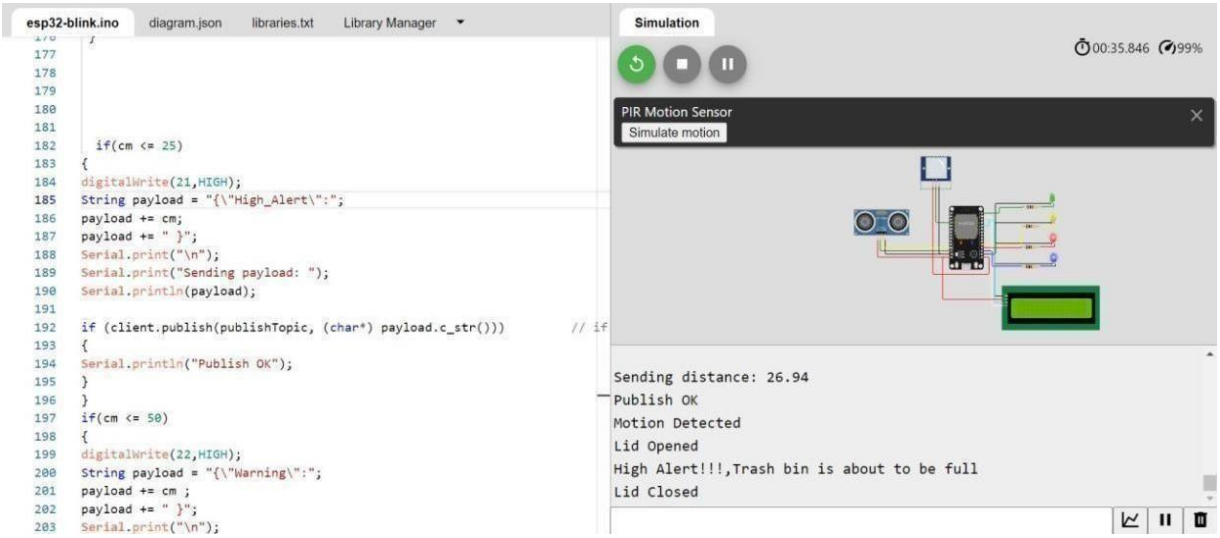
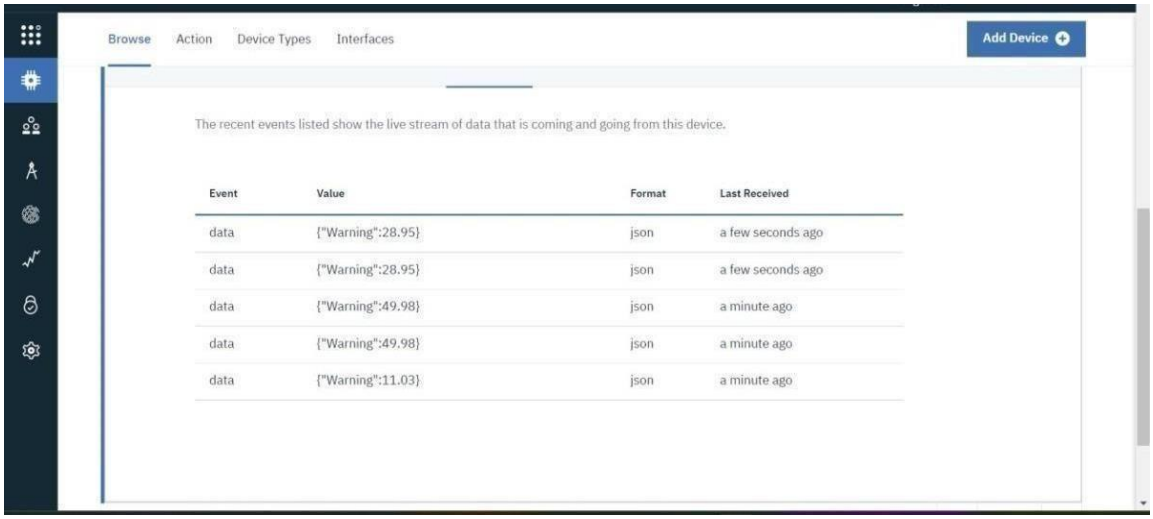
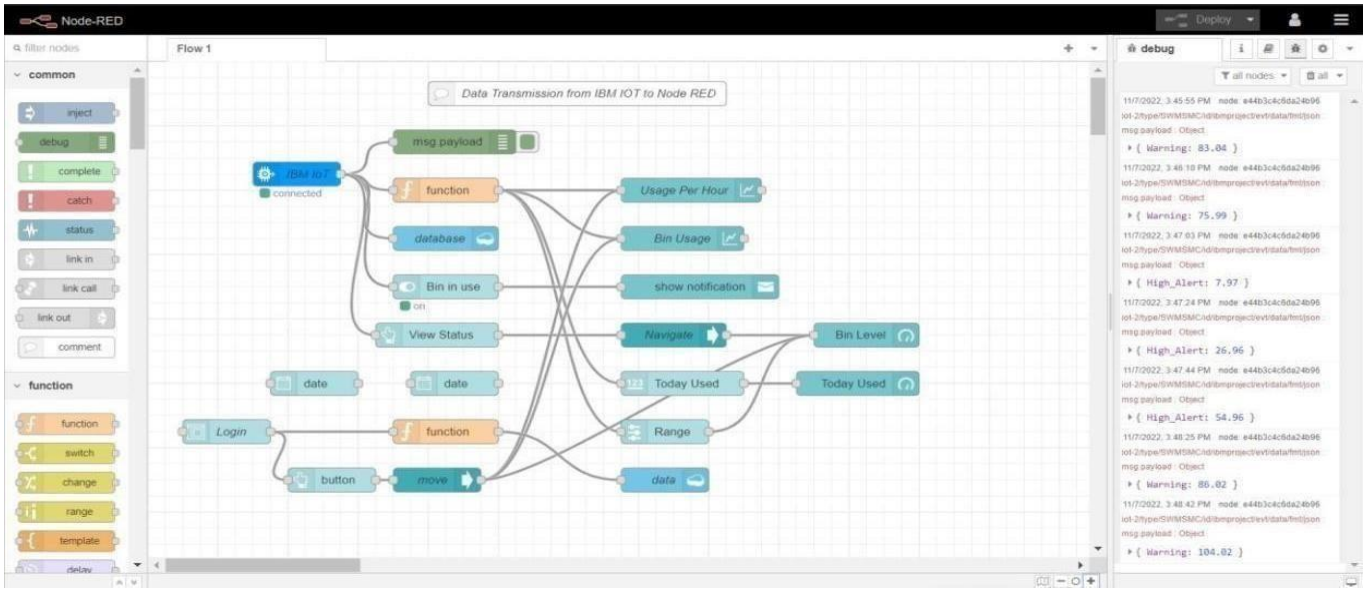
2. Simulate Wokwi connection to transmit data from wokwi account to IBM Watson IOT platform and then toNode Red dashboard.



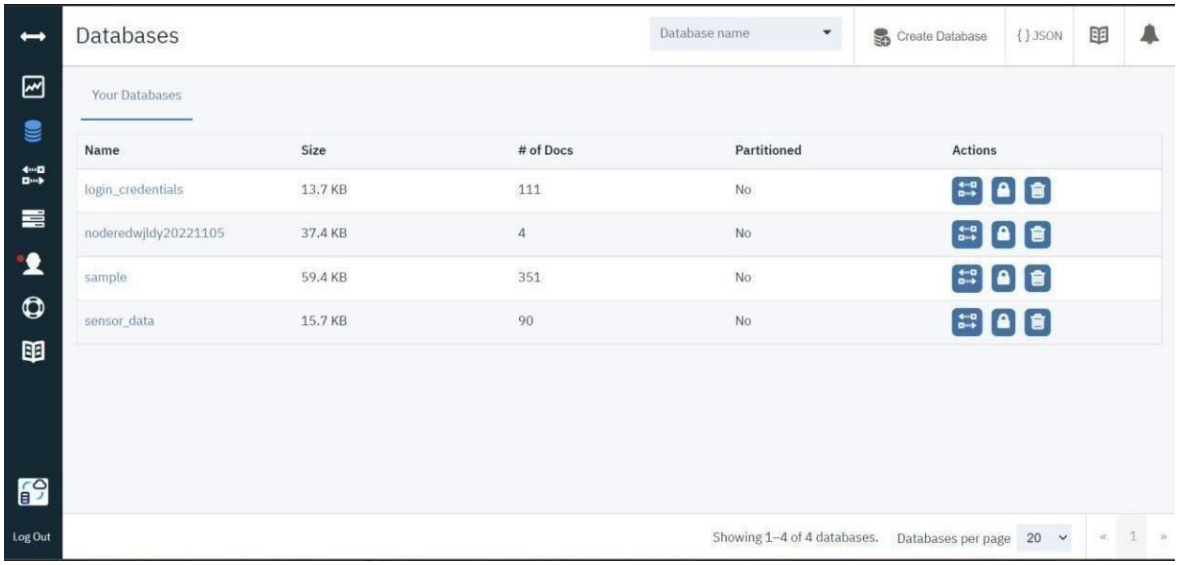
3. Data transfer to Watson IOT platform.

4. Data transfer from IBM Watson IOT platform and wokwi to Node red.





5.Storing database in IBM cloudant DB.



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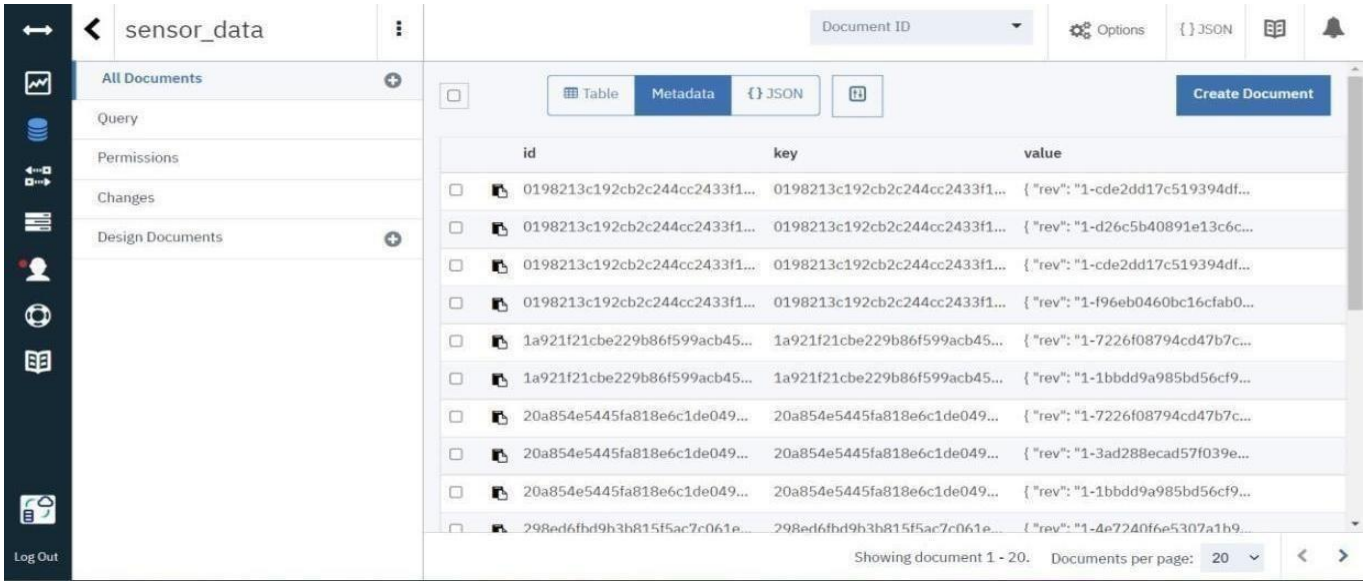
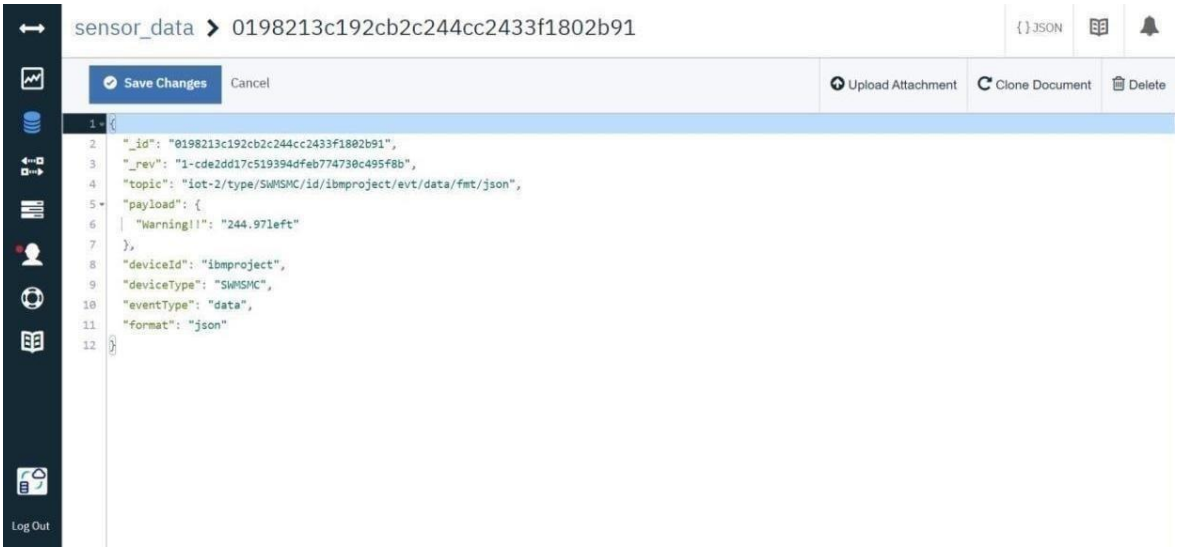
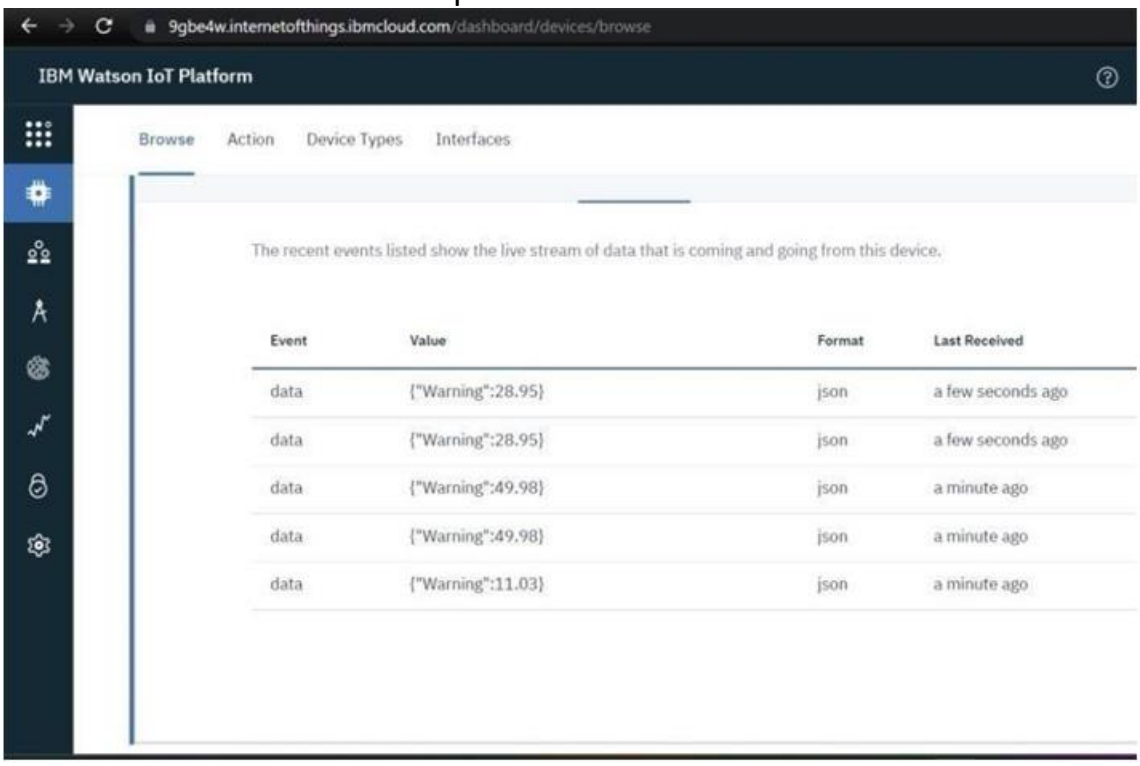


6.Data is stored in JSON format

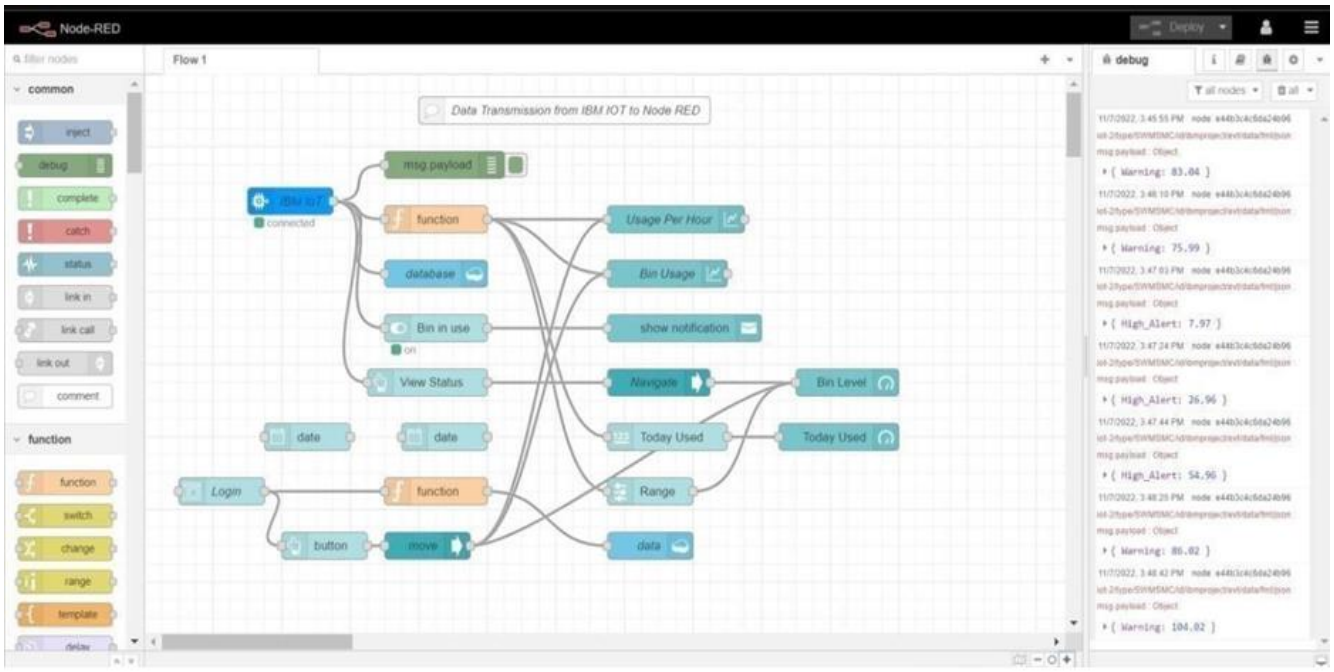


7.Simulate Wokwi connection to transmit data from wokwi account to IBM Watson IOTplatform and then to Node Red dashboard.

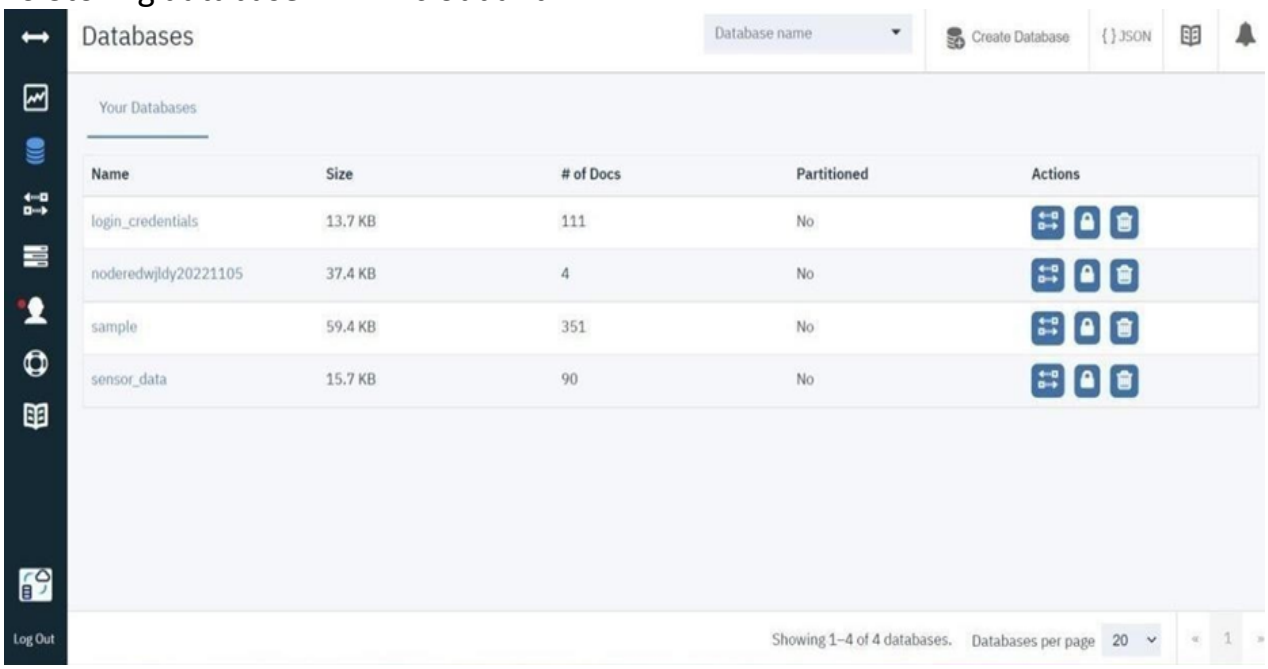
8.Data transfer to Watson IOT platform.

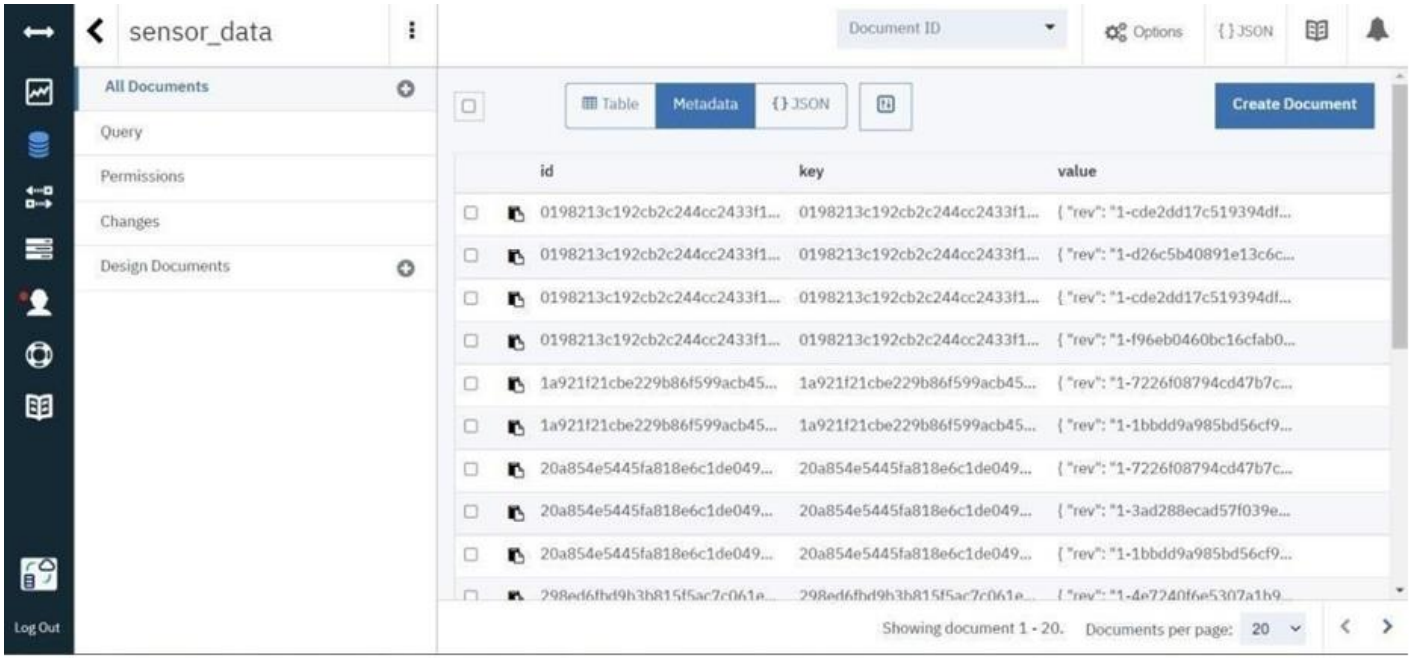


9.Data transfer from IBM Watson IOT platform and wokwi to Node red.

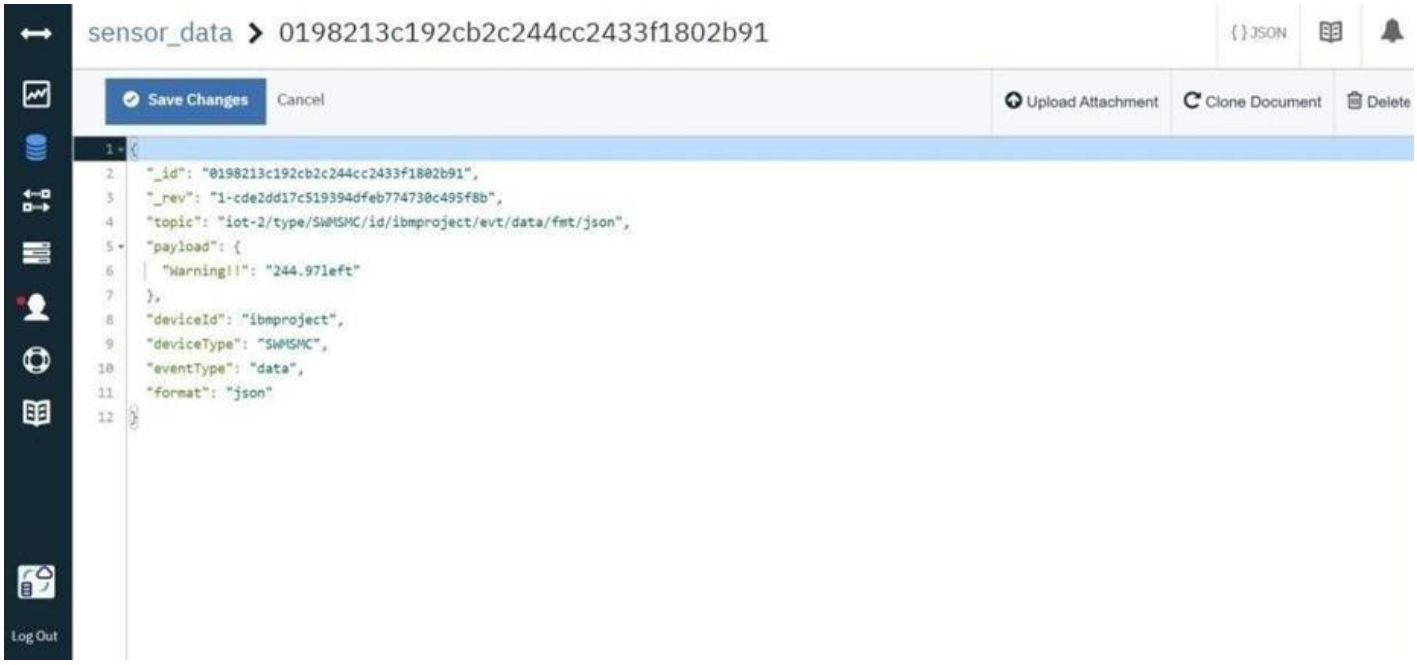


10.Storing database in IBM cloudant DB.





11.Data is stored in JSON format



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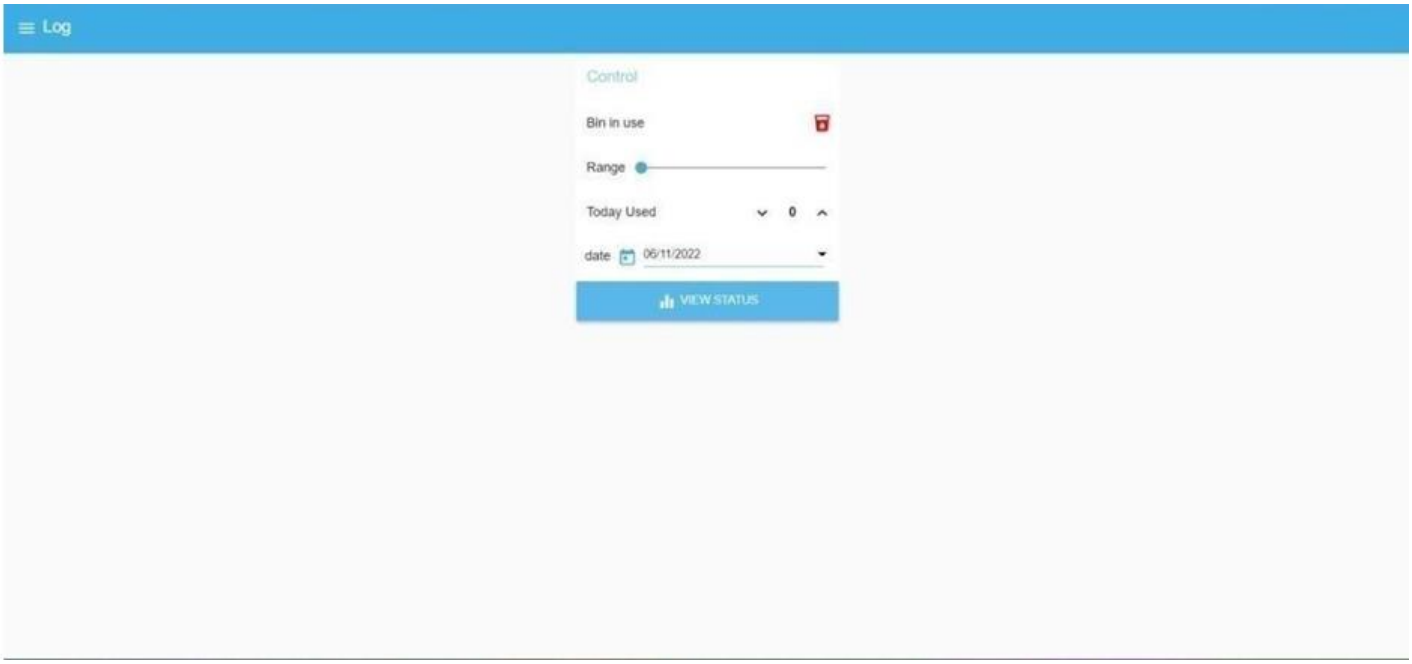
12.Web UI



8.RESULTS

8.1Performance Metrics

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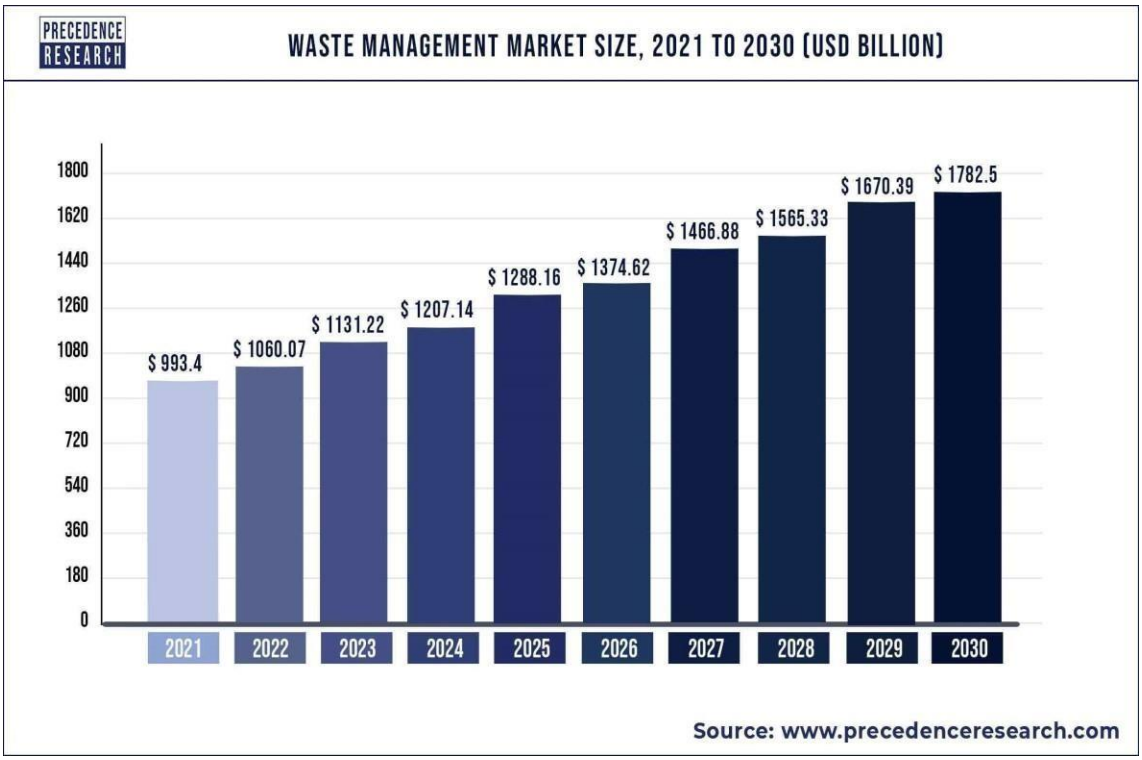

9.ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Reduction in Collection Cost
- No Missed Pickups
- Reduced Overflows
- Waste Generation Analysis
- CO2 Emission Reduction

DISADVANTAGES:

- System requires a greater number of waste bins for separate waste collection as per population in the city.
- This results into 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

12.Appendix

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-10180-1659110107

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