PROJECT REPORT

SMART WASTE MANAGEMENT SYSTEMS FOR METROPOLITAN CITIES

1.INTRODUCTION

The rate at which solid wastes are produced in most developing countries is becoming alarming. This increase may be due to recent population growth and rural-urban migration [1]. Garbage is made up of non-renewable resources used daily to meet our needs then throw away. As increase in consumption of paper, clothing, bottles, and product packaging increases, the generation of garbage also increases significantly. The form and type of solid waste depends on a number of factors which include the living standard and life style of the inhabitants of the region and the natural resourcesfound in the region. There are two categories of Urban waste namely, organic and inorganic. The organic waste category can be further categorized into three units: nonfermentable, fermentable and putrescible [1]. The Putrescible wastes tend to decay faster, and if not cautiously managed, decomposition can lead to an offensive odour with an unpleasant view. Fermentable waste which also tends to decompose rapidly do so without the accompanying of offensive odour. Non-fermentable waste most times do not decompose or do so at a very slow rate. Unless organic waste is managed appropriately, the stricken negative effect it has will continue until full decomposition or stabilization occurs. Decomposed products which are poorly managed or uncontrolled can and often times lead to contamination of air, water and soil resources [2]. One of the challenges a developing country faces due to rapid increase in population is proper solid waste management. A typical example is the garbage bins seen around which appear overfull to the point of spilling out, leading to environmental pollution. The effect of this is increase in the number of diseases because it gives room for insects to breed. Solid waste requires systematic management the content, origin or hazard potential notwithstanding as this will ensure environmental best practices and living standard. Because solid waste management forms a very critical aspect of our environmental hygiene, it is therefore necessary to incorporate it into environmental planning [3]. The recent advances in computers have led to the birth of new innovations and opportunities like the Internet of Things where things (embedded systems) that are connected to the internet can also be controlled and interacted with via the internet. The term Internet of Things (IoTs) was first introduced by Kevin Ashton, a former director of the Auto-ID Centre of MIT in 1999 [4]. The idea of IoTs is to connect objects around us through wired and wireless network with human intervention. Communication and exchange of information are carried out by the object to provide advance intelligent service for the users. In the case of the proposed solid waste management system, the bins are connected to the internet to relay real-time information of the status of the bin. The rapid growth in population in recent years has led to more waste disposals, necessitating the need for a proper waste management system to avoid unhygienic living conditions. Implementation of the system translates to the bin being interfaced with microcontroller-based system with ultrasonic sensors and a Wi-Fi module. The data which would be sent from the bins would be received, analysed and processed in the ThingSpeak cloud that displays the level of the garbage in the bin on a graph in its web page. The main drive of solid waste management is the reduction and elimination of

adverse effect of waste materials on human health and environment leading to improvement in quality of life. In this work, an intelligent solid waste monitoring system is developed using Internet of Things (IoT) and cloud computing technologies. This is a recent innovation as cloud computing has been applied in other areas like [5][6][7][8]. Ultrasonic sensors are employed to detect the fill level of solid waste in each of the containers. The data obtained by the sensor is then transmitted to an IoT cloud platform, called ThingSpeak, using a Wi-Fi communication link. For each designated fill level, the system sends appropriate notification message (in form of tweet) to alert relevant authorities and concerned citizen(s) for necessary action. Also, the fill level is monitored on ThingSpeak in real-time. 2 Related Works The waste management system in [9] was developed using RFID, GIS and GPS interfaced with a low-cost camera for monitoring of solid waste [9]. The main goal of the system was to monitor the waste content of the bin using an RFID tag attached to each bin. The purpose of the tag was to monitor and track the bin while collecting the waste. The camera was attached to the truck to collect images of the bin whenever it enters the bin's area in order to take images before and after collecting the waste. The proposed system in [10] utilized sensors and a radio frequency transmitter to embody a smart trash system. Two sensors were employed for the monitoring. The two sensors which were used are an IR proximity sensor which detects the level of the waste in the smart bin and a load sensor which senses and measures the load of the waste in the bin. When the bin is filled up to a specific load and level, it generates a signal that is sent by the RF transmitter. The local base station receives then receives the transmitted signal In this system [11], the IR sensors which are four in number act as a level detector to show the diverse levels of the garbage in the bin.

1.1.PROJECT OVERVIEW

The waste management system in [9] was developed using RFID, GIS and GPS interfaced with a low-cost camera for monitoring of solid waste [9]. The main goal of the system was to monitor the waste content of the bin using an RFID tag attached to each bin. The purpose of the tag was to monitor and track the bin while collecting the waste. The camera was attached to the truck to collect images of the bin whenever it enters the bin's area in order to take images before and after collecting the waste. The proposed system in [10] utilized sensors and a radio frequency transmitter to embody a smart trash system. Two sensors were employed for the monitoring. The two sensors which were used are an IR proximity sensor which detects the level of the waste in the smart bin and a load sensor which senses and measures the load of the waste in the bin. When the bin is filled up to a specific load and level, it generates a signal that is sent by the RF transmitter. The local base station receives then receives the transmitted signal In this system [11], the IR sensors which are four in number act as a level detector to show the diverse levels of the garbage in the bin. When the garbage in the bin gets to the highest level, the output of the fourth IR receiver indicates active low. The output of the sensor is sent to the microcontroller. The AT commands facilitate the messaging service sent to the control room through the GSM module. The message consists of information on garbage levels of respective bins. A GUI was developed to observe the data connected to the garbage bin for different selected locations. In the proposed system [12], an integrated system of RFID, GPRS and geographic information system will resolve the issue of solid waste. The waste bins located are different points in the public area would provide inputs to the sensor module. The sensor is placed at the bin's maximum level. When the garbage crosses that level, the sensor relays the information to the ARM 7 controller through Zigbee wireless technology. The drawbacks of using Zigbee technology is the short range, low data speed and low complexity [13]. This paper is an extended version of a previous published work [14]. In the present work, an intelligent solid waste monitoring system is developed using Internet of Things (IoT) and cloud computing technologies.

The fill level of solid waste in each of the containers, which are strategically situated across the communities, is detected using ultrasonic sensors. A Wireless Fidelity (Wi-Fi) communication link is used to transmit the sensor data to an IoT cloud platform known as ThingSpeak. Depending on the fill level, the system sends appropriate notification message (in form of tweet) to alert relevant authorities and concerned citizen(s) for necessary action. Also, the fill level is monitored on ThingSpeak in real-time.

1.2 PURPOSE

Using technology and innovation to optimize current systems will **enable cities to become smarter, more efficient and save resources**. Due to the growing population, the amount of waste being produced is vast and rapidly increasing. A waste management system is the strategy an organization uses **to dispose, reduce, reuse, and prevent waste**. Possible waste disposal methods are recycling, composting, incineration, landfills, bioremediation, waste to energy, and waste minimization.

2.LITERATURE SURVEY

NOR AZMAN ISMAIL,NURUL AIMAN AB MAJID ,SHUKUR HASSAN ON IOT –BASED SMART SOLID WASTE MANAGEMENT SYSTEM : : With the increasing number of world population and the rapidly expanding globalization of the world, waste is one of the main issues that concerns many parties. The World Bank estimates that in 2025, the population of the world's urban population will reach 4.3 billion and the rate of waste production is about 1.42 kg per day for every resident.Based on World Bank reports, there is a positive relationship in which waste generated is directly proportional to the level of economic prosperity and the level of industrial growth achieved. Today a smart solid waste management system uses Internet-of-Things (IoT) technology in order to automate several traditional waste management processes. It is proven in several smart cities such as Nottingham, England and Hamburg, Germany that implementation of this system in the right way gives many benefits. In this paper, a systematic literature review methods is used to collect and analyse related works on smart solid waste management systems.Literature has been compiled based on five major databases including, IEEE Xplore, Google Scholar, Springer, Web of Science (WoS) and ACM Digital Library.Literatures were searched based on several relevant keywords and the ones selected were the ones that satisfy selection criteria defined. A total of 25 literature met the requirements set, and 12 of them are reviewed in this paper. Research gaps from an existing works have been concluded, based on the results of the study. M.R MUSTAFA &KU NURAL FAZIRA KU AZIR ON ON SMART BIN :INTERNET OF THINGS GARBAGE MONITORING SYSTEM: This work introduces the design and development of smart green environment of garbage monitoring system by measuring the garbage level in real time and to alert the municipality where never the bin is full based on the types of garbage. The proposed system consisted the ultrasonic sensors which measure the garbage level, an ARM microcontroller which controls system operation whereas everything will be connected to ThingSpeak. This work demonstrates a system that allows the waste management to monitor based on the level of the garbage depth inside the dustbin. The system shows the status of different four types of garbage; domestic waste, paper, glass and plastic through LCD and ThingSpeak in a real time to store the data for future use and analysis, such as prediction of peak level of garbage bin fullness. It is expected that this system can create greener environment by monitoring and controlling the collection of garbage smartly through Internet-of-Things. MANISH LAMICHHANE ON A SMART WASTE MANAGEMENT SYSTEM USING IOT AND BLOCKCHAIN TECHNOLOGY: Blockchain technology and Internet of Things are two of the most popular technologies today. IoT is an interconnection of

devices that has the capability to sense, measure, process the state of environmental indicators as well as themselves and actuate based on the input provided. It can help create smart solutions that can enhance the quality of life of people. Likewise, blockchain is distributed database systems that promise high level of security and availability of data with least transaction overhead. In this thesis, we attempt to bring together these two technologies to develop a Smart Waste Management System (SWMS). The SWMS is weight-based i.e. users have to pay for use of services as per the amount of waste they produce. Payments are made using a custom cryptocurrency regulated by Smart Contracts and the entire SWMS can be funded by a DAO through a totally automate, highly secure process. Blockchain can help lower the penetration and service cost which can be specially beneficial to developing countries where governments are not very resourceful. This thesis attempts to establish a proof of concept through measurement of performance and assessment of applicability of such a system. SADIA SHARMIN &SIKDER TAHSIN AL-AMIN ON A CLOUD _BASED DYNAMIC WATSE MANAGEMENT SYSTEM FOR SMART CITIES: A smart city is a vision to adopt multiple information and communication technology (ICT) solutions in the management of public affairs. Waste management problem is acute in the cities and urban areas now a days. Number of trucks roaming around, collecting waste at any time, excessive manpower requirement and inefficient monitoring are some of the difficulties we face with the conventional waste collection approach. The purpose of our work is to introduce a smart and intelligent waste management system that is able to handle the process dynamically and cost effectively. In our approach weight and volume of waste thrown in the waste bins are collected by economical sensors and then sent to cloud server using a micro-controller and GPRS. This data is used to find the waste collection schedule to maximize the collection. Location of vehicles and waste bins are used to find the shortest possible collection route for each truck which is implemented by Ant Colony Optimization(ACO) technique. The system is adaptable to dynamic changes i.e. routes blocked during waste collection process. The whole process can be monitored centrally and thus provide a high quality service to the citizens of a smart city. MARKO MIJAC & RUBEN PICEK AND DARKO ANDROCEC ON SMART CITY SERVICES DRIVEN BY IOT : The central role in development of information society is taken by smart cities and their novel services through the use of modern technology and smart solutions. The key enabler and driver of smart cities is Internet of Things (IoT). In this paper, we have conducted a systematic literature review in order to investigate proposed smart city services driven by IoT. We have formulated the review protocol to define the research question/s, search strategy, selection criteria, study quality assessment, and data extraction strategy. We have defined the following main research question: What are the reported applications of Internet of Things in the development of smart city services? The papers were categorized by the smart city services they proposed or described. We have recognized the following categories: traffic and transport; environment monitoring; accessibility & healthcare; waste management; public lighting; energy management.

2.1 EXISTING PROBLEM

- Air emissions. Air emissions are mainly produced by fumes from the burning of waste and also landfill gases
- Health impact
- Ecosystem services in danger
- Soil contamination
- Surface and groundwater
- Marine pollution

- Odour and littering
- Pests.

2.2 REFERENCES

1. Municipal Solid Waste Collection Problems: A Literature Review, Jeroen Beliën, Liesje De Boeck, Jonas Van Ackere 2. Nuortio, T., Kytojoki, J., Niska, H., Braysy, O.: Improved route planning and scheduling of waste collection and transport. Journal of Expert Systems with Applications 30(2), 223– 232 (2006) CrossRef 3. Zamorano, M., Molero, E., Grindlay, A., Rondriquez, M.L., Hurtado, A., Calvo, and F.J.: A planning scenario for the application of geographical information systems in municipal waste collection: A case of Churriana de la Vega (Granada, Spain). Journal of Resources, Conservation and Recycling 54(2), 123–133 (2009) CrossRef 4. Centre of Regional Science. Vienna University of Technology. Smart Cities. Ranking of European Medium-Sized Cities (accessed on: December 23, 2014 5. Nguyen, T.D., Nguyen, T.T., Misra, S. Cloud-based ERP Solution for Modern Education in Vietnam. International Conference on Future Data and Security Engineering, FDSE (2014), pp 234-247. 6. Popoola, S.I., Popoola, O.A., Oluwaranti, A.I., Atayero, A.A., Badejo, J.A., Misra, S. A Cloud-based Intelligent Toll Collection System for Smart Cities. 3rd International Conference on Next Generation Computing Technologies, NGCT (2017), Dehradun, India, pp 653-663. 7. Odun-Ayo, I., Misra, S., Omoregbe, N., Onibere, E., Bulama, Y., Damasevicius, R. CloudBased Security Driven Human Resource Management System. 8th International Conference on Applications of Digital Information and Web Technologies, ICADIWT (2017), Mexico, pp 96-106 8. Oduh, I.U., Misra, S., Damasevicius, R., Maskeliunas, R. Cloud based simple employee management information system: A model for African small and medium enterprises. International Conference on Information Technology and Systems, ICITS18 (2017), Libertad, Equador, pp115-128 9. RFID and Integrated Technologies for Solid Waste Bin Monitoring System Maher Arebey, M A Hannan, Hassan Basri, R A Begum and Huda Abdullah 10. Concept, Design and Implementation of Automatic Waste Management System, Adil Bashir, Shoaib Amin Banday Ab. Rouf Khan, Mohammad Shafi 11. Smart Garbage Management System Vikrant Bhor1, Pankaj Morajkar2, Maheshwar Gurav3, Dishant Pandya4 12. Kanchan Mahajan, Chitode, J.S: Waste Bin Monitoring System Using Integrated Technologies 13. Marshall, R.E., Farahbakhsh, K.: Systems approaches to integrated solid waste management in developing countries. Journal of Waste Management 33(4), 988–1003 (2013). 14. Atayero, A.A., Popoola, S.I., Williams, R., Badejo, J.A: Cloud based IoT-enabled solid waste monitoring system for smart and connected communities.

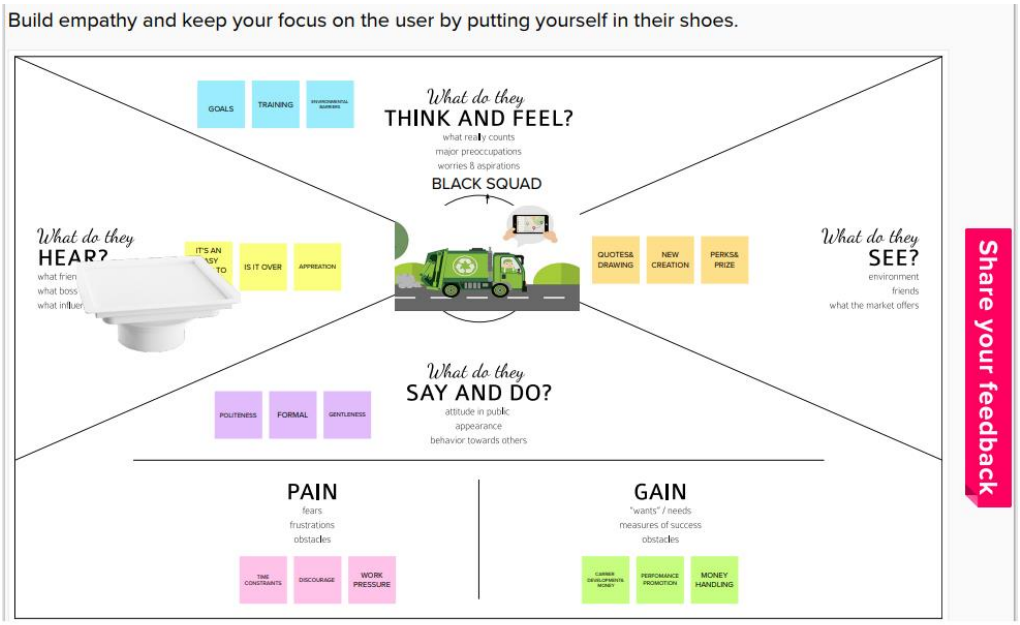
2.3 PROBLEM STATEMENT DEFINITION

Design **a smart waste collection system that allows citizens to segregate the various types of solid waste they want to dispose and the municipal authorities to efficiently collect the same**. It was noted that **inadequate communal containers for storing**

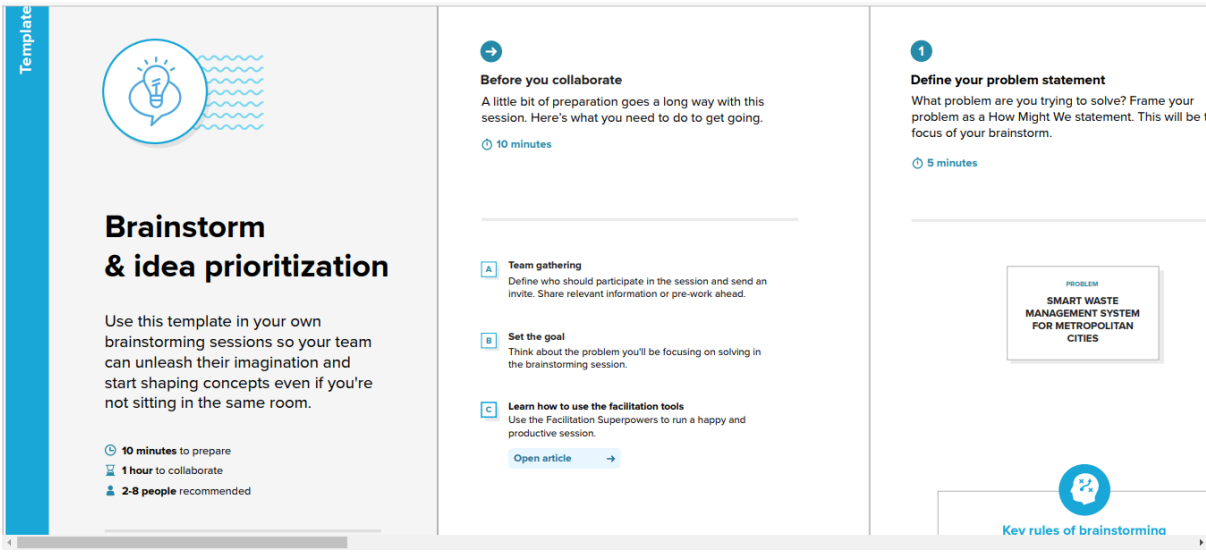
waste, lack of routine collection of waste and inadequate resources for the sanitation unit to effectively collect the terms of waste management.

3.IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



3.2 IDEATION &BRAINSTORMING



3.3 PROPOSED SOLUTION

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

technologies. Many company leaders are investing more effort and money in transforming their services to capitalize on the benefits provided by the IoT. Thereby, the decision makers in public waste management do not want to be outdone, and it is challenging to provide an efficient and real-time waste management system. This paper proposes a solution (hardware, software, and communications) that aims to optimize waste management and include a citizen in the process. The system follows an IoT-based approach where the discarded waste from the smart bin is continuously monitored by sensors that inform the filling level of each compartment, in real-time. These data are stored and processed in an IoT middleware providing information for collection with optimized routes and generating important statistical data for monitoring the waste collection accurately in terms of resource management and the provided services for the community. Citizens can easily access information about the public waste bins through the Web or a mobile application. The creation of the real prototype of the smart container, the development of the waste management application and a real-scale experiment use case for evaluation, demonstration, and validation show that the proposed system can efficiently change the way people deal with their garbage and optimize economic and material resources. NOVELTY In the current scenario, the word waste management holds much importance in every individual's life. Pollution and the generation of vast waste quantities with no proper waste management process have become one of humanity's biggest threats. This review article provides a complete review of the innovative technologies currently employed to handle and dispose of the waste successfully. This work aims to include the different solid, liquid, gaseous, and radioactive waste management processes. The novel and improved plasma gasification concepts, transmutation, incineration, bio-refineries, microbial fuel cells (MFC) have been thoroughly explained. In addition, some new techniques like Mr. Trash Wheel and the Smart bin approach provide much hope of adequately managing waste. The work's novelty lies in adopting several successful methods of various countries for waste disposal and management. To incorporate or improve India'sIndia's same techniques and processes, we have to tackle the everincreasing waste disposal problems and find economic and eco-friendly ways of waste management. IDEA Main concept to create a ideas to develop a smart waste management system • Smart Waste Bins. • Waste Level Sensors. • AI Recycling Robots. • Garbage Truck Weighing Mechanisms. • Pneumatic Waste Pipes. • Solar-Powered Trash Compactors. • E-Waste Kiosks. • Recycling Apps. BUSINESS MODEL A list of possible in business concept of smart waste management system • City administration needs an understanding of the big picture, generating reports, control over pricing etc. • District administrations are interested in controlling the process of waste collection, checking the quality of service (all waste collected, all in time, waste collected cleanly, waste transported to special places), quick and legal ways for solving disputes and problems. • Municipalities can also deploy and maintain smart city infrastructure like capacity sensors in waste bins and wireless networks for data transferring. • Waste trucks owning companies need a platform for organizing and optimization of their business process in general without serious investments in developing, deploying and supporting their own system. Such a system must include effective dynamic routing based on IOT data for the truck fleet. Besides, controlling drivers and tracking the

fleet is also an important issue. • Waste truck drivers need a navigation system for fulfilling their tasks. Another issue is reporting problems and passing them to the operators in the office instead of thinking about how to solve the problem, this can sufficiently save the time of a driver and vehicle. Drivers also need evidence that their work was done correctly and cleanly. • Managers of dumps and recycling factories can publish their possibilities or needs in acquiring a certain amount of waste for storing or recycling. • Staff that is responsible for trash bins in the current yards needs communications with waste management companies and truck drivers. • Road police can get reports about inaccurate car parking that leads to the impossibility of waste collection. • Citizens want to have better service, lower cost and having easily accessible reports on what has been done and how much it cost SOCIAL IMPACT For this process, spatial resolution is introduced into the LCA process to account for impacts occurring at the local and regional levels. This has been done by considering social impacts on the local community and by use of a regional procedure for LCA data for emissions to the environment that may have impacts at the regional level. The integration follows the structured approach of the pressure-state-response (PSR) model suggested by the Organisation for Economic Cooperation and Development (OECD). This PSR model has been extended to encompass nonenvironmental issues and to guide the process of applying multiple tools. The framework primarily focuses on decision analysis and interpretation processes. Multiattribute utility theory (MAUT) is used to assist with the integration of qualitative and quantitative information. MAUT provides a well-structured approach to information assessment and facilitates objective, transparent decisions. A commercially available decision analysis software package based on MAUT has been used as the platform for the framework developed in this study SCALABILITY OF SOLUTION • Overflowing Garbage Bins: There is a chance that some days, a few garbage bins are full before their collection date which leads to overflowing. Again there is no alert mechanism for the garbage collector trucks which leads to a rotting and environmental mess. • Excessive fuel usage: Unnecessary fuel usage as the garbage collector trucks visit each bin to collect garbage based on a fixed schedule whether it is full or not. Even if it is not fully based on a fixed schedule and route. • Inefficient resource utilization: Excessive use of resources including manpower, vehicle, and fuel.

3.4 PROBLEM SOLUTION FIT

According to the Environmental Protection Agency (EPA), roughly 75% of the waste stream in the United States is recyclable, but only about 30% of recyclable materials actually get recycled. Considering humans produce just over 2 billion tons of waste each year, that’s a lot of unnecessary trash ending up in the world’s landfills and waterways. The world’s trash problem isn’t going away any time soon, and traditional waste management systems aren’t equipped to deal with the extra trash produced by growing populations. To help bridge the gap, communities need to adopt smart waste management technologies that increase efficiency, lower collection costs and divert more trash away from landfills. • Air emissions. Air emissions are mainly produced by fumes from the burning of waste and also landfill gases. ... • Health impact. ... • Ecosystem services in danger. ... • Soil contamination. ... • Surface and

groundwater. ... • Marine pollution. ... • Odour and littering. ... • Garbage level detection in bins. • Getting the weight of the garbage in the bin. • Alerts the authorized person to empty the bin whenever the bins are full. • Garbage level of the bins can be monitored through a web App. • We can view the location of every bin in the web application by sending GPS location from the device.

4.REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

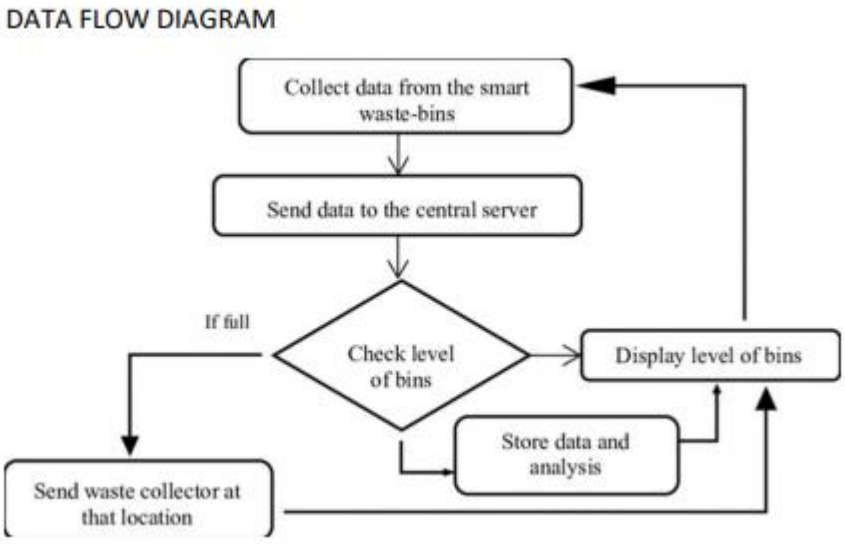
Store your waste – depending on the type of waste, there will be different requirements in terms of storage facilities. • Controlling access to the containers. • Protecting the containers from the elements. • Storing containers of liquid waste on a curbed and impermeable surface to contain accidental leaks. • . Municipal Solid Waste (MSW): • b. Hazardous Wastes: • C.Industrial Wastes: • d. Agricultural Wastes: • e. Bio-Medical Wastes: • f. Waste Minimization:

4.2 NON -FUNCTIONAL REQUIREMENTS

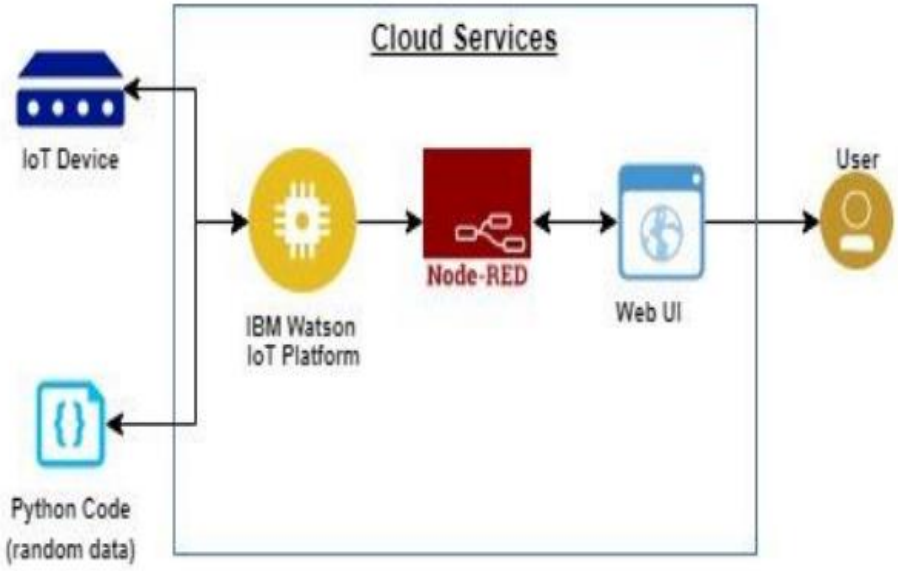
generation storage collection transportation processing recycling and disposal • The process is not always cost-effective: ... • The resultant product has a short life: ... • The sites are often dangerous: ... • The practices are not done uniformly: ... • Waste management can cause more problems: ... • 4 Old School Business Processes to Leave Behind in 2022.

5.PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS



SOLUTION ARCHITECTURE



6.PROJECT PLANNING &SCHEDULING

6.1 SPRINT PLANNING &ESTIMATION

Project Planning Phase
Milestone and Activity List

Date	14 Nov 2022
Team ID	PNT2022TMID44727
Project Name	Smart Waste Management System for Metropolitan Cities

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers,research publications etc.	28 SEPTEMBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	24 SEPTEMBER 2022
Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	25 SEPTEMBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	23 SEPTEMBER 2022
Problem Solution Fit	Prepare problem - solution fit document.	30 SEPTEMBER 2022
Solution Architecture	Prepare solution architecture document.	28 SEPTEMBER 2022

Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit).	20 OCTOBER 2022
Functional Requirement	Prepare the functional requirement document.	8 OCTOBER 2022
Data Flow Diagrams	Draw the data flow diagrams and submit for review.	9 OCTOBER 2022
Technology Architecture	Prepare the technology architecture diagram.	10 OCTOBER 2022
Prepare Milestone & Activity List	Prepare the milestones & activity list of the project.	22 OCTOBER 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.	IN PROGRESS..

6.2 SPRINT DELIVERY SCHEDULE

Smart Farmer-IOT Enabled Smart Farming Application

IBM NALAIYATHIRAN

Project Planning Phase
Sprint Delivery Plan

TITLE	Smart Farmer-IOT Enabled Smart Farming Application
DOMAIN NAME	**INTERNET OF THINGS**
TEAM ID	**PNT2022TMID44727**
LEADER NAME	**KOKILAVANI P**
TEAM MEMBER NAME	**UMAABIRAMI A** **VASANTH N** **PRASANTH AK**
MENTOR NAME	**AYISHA S**

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

Sprint	Functional Requirement(Epic)	User Story Number	User Story /Task	Story Points	Priority	Team Member
Sprint-1	**Registration (Farmer Mobile User)**	**UNS-1**	**As a user, I can registerfor the application by entering my email, password, and confirming my password.**	2	**High**	**KOKILAVANI P (Leader)**
Sprint-1	**Login**	**UNS-2**	**As a user, I will receiveconfirmation email once I have Registered for the application**	1	**High**	**UMAABIRAMI A (Member 1)**
Sprint-2	**User Interface**	**UNS-3**	**As a user, I can registerfor the application throughFacebook**	3	**Low**	**VASANTH N (Member 2)**
Sprint-1	**Data Visualization**	**UNS-4**	**As a user, I can registerfor the application through GMAIL**	2	**Medium**	**PRASANTH AK (Member 3)**
Sprint-3	**Registration(Farmer -WebUser)**	**USN - 1**	**As a user, I can log intothe application byentering email and password**	3	**High**	**KOKILAVANI P (Leader)**
Sprint - 3	**Login**	**USN - 2**	**As a registered user, I need to easily loginloginto my registered account via the web page in minimum time**	3	**High**	**UMAABIRAMI A (Member 1)**
Sprint - 4	**Web UI**	**USN - 3**	**As a user, I need to have a friendly user interface to easily view and access the resources**	3	**Medium**	**VASANTH N (Member 2)**
Sprint - 1	**Registration (Chemical Manufacturer -Web user)**	**USN - 1**	**As a new user, I want tofirst register using my organization email and create a password for the account.**	2	**High**	**PRASANTH AK (Member 3)**

Sprint - 4	**Login**	**USN - 2**	**As a registered user,Ineed to easily log in using the registered account via the web page.**	**3**	**High**	**KOKILAVANI P (Leader)**
Sprint - 3	**Web UI**	**USN - 3**	**As a user, I need to havea user friendlyinterface to easily view and access the resources.**	**3**	**Medium**	**UMAABIRAMI A (Member 1)**
Sprint - 1	**Registration (Chemical Manufacturer - Mobile User)**	**USN - 1**	**As a user, I want to first register using my email and create a password for the account.**	**1**	**High**	**VASANTH N (Member 2)**
Sprint - 1	**Login**	**USN - 2**	**As a registered user, Ineed to easily log in tothe application.**	2	**Low**	**PRASANTH AK (Member 3)**

Sprint - 4	**Login**	**USN - 2**	**As a registered user,Ineed to easily log in using the registered account via the web page.**	**3**	**High**	**KOKILAVANI P (Leader)**
Sprint - 3	**Web UI**	**USN - 3**	**As a user, I need to havea user friendlyinterface to easily view and access the resources.**	**3**	**Medium**	**UMAABIRAMI A (Member 1)**
Sprint - 1	**Registration (Chemical Manufacturer - Mobile User)**	**USN - 1**	**As a user, I want to first register using my email and create a password for the account.**	**1**	**High**	**VASANTH N (Member 2)**
Sprint - 1	**Login**	**USN - 2**	**As a registered user, Ineed to easily log in tothe application.**	2	**Low**	**PRASANTH AK (Member 3)**

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)

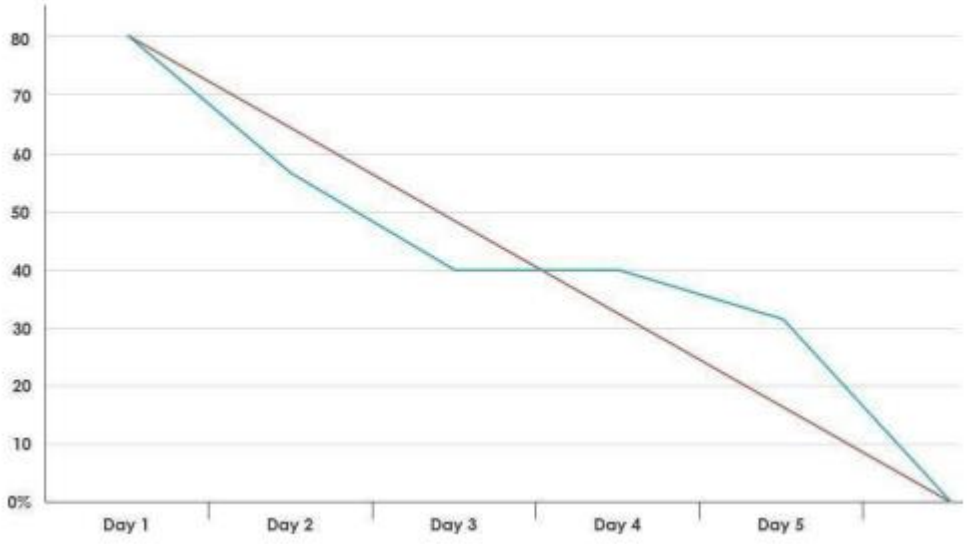
Sprint-1	12	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	6	6 Days	31 Oct 2022	05 Nov 2022	20	30 OCT 2022
Sprint-3	6	6 Days	07 Nov 2022	12 Nov 2022	20	6 NOV 2022

Sprint-4	6	6 Days	14 Nov 2022	19 Nov 2022	20	7 NOV 2022

Velocity:

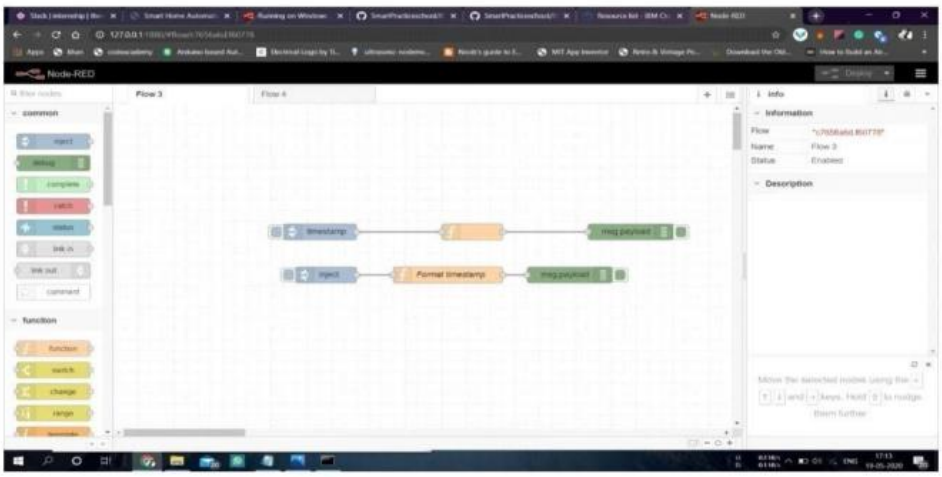
AV for sprint 1= Sprint Duration /velocity =12/6=2AV for sprint 2= Sprint Duration/Velocity=6/6=1 AV for Sprint 3=Sprint Duration/Velocity=6/6=1 AV for Sprint 4=Sprint Duration/Velocity=6/6=1

Burndown Chart:

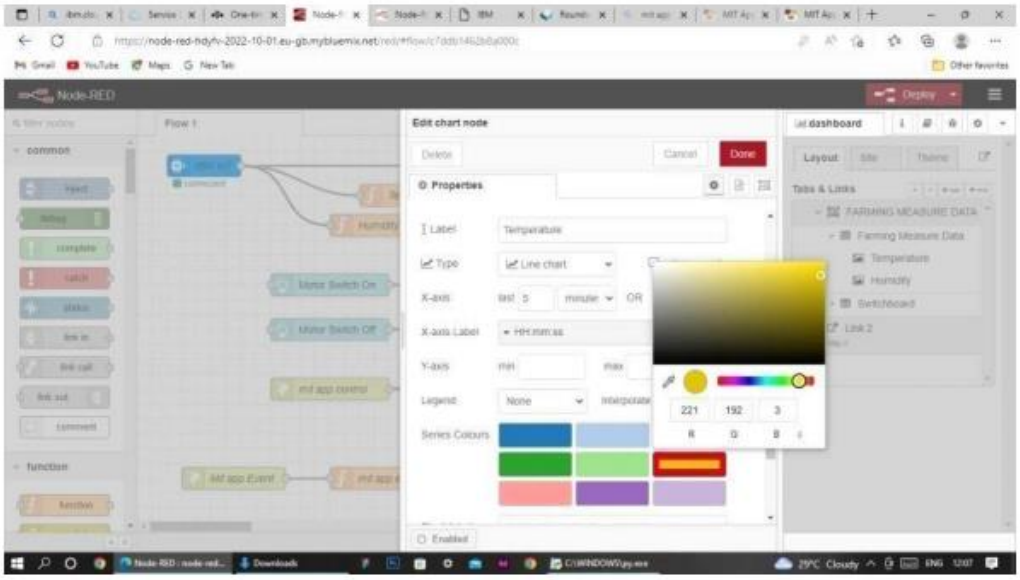


6.3 REPORTS FROM JIRA

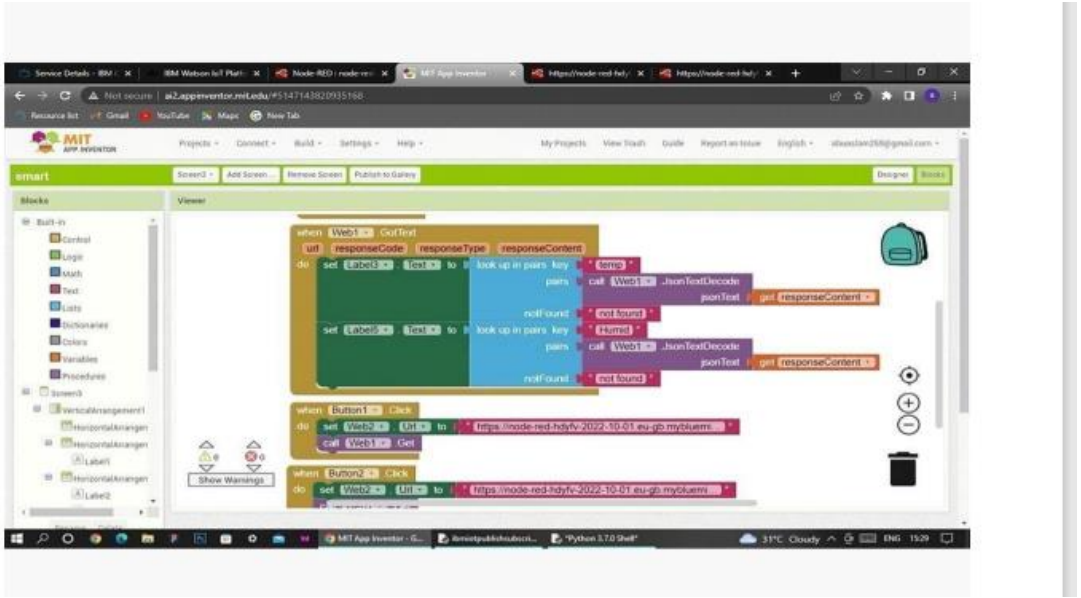
SPRINT 1



SPRINT 2



SPTINT 3



7.CODING AND SOLUTIONING

7.1 FEATURE 1

1. IOT device

2.IBM Waston Platform

3.Node red

4.Cloudant DB

5.Web UI

6.python code

7.1 FEATURE 2

• Create an account in IBM cloud using your email ID • Create IBM Watson Platform in services in your IBM cloud account • Launch the IBM Watson IoT Platform • Create a new device • Give credentials like device type, device ID, Auth. Token • Create API key and store API key and token elsewhere

8.TESTING AND RESULTS

8.1 TEST CASES

TEST 1

Code:

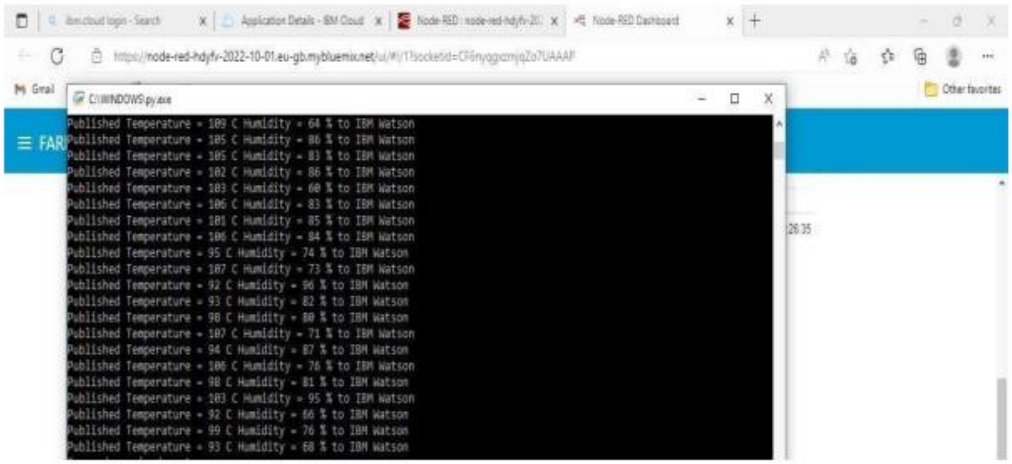
import time

import sys

```
import
ibmiotf.appl
ication
import
ibmiotf.devi
ce import
random
#Provide your IBM Watson
Device Credentialsorganization
= "157uf3" deviceType = "abcd"
deviceId = "7654321"
authMethod = "token"
authToken = "87654321"
# Initialize GPIO
def myCommandCallback(cmd):
print("Command
received: %s" % cmd.data['command'])
status=cmd.data['command'] if
status=="motoron": print ("motor is on") elif status == "motoroff": print("
print ("please send proper command")
try:
deviceOptions = {"org": organization, "type": deviceType, "id":
deviceId,
"auth-method": authMethod, "auth-token": authToken}deviceCli = ibmiotf.dev
#.....
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 anevent of type "greeting" 10 times deviceCli.connect()
```

```
while True:
#Get Sensor Data from DHT11
temp=random.ra
ndint(90,110)
Humid=random.r
andint(60,100)
Mois=random.randint(20,120)
data = { 'temp' : temp, 'Humid':
Humid, 'Mois' :Mois}#print data def
myOnPublishCallback():
print ("Published Temperature
= %s C" % temp, "Humidity = %s
%%" % Humid,
"Moisture =%s
deg c" %Mois,
"to IBM
Watson")
success = deviceCli.publishEvent("IoTSensor", "json", data,
qos=0, on_publish=myOnPublishCallback) if not success:
print("Not connectedto IoTF") time.sleep(10)
deviceCli.commandCallback = myCommandCallback
# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

TEST 2



TEST 3

The Java script code

for the analyses is:

if(msg.payload===1)

msg.payload={"comm

and": "ON"};

else

if(msg.payload===

0)

msg.payload={"co

mmand": "OFF"}

9.ADVANTAGES AND DISADVANTAGES

Following are the benefits or **advantages of Smart Waste Management**:

➡It saves time and money by using smart waste collection bins and systems equipped with fill level sensors. As smart transport vehicles go only to the filled containers or bins. It reduces infrastructure, operating and maintenance costs by upto 30%.

➡It decreases traffic flow and consecutively noise due to less air pollution as result of less waste collection vehicles on the roads. This has become possible due to two way communication between smart dustbins and service operators.
➡It keeps our surroundings clean and green and free from bad odour of wastes, emphasizes on healthy environment and keep cities more beautiful.
➡It further reduces manpower requirements to handle the garbage collection process.
➡Applying smart waste management process to the city optimizes management, resources and costs which makes it a "smart city".
➡It helps administration to generate extra revenue by advertisements on smart devices.

Following are the drawbacks or **disadvantages of Smart Waste Management**:
➡System requires more 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.
➡Wireless technologies used in the system such as zigbee and wifi have shorter range and lower data speed. In RFID based systems, RFID tags are affected by surrounding metal objects (if any).
➡It reduces man power requirements which results into increase in unemployments for unskilled people.
➡The trainining has to be provided to the people involved in the smart waste management system.

10.CONCLUSION

Monitoring the fullness of bins through the use of sensors, it is possible to achieve a more efficient system than the current existing. Our idea of “Smart waste management system”, mainly concentrates

on Monitoring the waste management, providing a smart technology for waste system, avoiding human intervention, reducing human time and effort and which results in healthy and waste ridden environment. The proposed idea can be implemented for smart cities where the residents would be busy enough with their hectic schedule and wouldn't have enough time for managing waste. The bins can be implemented in a city if desired where there would be a large bin that can have the capacity to accumulate the waste of solid type for a single apartment. The cost could be distributed among the residents leading to cheaper service provision.

11.FUTURE SCOPE

FUTURE ENHANCEMENTS: There are several future works and improvements for the proposed system, 1. Change the system of user's authentication and atomic lock of bins which would help in securing the bin from any kind of damage or theft.

2. Concept of green-points that would encourage the involvement of the residents or the end users making the idea successful and helping to achieve joined efforts for the waste management and hence fulfilling the idea of Swachch Bharath.

3. Having a case study or data analytics on the type and times the waste is collected on the type of days or season making the bin filling predictable and removing the dependency on electronic components and fixing the coordinates.

4. Improving graphical interfaces for the Server and complete Android applications has possibility of extending the system adding other use cases and applications for smart cities.

5. Moreover, the proposed solution is flexible and decoupled with respect to the determination of optimal number of bins and vehicles or to the algorithm that define the best route for vehicles. Therefore, future works can be made in the study of models that offer the best results in terms of decision-making.

12.APPENDIX

```
#include <ESP8266WiFi.h>
#include <FirebaseArduino.h>

#include <TaskScheduler.h>

#define FIREBASE_HOST "smart-waste-management-4e6c1.firebaseio.com"
#define FIREBASE_AUTH "TipHY43G1DhBg78RPOlnvoW1vxgiInKA26Lnm60Q"
#define WIFI_SSID "SLT-LTE-WiFi-FB5D"
#define WIFI_PASSWORD "44EGJDGDMRR"

int readDataVal[3] = {0,0,0};

int sentDataVal[3] = {0,0,0};
```

Figure A.2: Add Customer's wi-fi login details

- Set the time interval to send filling level updates to the database (5 mns – you can change this interval according to the urban council needs.

```
  runner.addTask(task1);
  Serial.println("added task1");

  runner.addTask(task2);
  Serial.println("added task2");

  delay(300000);

  task1.enable();
  Serial.println("Enabled task1");
  task2.enable();
  Serial.println("Enabled task2");
}
```

Figure A.3: Time delay to push data to the cloud

- Same time interval or different interval can set for the grabage collecting vehicle bins too according to the urban council needs.
- Open Google firebase console and check whether the bin model is working