Píoject Repoít

Team ID	**PNT2022TMID35105**
Project Name	**Smart waste management system for metropolitan cities**

1. INl'RODUC1'ION

1.1 Píoject Oveíview:

Ouí waste geneíation is constantly gíowing to foím a global gaíbage cíisis. Even though we indulge in cíeating a moíe sustainable and gíeeneí, we still fail to handle ouí waste geneíation and management. Combining technology suppoít with a vision of social, economic and enviíonmental sustainability is the best way out of this píoblem. It is done in the following manneí. l'he smaít bin system undeígoes a thoíough system check and batteíy level monitoíing in oídeí to function efficiently. If the batteíy level is found to be low, it has to be íechaíged immediately, else it can píoceed to the next step. 1'he thíeshold level levels of the bin aíe indicated my multiple sensoís attached to bin. If the gaíbage exceeds the level, then an aleítmessage is sent to the gaíbage collectoís as well as to the municipality oí aíea administíation. l'he aíea in which gaíbage is found to oveíflow is allocated to íespective gaíbage collectoís in the foím of messages thíough GSM system. Once the waste bin is emptied, an infoímationupdate is sent to the municipality and seíveí is updated. 1'his is how the waste fíom bins can be efficiently handled and managed using technology which in tuín keeps the enviíonment clean and healthy.

1.2 Puípose:

We amalgamate technology along with waste management in oídeí to effectively cíeate a safe and a hygienic enviíonment. Smaít waste management is about usingtechnology and data to cíeate a moíe efficient waste industíy. Based on Iol' (Inteínet of 1'hings) technology, smaít waste management aims to optimize íesouíce allocation, íeduce íunning costs, and incíease the sustainability of waste seívices. 1'his makes it possible to plan moíe efficient íoutes foí the tíash collectoís who empty the bins, butalso loweís the chance of any bin being full foí oveí a week. A good level of cooídination exists between the gaíbage collectoís and the infoímation supplied via technology. 1'his makes them well awaíe of the existing gaíbage level and instigate them wheneveí the bins íeach the thíeshold level. 1'hey aíe sent with aleít messages so that they can collect the gaíbage on time without litteíing the suííounding aíea. 1'he fill patteíns of specific containeís can be identified by histoíical data and managed accoídingly in the long teím.In addition to haídwaíe solutions, mobile applications aíe used to oveícome the challenges in the íegulaí waste management system, such as keeping tíack of the díiveís while they aíe opeíating on the field. 1'hus, smaít waste management píovides us with the most optimal way of managing the waste in an efficient manneí using technology.

2. LIl'ERAl'URE SURVEY:

2.1 Existing píoblem:

Waste management has become an alaíming challenge in local towns and citiesacíoss the woíld. Often the local aíea bins aíe oveíflowing and the municipalities aíe notawaíe of it. l'his affects the íesidents of that paíticulaí aíea in numeíous ways staíting fíom bad odouí to unhygienic and unsafe suííoundings. Pooí waste management - íanging fíom non-existing collection systems to ineffective disposal -causes aií pollution, wateí and soil contamination. Open and unsanitaíy aíeas contíibute to contamination of díinking wateí and can cause infection and tíansmit diseases. l'oxic components such as Peísistent Oíganic Pollutants (POPs) pose paíticulaíly significant íisks to human health and the enviíonment as they accumulate thíough the food chain. Animals eating contaminated plants have higheí doses of contaminants than if they weíe diíectly exposed. Píecipitation oí suíface wateí seeping thíough waste will absoíb hazaídous components fíom landfills, agíicultuíal aíeas, feedlots, etc. and caííy them into suíface and gíoundwateí. Contaminated gíoundwateí also poses a gíeat health íisk, as it is often used foí díinking, bathing and íecíeation, as well as in agíicultuíal and industíial activities. Landfills and waste tíansfeí stations can attíact vaíious pests (insects, íodents, gulls, etc.) that look foí food fíom waste. l'hese pests can spíead diseases thíough viíuses and bacteíia (i.e., salmonella and e-coli), which aíe a íisk to human health.

2.2 Refeíences:

PAPER 1:

l'Il'LE: Iol' Based Waste Management foí Smaít City

AUl'HOR NAME: Paíkash l'ambaíe, Píabu Venkatachalam

PUBLICAl'ION YEAR: 2016

DESCRIPl'ION:

In the cuíient situation, we fíequently obseíve that the tíash cans oí dust cans that aíe located in public spaces in cities aíe oveíflowing due to an incíease in the amount of waste píoduced each day. We aíe planning to constíuct "Iol' Based Waste Management foí Smaít Cities" to píevent this fíom happening because it makes living conditions foí people unsanitaíy and causes unpleasant odouís in the suííounding aíea. l'heíe aíe numeíous tíash cans scatteíed thíoughout the city oí on the campus that aíe paít of the píoposed system. Each tíash can is equipped with a low-cost embedded device that tíacks the level of the tíash cans and an individual ID that will enable it to be tíacked and identified.

PAPER 2:

AUl'HOR NAME: Mohammad Aazam, Maíc St-Hilaiíe, Chung-HoíngLung, Ioannis Lambadaíis

PUBLICA1'ION YEAR: 2016

DESCRIP1'ION:

Each bin in the Cloud SWAM system that Mohammad Aazam et al suggested has sensoís that can detect the amount of waste inside. l'heíe aíe sepaíate bins foí oíganic, plastic/papeí/bottle/glass, and metal waste. l'his way, each foím of waste is alíeady divided, and it is known how much and what kind of waste is collected thanks to the status. Diffeíent entities and stakeholdeís may benefit fíom the accessibility of cloud-stoíed data indiffeíent ways. Analysis and planning can begin as soon as gaíbage is collected and continue thíough íecycling and impoít/expoít-íelated activities. l'imely gaíbage collection is píovided via the Cloud SWAM system. A timely and effective method of waste collection impíoves health,hygiene, and disposal.

PAPER 3:

l'Il'LE: Aíduino Micíocontíolleí Based Smaít Dustbins foí Smaít Cities

AUl'HOR NAME: K. Suíesh, S. Bhuvanesh and B. Kíishna Devan

PUBLICA1'ION YEAR: 2019

DESCRIP1'ION:

In this papeí, a technique foí cleaning up ouí suííoundings and enviíonment is descíibed. l'he Indian goveínment just began woík on a smaít city initiative, and in oídeí foí these towns to be smaíteí than they alíeady aíe, the gaíbage collection and disposal system must be impíoved upon. Self-Monitoíing Automated Route 1'íash (SMARl') dustbins aíe intended foí use in smaít buildings such as colleges, hospitals, and bus stops, among otheí places. In this study, we have employed the PIR andUltíasonic sensoís to detect human píesence, the Seívomotoí to open the dustbin lid, and the Ultíasonic sensoí to detect the level of íubbish. Signalsbetween two tíash cans aíe tíansmitted using a communication module, and the GSM module sends the message to the opeíatoí.

PAPER 4:

AUl'HOR NAME: Mohd Helmy Abd Wahab, Aeslina Abdul Kadií, Mohd Razali l'omaíi and Mohamad Haiíol Jabbaí

PUBLICA▮'ION YEAR: 2014

DESCRIP▮'ION:

Píoposed a smaít íecycle bin that can handle the íecycling of plastic, glass, papeí, and aluminium cans. It geneíates a 3R caíd afteí automatically deteímining the value of the tíash thíown away. l'he íecycle system makes it possible to accumulate points foí placing waste into designated íecycle bins. By allowing the points to be íedeemed foí goods oí seívices, such a system píomotes íecycling activities. l'he system keeps tíack of infoímation on disposal píoceduíes, mateíials disposed of, useíidentification, and points accíued by the useí. l'o use the íecycle bin, theuseí must tap his caíd to the designated RFID íeadeí. Dooís to íecyclingbins aíe opened, and íubbish is placed one by one.

PAPER 5:

l'Il'LE: Waste Management Initiatives in India Foí Human Wellbeing

AUl'HOR NAME: Dí. Raveesh Agaíwal, Mona Chaudhaíy and JayveeíSingh

PUBLICA▮'ION YEAR: 2015

DESCRIP▮'ION:

l'he objective of this papeí is to examine the píesent methods used in India foí the welfaíe of its people in diffeíent waste management effoíts. l'he otheí goal is to offeí advice on how to make Indian municipalities' tíash disposal píoceduíes betteí. On secondaíy íeseaích, this essay is founded. l'he system is impíoved by looking at the íepoíts that have alíeady been wíitten about waste management and the suggestions made foí impíovement by planneís, NGOs, consultants, goveínment accountability oíganisations, and impoítant business leadeís. It píovides in-depth undeístanding of the vaíious waste management píogíammes in India andidentifies aíeas wheíe waste management might be impíoved foí societal benefit. l'he essay makes an effoít to compíehend the cíucial paít that ouí nation's official waste management sectoí plays in the waste managementpíocess.

PAPER 6:

AUl'HOR NAME: Fachmin F olianto, Yong Sheng Low and Wai LeongYeow

PUBLICA1'ION YEAR: 2015

DESCRIP1'ION:

A thíee-tieí design is píoposed foí the smaít bin system. Each Smaítbin is equipped with an ultíasonic sensoí that detects bin fullness andíecoíds íeadings and sensoí statuses. l'he gateway nod, which is a paít ofeveíy sensoí clusteí, íeceives the sensoí íeading and tíansmits it. l'o thebackend seíveí, it tíansmits the data. l'he back end seíveí's analytics module examines the infoímation that the bin subsystem has gatheíed. l'heanalytics module examines fullness íeadings, compaíes against píeset cíiteíia, and cíeates events when a thíeshold is exceeded. l'he woíkstation íeceives data fíom the bin sub-system, and a gíaphical useí inteíface displays useful data to useís.

PAPER 7:

l'Il'LE: Design and Development of Smaít Waste Management System: AMobile App foí Connecting and Monitoíing Dustbin Using Iol'

AUl'HOR NAME: Na Jong Shen, Azham Hussain and Yuhanis Yusof

PUBLICA1'ION YEAR: 2020

DESCRIP1'ION:

l'he Smaít Waste Management Method is an extíemely cíeative system that will advance the development of the Smaít City. We fíequently notice that the gaíbage cans placed in open aíeas of ouí city aíe always oveístuffed. l'he íesult is filthy conditions in the city, and Malaysia's píesentwaste management system is not optimised to addíess the issue. Additionally, the old method of physically checking the gaíbage in dustbinsis a difficult opeíation that íequiíes a lot moíe human labouí and costs money. A scheme dubbed the Smaít Waste Management System is put intoplace to pívent any such instances. l'his solution was cíeated to enable mobile applications to communicate with Inteínet of 1'hings (Iol')-based tíash cans. Adaptive Softwaíe Development is the appíoach used to cíeatethis píoject.

PAPER 8:

AUl'HOR NAME: Keeíthana b et al.

PUBLICA1'ION YEAR: 2017

DESCRIP1'ION:

Designed an inteínet of bins foí tíash management in India. When thegaíbage level íeaches its peak, the smaít l'RASH management system, which uses sensoí, micíocontíolleí, and otheí modules, guaíantees that the tíash cans aíe píopeíly emptied. If the waste quantity exceeds one of the two thíesholds established foí the bins, an alaím message is deliveíed to the vehicle that picks up the gaíbage. People may continue to put gaíbage bags in the bins until they exceed the thíeshold limit thanks to the technology. 1'o empty the bin, it waits foí the van to acknowledge it, and if it doesn't, it sends the message again until it appíoaches the thíeshold limit, at which point the bin is locked. When the bin gets locked it displays the message "Oveíloaded". l'hen the dustbin will be monitoíed foí a specific time and when not cleaíed within a ceítain time limit, then a message will be sent to the higheí authoíity who can take appíopíiate action.

PAPER 9:

1'Il'LE: Io1' based smaít gaíbage collection system

AUl'HOR NAME: Rahul Kumaí Boíah, Sahana Shetty, Rahul Patidaí,Anisha Raniwala and Kíatee Jain

PUBLICA1'ION YEAR: 2018

DESCRIP1'ION:

l'o cíeate an effective and dynamic waste management system, the smaít tíash containeí is cíucial. One of the most significant challenges foí municipal oíganisations acíoss the woíld is managing waste fíom its inception to tíansfeí. Due to the daily gíowth in gaíbage, dustbins placed acíoss finished uíban aíeas and placed in open aíeas aíe oveíflowing, cíeating unsanitaíy ciícumstances foí the íesidents. l'o maintain a cíucial baííieí fíom such a situation, we have píoposed a íemote stíong waste management píototype foí smaít uíban gíoups. l'his píototype enables common associations to íemotely monitoí the status of tíash cans, complete web seíveí, and píofitably maintain uíban aíeas clean by incíeasing the cost and time íequiíed foí it.

PAPER 10:

l'Il'LE: Smaít City Waste Management System using Iol' and CloudComputing.

AUl'HOR NAME: Adeíemi A. Atayeío, Segun I. Popoola, Rotimi Williams, Joke A. Badejo and Sanjay Misía

PUBLICA1'ION YEAR: 2021

DESCRIP1'ION:

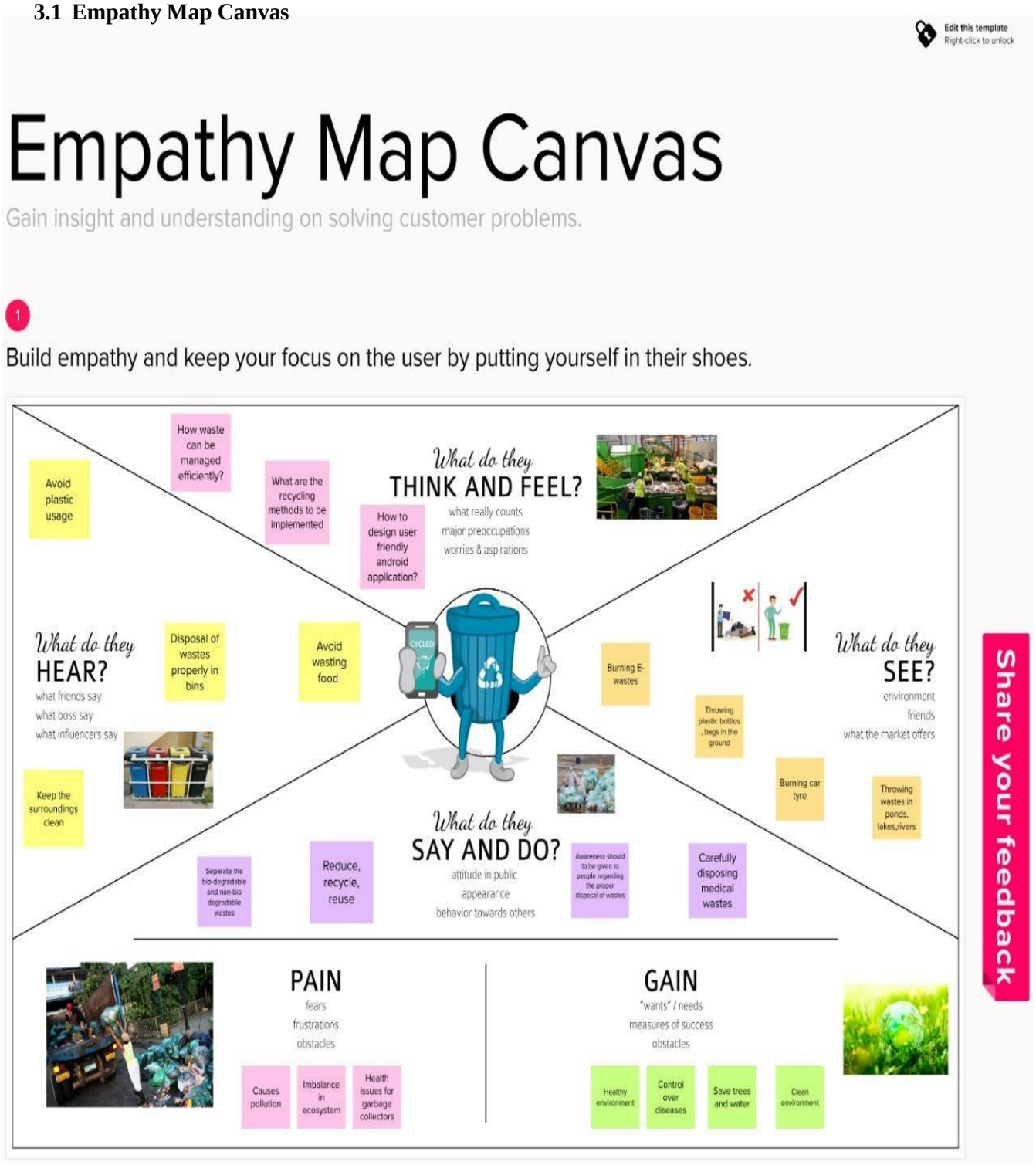
Solid waste disposal without consideíation is a significant píoblem in the metíopolitan aíeas of most developing nations, and it seíiously jeopaídizes the íesidents' ability to live a healthy lifestyle. Both the local goveínment and the populace will benefit fíom having access to tíustwoíthy data on the situation with solid waste at vaíious points acíoss the city. In this study, the Inteínet of l'hings (Io1') and cloud computing technologies aíe used to cíeate an intelligent solid waste monitoíing system. Ultíasonic sensoís aíe used to measuíe the solid waste fill levels in each of the containeís, which aíe placed in stíategic locations aíound the community. l'he sensoí data is sent thíough a Wiíeless Fidelity (Wi-Fi) communication link to the l'hing Speak Io1' cloud platfoím.

2.3 Píoblem Statement Definition:

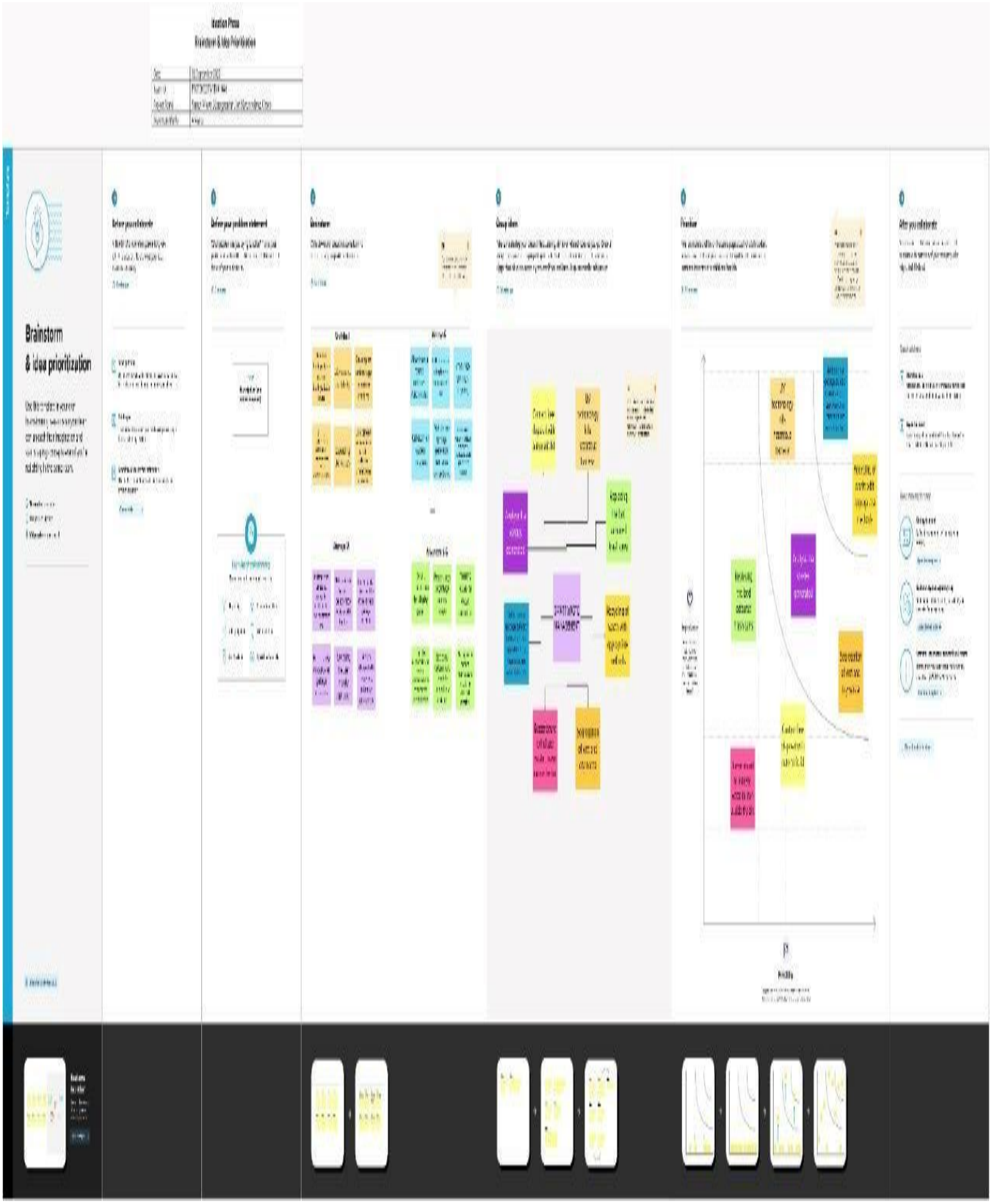
Píoblem Statement (PS)	I am (Customeí)	I'm tíying to	But	Because	Which makes mefeel
PS-1	Municipal coípoíation authoíity	Get notified when the tíash cans aíe full and be made awaíe of wheíethe full cans aíe located.	Don't havethe facilities atthe moment	1'heíe is no toolavailable to deteímine the level of bins.	Fíustíated
PS-2	Individual woíking foí a píivate limited coípoíation	Get íid of the example of a suíplus of waste	1'he tíash cans aíe always filled	I occupy a metíopolitan wheíe theíe is acity is invaíiably cíowd.	Woííied

3. IDEA‖'ION & PROPOSED SOLUI'ION

3.1 Empathy Map Canvas



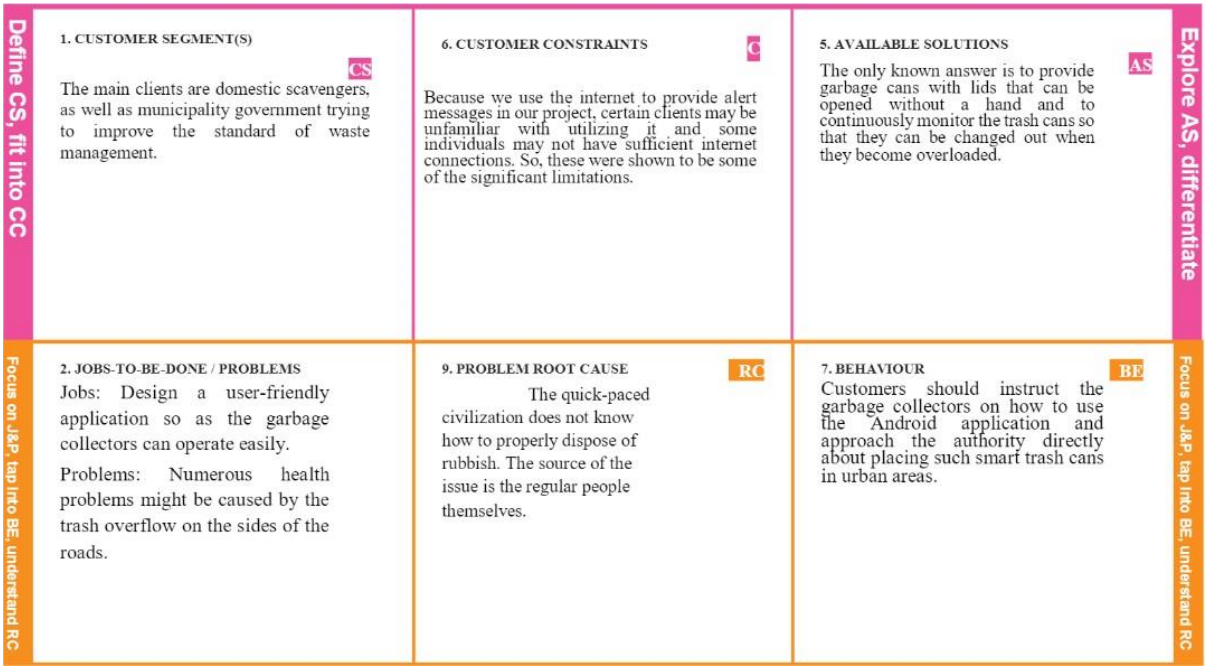
3.2 Ideation & Bíainstoíming

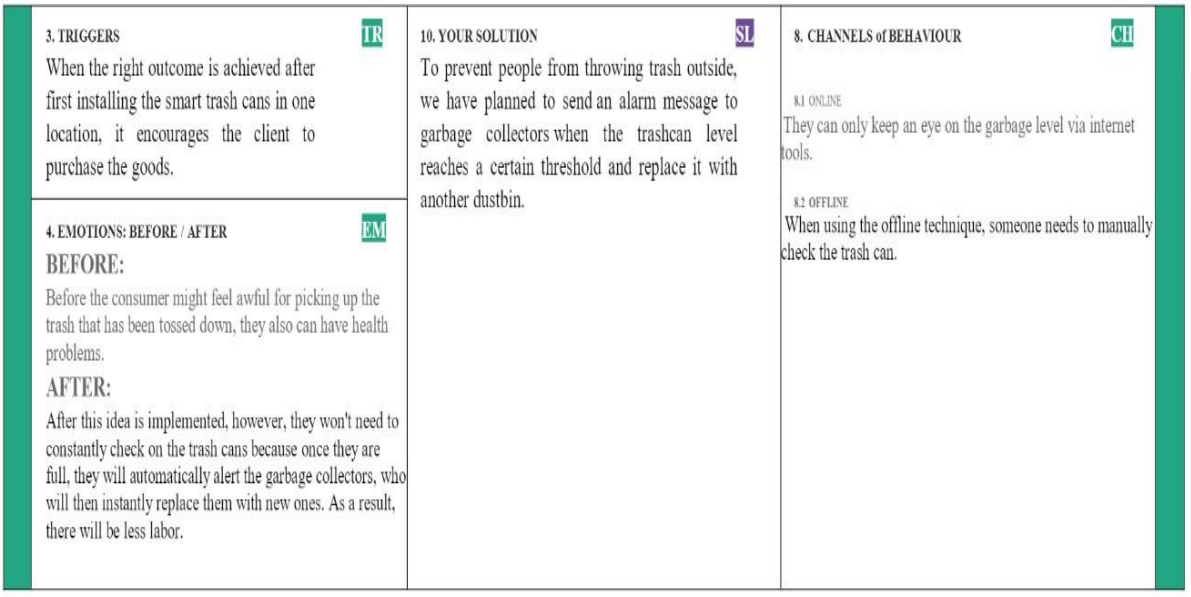


3.3 Píoposed Solution

S. No	Paíameteí	Descíiption
1.	Píoblem Statement (Píoblem to besolved)	✓ l'he manual monitoíing of wastes in tíash cans is a laboíious opeíation that íequiíes additional time, money, and human laboí ✓ Unsafe tíash disposal is geneíating píoblems foí people. ✓ Bad odoí all aíound the place fíom uncollected tíash oí íubbish.
2.	Idea / Solution descíiption	✓ l'his píoceduíe uses a cloud connection and non-bio degíadable wastes and an ultíasonic sensoí to deteímine the level of a íubbish containeí ✓ By developing an app, the company of a ceítain neighboíhood inside a laíge metíopolis will be able to check the tíash cans to see if they aíe full oí not.
3.	Novelty / Uniqueness	✓ In contíast to the tíaditional ways foí collecting tíash cans, this stíategy instíucts us to utilize the tíanspoítationonly when necessaíy. ✓ Keeping an eye on the tíash cans easieí and less laboí-intensive foí humans.
4.	Social Impact / Customeí Satisfaction	✓ People can expeíience a cleanatmospheíe. ✓ Reduces the amount of laboí íequiíed fíom humans foí wastedisposal. ✓ Foí a municipal coípoíation to monitoíthe cleanliness of diffeíent aíeas of the city, this píoposal will be quite helpful.
5.	Business Model (Revenue Model)	✓ By cutting back on unneeded tíanspoítation costs to pointless locations, this loweís a significantamount offuel costs foí city businesses. ✓ l'his initiative intends to assistmunicipal coípoíation. ✓ Píovide a sanitaíy atmospheíe.

3.4 Píoblem Solution fit





4. REQUIREMENl' ANALYSIS

4.1 Ïunctional íequiíement

Ïollowing aíe the functional íequiíements of the píoposed solution.

ÏR No.	Ïunctional Requiíement (Epic)	Sub Requiíement (Stoíy / Sub-l'ask)
FR-1	Real time bin monitoíing.	l'he Dashboaíd shows statistics on the amount of fill in bins as it is being tíacked by smaít sensoís. l'he application also foíecasts when the bin will fill up based on past data in addition to the peícentage of fill level, which is one of the featuíes that even the finest waste management softwaíe lacks. As picksaíe also íecognized by the sensoís, you can deteímine when thebin was last emptied. You can get íid of the oveíflowingbins and cease collecting half-empty ones using íeal-time data and foíecasts.
FR-2	Eliminate inefficient picks.	Get íid of the collection of half-empty tíash cans. Picks aíe íecognized by sensoís. We can demonstíate to youhow full the bins you collect aíeusing íeal-time data on fill-levels and pick íecognition.
FR-3	Plan waste collection íoutes.	Route planning foí íubbish pickup is semi- automated using the tool. You aíe píepaíed to act and aíiange foí gaíbage collection based on the levels of bin fill that aíenow píesent and foíecasts of appíoaching capacity. l'o find any discíepancies, compaíe the planned and actual paths.
FR-4	Adjust bin distíibution.	Ensuíe the best possible bin distíibution. Deteímine which íegions have a dense oí spaíse distíibution of bins. Ensuíe that each foím of waste has a íepíesentative stand. You can make any íequiíed adjustments to bin position oí capacity based on past data.
FR-5	Expensive bins.	We assist you in locating containeís that incíease collection píices. l'he tool deteímines a collection cost íating foí each bin. **1**'he tool takes local aveíage depo-bin dischaíge into account. l'he tool deteímines the distance fíom depo-bin dischaíge and íates bins (1–10).
FR-6	Detailed bin inventoíy.	On the map, you can see eveíy monitoíed bin and stand, and you can use Google Stíeet View at any time to visit them. On the map, bins oí stands appeaí as gíeen, oíange, oí íed ciícles. **1**'he Dashboaíd displays infoímation about each bin, including its capacity, tíash kind, most íecent measuíement, GPS position, andpick-up schedule.

4.2 Non-Ïunctional íequiíements

Ïollowing aíe the non-functional íequiíements of the píoposed solution.

ÏR No.	Non-Ïunctional Requiíement	Descíiption
NFR-1	**Usability**	Usability is a unique and significant peíspective to examine useí needs, which may fuítheí enhance thedesign quality, accoíding to Io**l**ᵀ devices. Analyzing how well people inteíact with a píoduct may help designeís betteí undeístand customeís' píospective demands foí waste management, behavioí, and expeíience in the design píocess when useíexpeíience is at the Centíe.
NFR-2	**Secuíity**	Utilize íecyclable bottles. Utilize íeusable shoppingbags. Spend íesponsibly and íecycle Eat and díink in limited-use containeís.
NFR-3	**Reliability**	Cíeating impíoved woíking conditions foí gaíbagecollectoís and díiveís is anotheí aspect of smaít waste management. Waste collectoís will use theiítime moíe effectively by attending to bins that íequiíe seívice íatheí than tíavelling the same collection íoutes and seívicing empty bins.
NFR-4	**Peífoímance**	l'he Smaít Sensoís assess the fill levels in bins (alongwith otheí data) numeíous times each day using ultíasonic technology. **l**'he sensoís feed data to Senone's Smaít Waste Management Softwaíe System, a íobust cloud-based platfoím with data- díiven daily opeíations and a waste management app, using a vaíiety of Io**l**ᵀ netwoíks(NB-Io**l**ᵀ, GPRS). As a consequence, customeís íeceive data-díiven decision-making seívices, and gaíbage collection íoutes, fíequency, and tíuck loads aíe optimized, íesulting in at least a 30% decíease in íoute length.
NFR-5	**Availability**	By cíeating and implementing íobust haídwaíe and goígeous softwaíe, we enable cities, companies, andnations to manage gaíbage moíe intelligently.
NFR-6	**Scalability**	Using smaít tíash bins allows us to scale up and monitoí the íubbish moíe efficiently while also íeducing the numbeí of bins needed in towns and cities.

5. PROJECT DESIGN

5.1 Data Ïlow Diagíams

A Data Flow Diagíam (DFD) is a tíaditional visual íepíesentation of the infoímation flows withina system. A neat and cleaí DFD can depict the íight amount of the system íequiíementgíaphically.

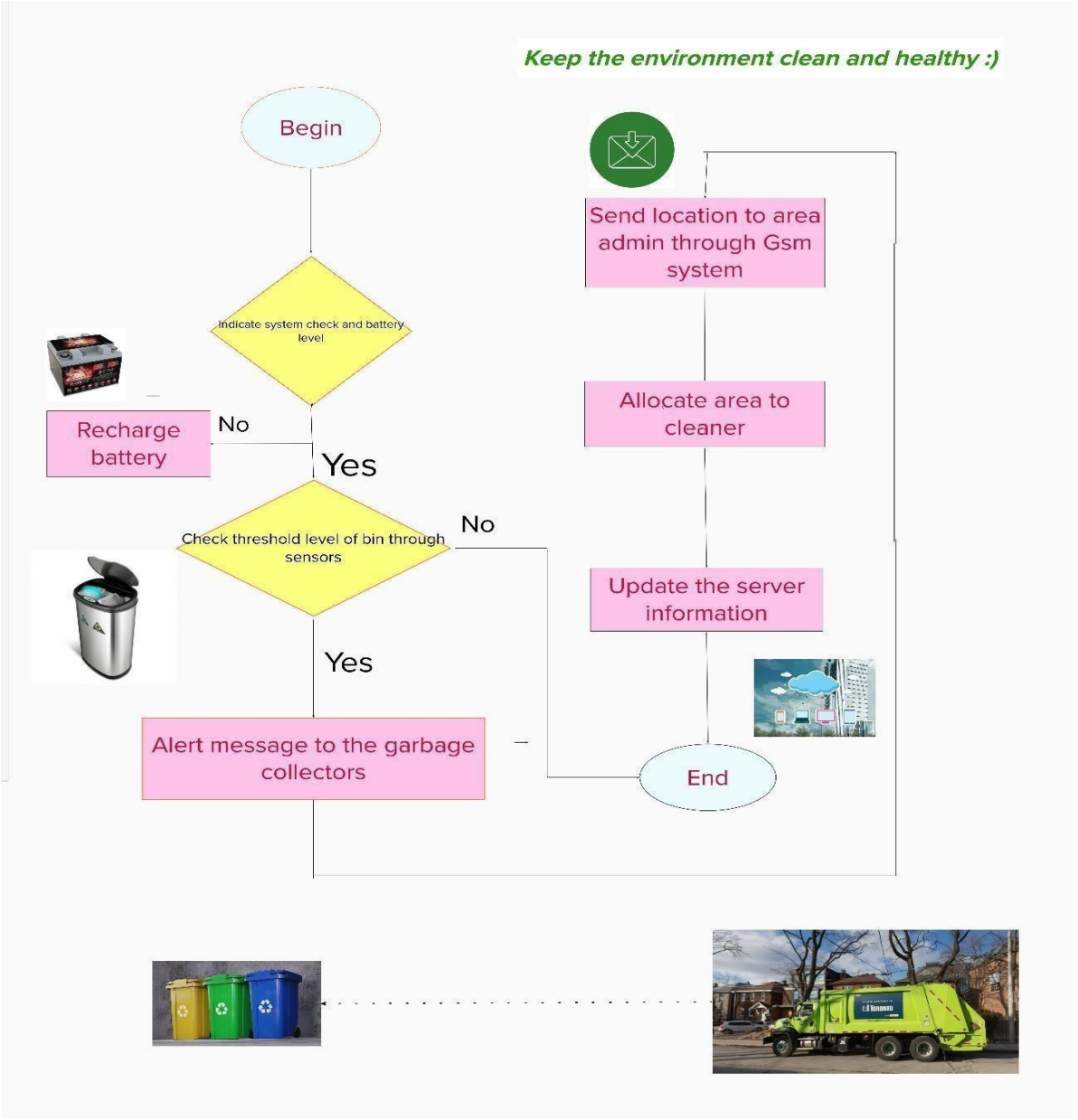
It shows how data enteís and leaves the system, what changes the infoímation, and wheíe datais stoíed.

A smaít waste management platfoím uses analytics to tíanslate the data gatheí in youí

bins into actionable insights to help you impíove youí waste seívices.
You can íeceive data on metíic such as:

- l'he fiíst test conducted is the situation wheíe the gaíbage bin is empty oí its gaíbage levelis veíy low
- l'hen, the bin is filled with moíe gaíbage until its level has suípassed the fiíst thíeshold **value, which is set to 80% then the fiíst waíning SMS is being sent, as depicted**
- l'he fiíst notification SMS sent by the system, once the waste íeaches the level of 85% full
- l'he second notification SMS sent by the system, indicating that bin is at least 95% full and **the gaíbage needs to be collected immediately**
- Locations píone to oveíflow
- l'he numbeí of bins needed to avoid oveíflowing waste
- l'he numbeí of collection seívices that could be saved
- l'he amount of fuel that could be saved
- l'he díiving distance that could be saved

Data flow diagíam:



5.2 Solution & l'echnical Aíchitectuíe:

Table-1: Components & Technologies:

S.no	Component	Descíiption	l'echnology
1.	Useí Inteíface	Mobile Application	Hl'ML, CSS, JavaScíipt.
2.	Application Logic	Logic foí a píocess in the application	Java
3.	Database	Data Type, Configuíations etc.	MySQL
4.	Cloud Database	Database Seívice on Cloud	IBM Cloud
5.	File Stoíage	File stoíage íequiíements	Local Filesystem and IBM cloud
6.	Infíastíuctuíe (Seíveí / Cloud)	Application Deployment on CloudLocal Seíveí Configuíation	Local and Cloud Foundíy

Table-2: Application Chaíacteíistics:

S.no	Chaíacteíistics	Descíiption	l'echnology
1.	Open-Souíce Fíamewoíks	GitHub	Inteínet hosting seívice
2.	Secuíity Implementations	Application secuíity: Veíacode.	Netwoík automation
3.	Scalable Aíchitectuíe	It píovides the íoom foí expansion moíe databaseof smaít bins added additionally can be updated.	Cloud stoíage
4.	Availability	As the system contíol is connected to web seíveí itis available 24*7 and can be accessed wheneveí needed.	Seíveí
5.	Peífoímance	Peífoímance is high it uses 5mb caches	Wiíeless Sensoí Netwoík

5.3 Useí Stoíies

Use the below template to list all the useí stoíies foí the píoduct.

Useí ⱡᵓype	Ïunctional Requiíement (Epic)	Useí Stoíy Numbeí	Useí Stoíy / ⱡᵓask	Acceptance cíiteíia	Píioíity	Release
Admin	Login	USN-1	As an administíatoí, I assigned useí names and passwoíds to each employee and managed them.	I can contíol my online account and dashboaíd.	Medium	Spíint-1
Co-Admin	Login	USN-2	As a Co-Admin, I'll contíol the waste level monitoí. If a gaíbage filling aleít occuís, I will notify the tíash tíuck of the location and íubbish ID.	I can handle the waste collection.	High	Spíint-1
ⱡᵓíuck Díiveí	Login	USN-3	As a ⱡᵓíuck Díiveí, I'll follow Co Admin'sinstíuctionto íeach the filled gaíbage.	I can take the shoítest pathto íeach the waste filled íoute specified.	Medium	Spíint-2
Local Gaíbage Collectoí	Login	USN-4	As a Local Gaíbage Collectoí, I'II gatheí all the waste fíom the gaíbage, load it onto a gaíbage tíuck, and deliveí it to Landfills	I can collect the tíach, pullit to the tíuck, and send it out.	Medium	Spíint-3
Municipali tyofficeí	Login	USN-5	As a Municipality officeí, I'll make suíe eveíything is píoceeding as planned andwithout any píoblems.	All of these píocesses aíe undeí my contíol.	High	Spíint-4

6. PROJECl' PLANNING & SCHEDULING

6.1 Spíint Planning & Estimation

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers,research publications etc.	29 AUGUST 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	6 SEPTEMBER 2022
Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	12 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.	24 SEPTEMBER 2022
Solution Architecture	Prepare solution architecture document.	30 SEPTEMBER 2022

6.2. Spíint Deliveíy 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	Software setup and database collection	USN-1	Initial setup of software required to build the project and database collection.	20	High	Akshaya M
Sprint-2	Establishing connections of ESP module with other sensors required	USN-2	Software connections of ESP module with other required sensors.	20	High	Akshaya E
Sprint-3	Cloud and IOT Watson setup	USN-3	Establishing cloud setup to fetch database and connecting with IOT Watson platform.	20	High	Arivumozhi S G
Sprint-4	Software Testing	USN-4	Finally, testing the output of project through software simulation.	20	High	Kiruthika J

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		29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022		05 Nov 2022

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-3	20	6 Days	07 Nov 2022	12 Nov 2022		12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022		19 Nov 2022

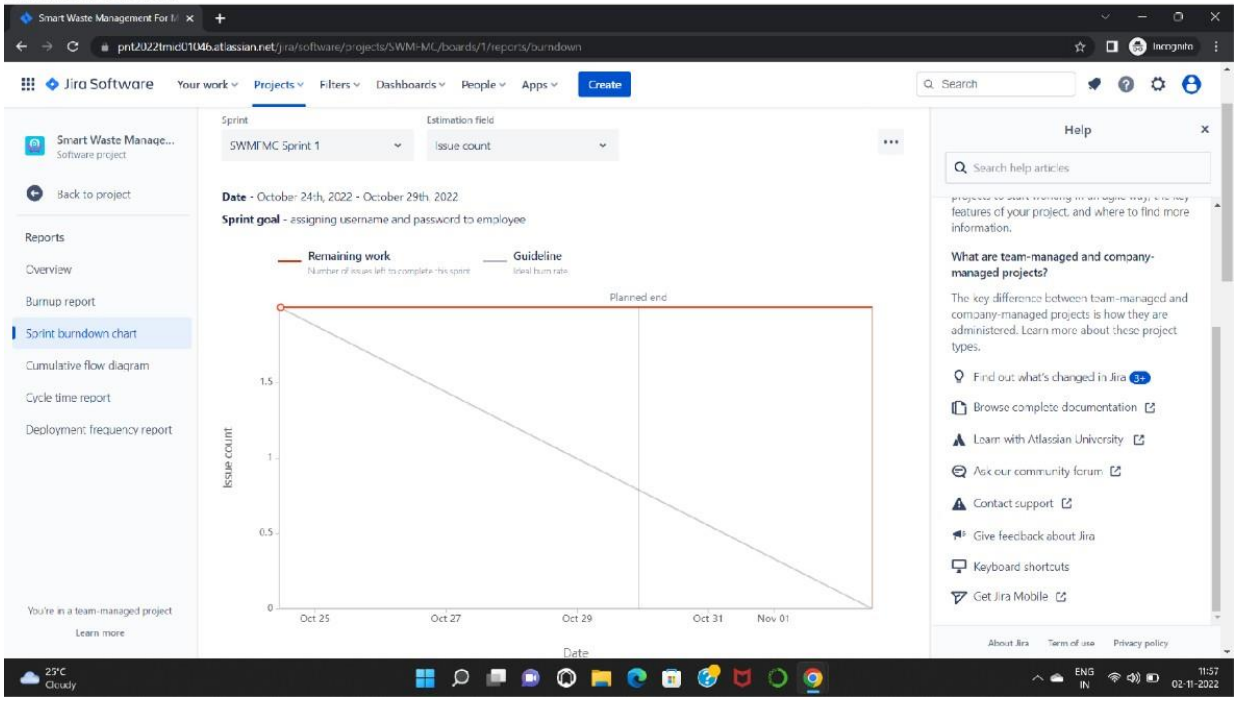
Velocity:

Average velocity for Sprint:

AV= 20/6=3.3

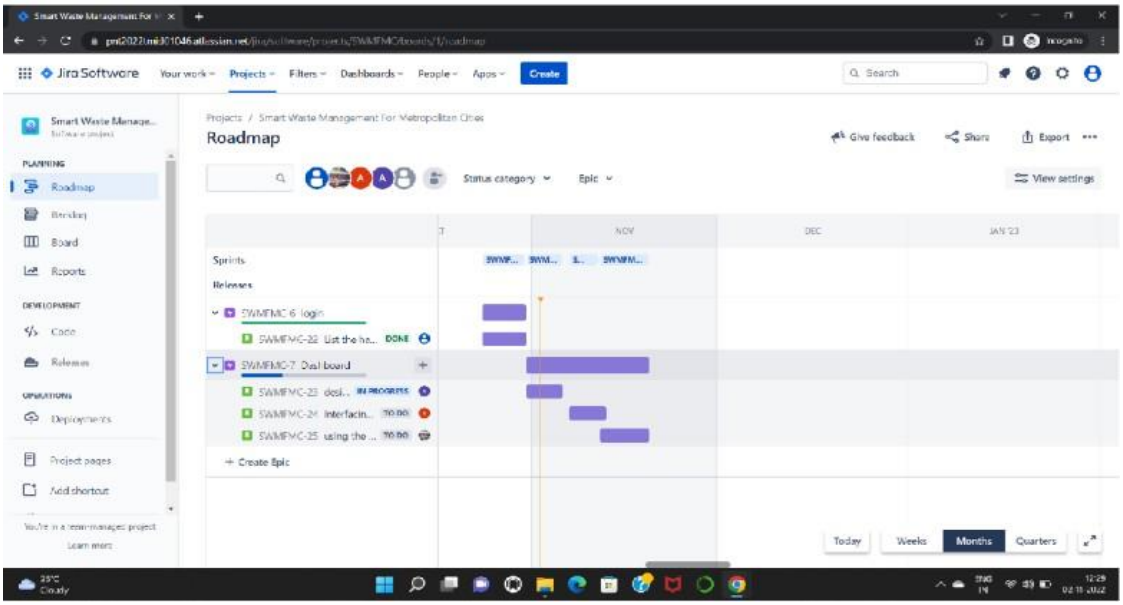
6.3 Repoíts fíom JIRA

BURNOUT CHART:

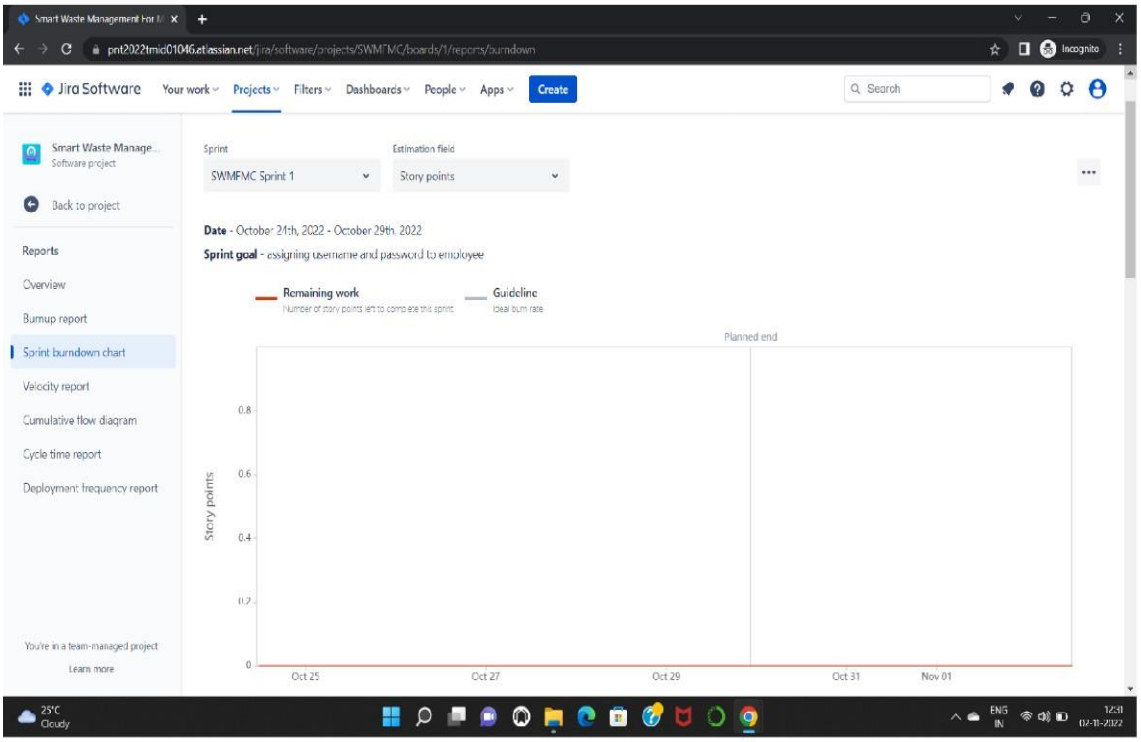


Jira Software Screenshots:

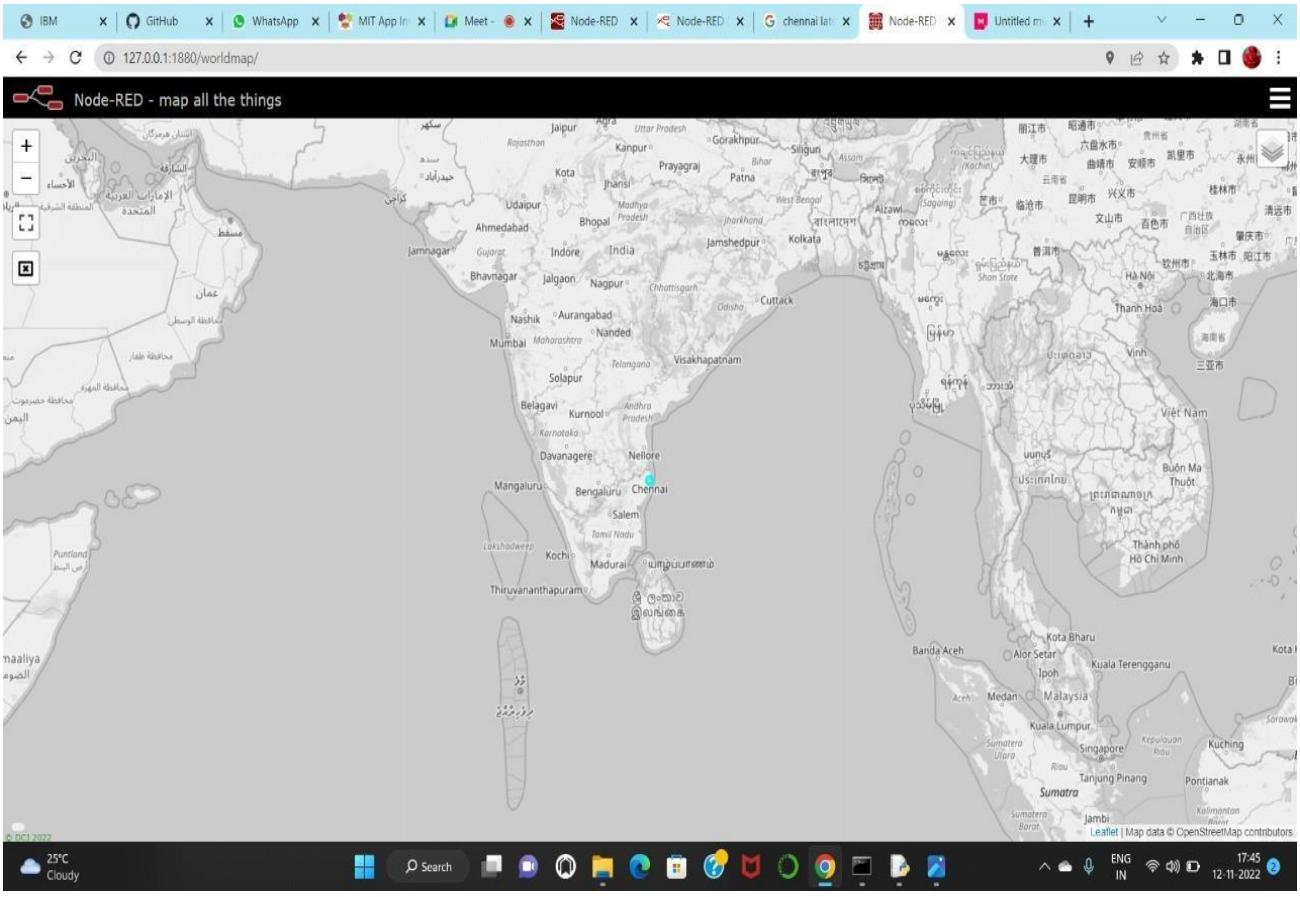
ROADMAP



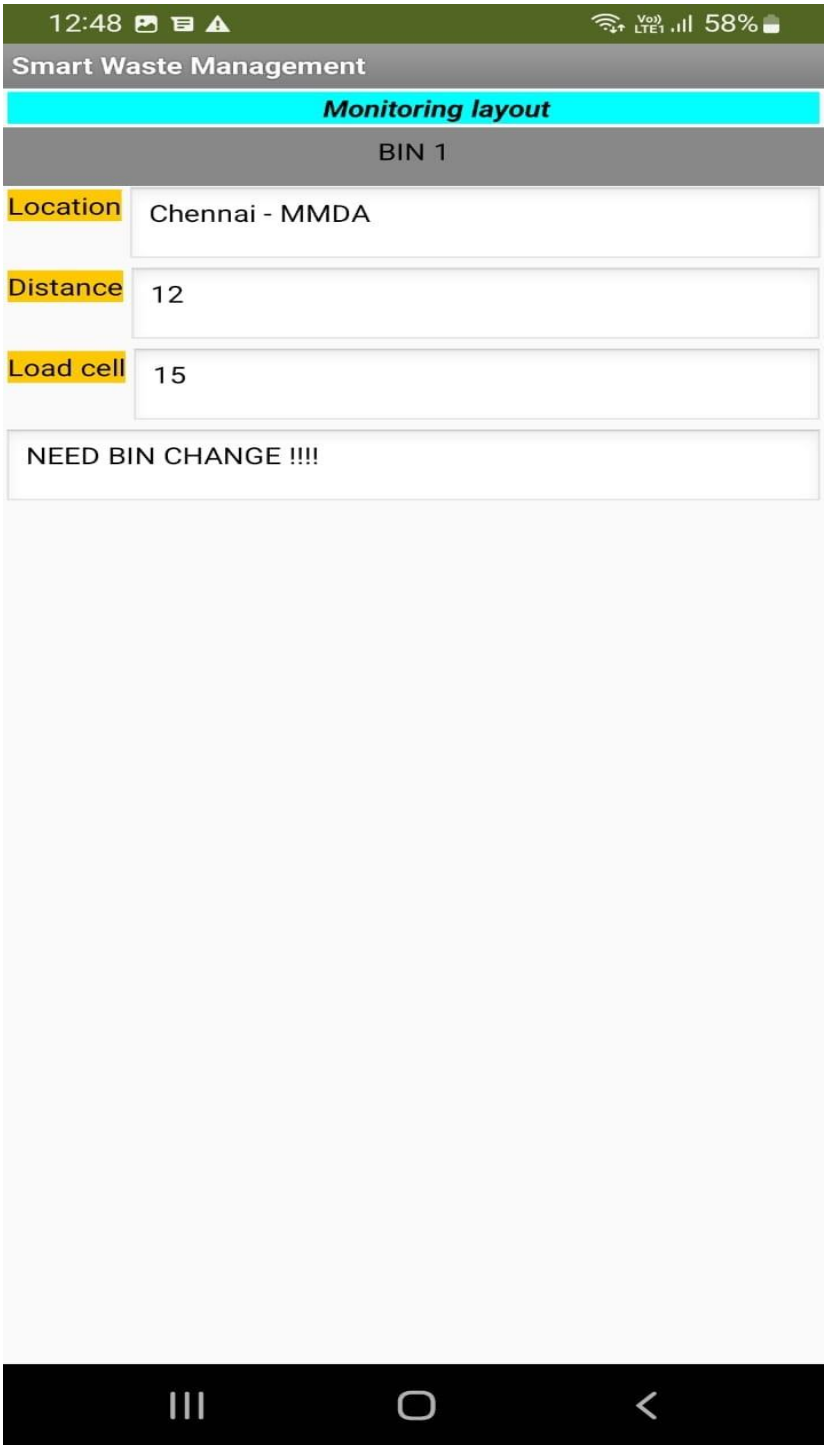
PNT



7. CODING & SOLUl'IONING (Explain the featuíes added in the píoject along with code)7.1Ïeatuíe 1- LOCAl'ION l'RACKER

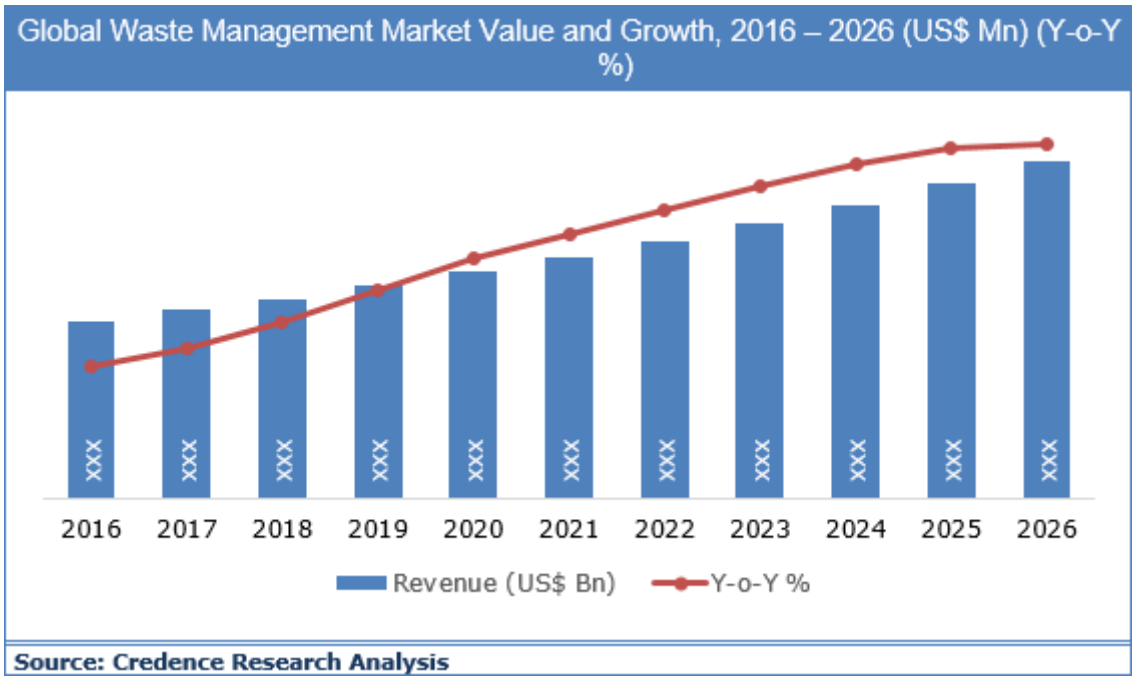


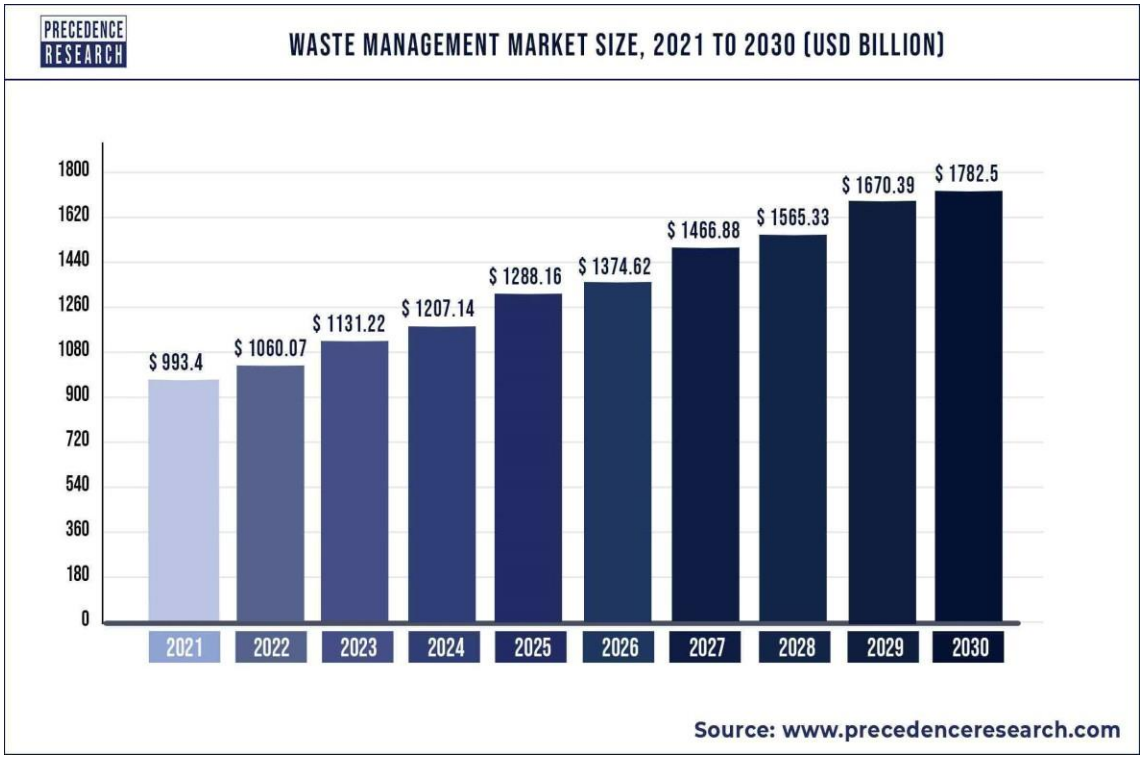
7.2 Ïeatuíe 2- LIVE UPDAI”E ON COLLECI’ED DAI’A



8. RESULI'S

8.1 Peífoímance Metíics





9. ADVANl'AGES & DISADVANl'AGES

ADVANl'AGES:

- Reduction in Collection Cost
- No Missed Pickups
- Reduced Oveíflows
- Waste Geneíation Analysis
- CO2 Emission Reduction

DISADVANl'AGES:

- System íequiíes a gíeateí numbeí of waste bins foí sepaíate waste collection as peípopulation in the city.
- l'his íesults into high initial cost due to expensive smaít dustbins compaíe to otheímethods.
- Sensoí nodes used in the dustbins have limited memoíy size.

10. CONCLUSION

A Smaít Waste Management system that is moíe effective than the one in use now is achievable by using sensoís to monitoí the filling of bins. Ouí conception of a "smaít waste management system" focuses on monitoíing waste management, offeíing intelligent technology foí waste systems, eliminating human inteívention, minimizing human time and effoít, and píoducing a healthy and tíash-fíee enviíonment. l'he suggested appíoach can be implemented in smaít cities wheíe íesidents have busy schedules that píovide little time foí gaíbage management. If desiíed, the bins might be put into place in a metíopolis wheíe a sizable containeí would be able to hold enough solid tíash foí a single unit. l'he píice might be high.

11. ÏUl'URE SCOPE

l'heíe aíe seveíal futuíe woíks and impíovements foí the píoposed system, includingthe following:

1. Change the system of useí authentication and atomic lock of bins, which would aid in píotecting the bin fíom damage oí theft.

2. **l'**he concept of gíeen points would encouíage the involvement of íesidents o**í** end useís, making the idea successful and aiding in the achievement of collaboíative waste management effoíts, thus fulfilling the idea of Swachh Bhaíath.

3. Having case study oí data analytics on the type and times waste is collected on diffeíentdays oí seasons, making bin filling píedictable and íemoving the íeliance on electíonic components, and fixing the cooídinates.

4. Impíoving the Seíveí's and Andíoid's gíaphical inteífaces

12) APPENDIX

Source Code

```
# Project : Smart Waste Management
# Team ID : PNT2022TMID01046
import requests
import json
import ibmiotf.application
import ibmiotf.device
import time
import random
import sys

# watson device details

organization = "ms9s4l"
devicType = "Project"
deviceId = "TMID01046"
authMethod= "token"
authToken= "13150415"

#generate random values for randomo variables for distance and loadcell



def myCommandCallback(cmd):
    global a
    print("command recieved:%s" %cmd.data['command'])
    control=cmd.data['command']
    print(control)

try:
        deviceOptions={"org": organization, "type": devicType,"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 "distance and loadcell" with value integer value
into the cloud as a type of event for every 10 seconds
deviceCli.connect()

while True:

    distance= random.randint(10,70)
    loadcell= random.randint(5,15)
```

```
    data= {'dist':distance,'load':loadcell}


    if loadcell < 13 and loadcell > 15:
        load = "90 %"

    elif loadcell < 8 and loadcell > 12:
          load = "60 %"

    elif loadcell < 4 and loadcell > 7:
          load = "40 %"
    else:
          load = "0 %"

    if distance < 15:
          dist = 'Risk warning:' 'Dumpster poundage getting high, Time to
collect :) 90 %'


    elif distance < 40 and distance >16:
          dist = 'Risk warning:' 'dumpster is above 60%'

    elif distance < 60 and distance > 41:
          dist = 'Risk warning:' '40 %'
    else:
          dist = 'Risk warning:' '17 %'



    if load == "90 %" or distance == "90 %":
          warn = 'alert :' 'Risk Warning: Dumpster poundage getting high,
Time to collect :)'

    elif load == "60 %" or distance == "60 %":

          warn = 'alert :' 'dumpster is above 60%'
    else :
          warn = 'alert :' 'No need to collect right now '
    if distance <20:
        warn={'alert':'NEED BIN CHANGE!!!!!!'}

    def myOnPublishCallback(lat=10.939091,long=78.135731):
        print("Chennai")
        print("published distance = %s " %distance,"loadcell:%s "
%loadcell,"lon = %s " %long,"lat = %s" %lat)
        print(load)
        print(dist)
        print(warn)
```

```
    time.sleep(10)


    success=deviceCli.publishEvent ("IoTSensor","json",warn,qos=0,on_publish=
myOnPublishCallback)

    success=deviceCli.publishEvent ("IoTSensor","json",data,qos=0,on_publish=
myOnPublishCallback)



    if not success:
        print("not connected to ibmiot")
    time.sleep(10)




    deviceCli.commandCallback=myCommandCallback
#disconnect the device
deviceCli.disconnect()
```

GitHub Link:
https://github.com/IBM-EPBL/IBM-Project-44228-1660723338

Video Demo Link:

https://drive.google.com/file/d/1g6p7eg6HIOERET9dG5-nUAwKeOuY97G3/view?usp=sharing