**SMART WASTE MANAGEMENT SYSTEM FOR METROPOLITAN CITIES**

**Team ID: PNT2022TMID31030**

**A PROJECT REPORT**

Submitted by

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**Abstract**

To make the human habitation more comfortable Smart cities are integrating the mobile and web applications. One among those solutions is to provide efficient and effective garbage management system which is an environmentally friendly. As of now collecting garbage includes routine garbage trucks collecting garbage once in a week. So that it is not only doesn't cover every zone of the city but is a completely inefficient use of government resources. This paper proposes mobile or web based system for the govt. in an exceedingly efficient thanks to utilize on the market resources to with efficiency manage the overwhelming amounts of garbage collected every day, whereas conjointly providing a much better answer for the inconvenience of disposal for the citizens. This will be done by a network of wise bins that integrates cloud-based techniques to observe and analyze data collected to produce sibylline routes generated through admin for garbage trucks. Associate mobile or web app is developed for the lads and also the citizens, that primarily provides the generated routes for the personnel and finds the nearest accessible good bin for citizens.

**Key Words: Smart city, Garbage Management, IOT, Data Mining**

**1. Introduction**

Appropriate waste administration is a fundamental necessity in any sort of a climate. Typically cleaning in these conditions are done toward the beginning of the day and the evening. On the off chance that you take a metropolitan city like Colombo as a rule there are around 1,200,000 to 1,500,000 representatives heading for their workstations each day. For every one of those individuals, there are simply insufficient trash canisters accessible. In the city of metropolitan urban communities, many individuals are passing a similar area around one moment. Around 95% of individuals are conveying food covers, polythene packs, and plastic jugs. In the event that they arrange all them without a moment's delay, the containers will be filled in a few minutes. At the point when they top off individuals simply litter their rubbish around the trash containers on the grounds that there is no place else to put them. The conspicuous answer for this is for the cleaning staff to remain close to trash canisters consistently till they top off to clean them. This is certifiably not a genuine arrangement. It takes much additionally cleaning staff and costs a great deal of cash. Along these lines, it is illogical. A similar situation is occurring in workstations. For example, a bank or an administration office cafeteria normally has around five to six trash canisters to serve many representatives. This is essentially insufficient. There are some outstanding negative impacts while considering the trash canisters continually being full. One of the primary impacts is the encompassing territory beginning to smell and be horrendous. At the point when the trash containers are full individuals put their refuse on sides of the trash receptacles. At the point when this is accomplished for quite a while, first it begins to smell awful. In this way, other people who come later tend not to go close and toss their waste toward the trash canisters. On the off chance that there are any extra food things, tossing it makes them spill. This pulls in creatures like felines, canines, and flies. What's more, these creatures spill them considerably more. Another negative impact is the illnesses that spread. It's the trash that spread them, however the creatures additionally can be a source.

**1.1 Project overview**

With the increasing population and industrialization of nations throughout the globe, waste has become a great concern for all of us. Over years, researchers figured that only waste management is not enough for its proper treatment and disposal techniques to preserve our environment and keeping it clean in this era of globalization. With the help of technology research we have introduce "Smart Waste Management System" and initiatives that ensures reduced amount of time and energy required to provide waste management services. In the present day scenario, many times we see that the garbage bins or Dust bin are placed at public places in the cities are overflowing due to increase in the waste every day. It creates unhygienic condition for the people and creates bad smell around the surroundings this leads in spreading some deadly diseases & human illness, to avoid such a situation we are planning to design "Smart Waste Management System". In this proposed System there are multiple dustbins located throughout the city these dustbins are provided with low cost embedded device which helps in tracking the level of the garbage bins and an unique ID will be provided for every dustbin in the city so that it is easy to identify which garbage bin is full. When the level reaches the threshold limit, the device will transmit the level along with the unique ID provided. These details can be accessed by the concern authorities from their place with the help of Internet and an immediate action can be made to clean the dustbins.

**Keywords:- Smart, Dustbin, Waste, Unique Id, Tracking, Authorities etc.**

**1.2 Purpose**

The sole purpose of the system requirement and specification is to give detailed information of what the cleanv: waste management system will incorporate from the developer’s view before implementation of the system for use. Assessment and functionality will also be looked into to ensure it meets the envisioned purpose to help in waste management so as reduce pollution of the environment.

**2. Literature Survey**

There are different company and individual team which are contributing in the similar waste management project. Where some of the project has more functionality and some of the project has more limitation. After some research we found some similar task project and website which provide similar feature equipment.

**i.Fohar Malai**

Fohar Malai is a Startup Based on Waste management & integrated environmental solutions in Nepal. We have invested in developing waste solutions for a changing world. Today, this includes not just disposal and recycling, but personal counseling to help customers achieve their green goals, including zero waste. Fohor Malai recover the energy from the waste, called WTE(waste to energy). With the sensor based network of recycling facilities, our entire business can adapt to meet the needs of every distinct customer segment. As Startup, our motto is to maximize resource value while minimizing impact in order to further both economic and environmental sustainability for all human.

**"From everyday collection, to environmental protection, think green. Think Waste Management."**

**2.1 Existing problems**

Employees heading for his or her workstations each morning. For all those folks, there are simply not enough garbage bins available. On the streets of urban cities, many people are Passing constant location around one minute. The obvious resolution to the present is for the improvement workers to remain close to garbage bins on a daily basis until they extra service to wash them. This can be not a true solution. There are some notable negative effects once considering the rubbish bins continuously being full. One among the most effects is that the encompassing space commencing to smell and be very unpleasant. The garbage bins are full folks place their trash on sides of the rubbish bins.

**2.2 References**

**2.2.1  A Smart Waste Management Solution Geared towards Citizens.**

The authors **Padini et al** presented a hardware and software approach to waste management that allows the users to be part of the management process. The proposed system employs the use of IoT technology that constantly monitors the level of waste in garbage bins in real time. The sensed data are stored and processed using a middleware and provides statistical information regarding the status of the waste in the garbage bins. Users can obtain the waste information through a web page or mobile application. A prototype was presented, and a use case evaluation of the approach was demonstrated and validated.

**2.2.2. A Door-to-Door Waste Collection System Case Study: A Survey on its Sustainability and Effectiveness.**

**Laurieri et al**  presented a survey based on residents’ habit in generating and managing recycle waste as well as the financial cost and environmental impacts of the adopted door-to-door waste collection scheme in Altamura, Italy. The authors proposed a weekly garbage bin collection scheme to provide an efficient and waste collection service to the people living in the town. This approach was an aim to design a smart device to assist people in the proper handling of waste management.

**2.2.3. Case for cleanv**

Waste management system From the research and work done by Padini et al and Laurieri et al, they solved major challenges that helped solve the issue of environment and management through creative garbage collection strategies. With cleanv ‘environmental management system’ some of the things like collaboration with waste management companies and recycling companies will be added as well as complaint feature to report irresponsible disposal of waste in the environment making it more efficient and reliable.

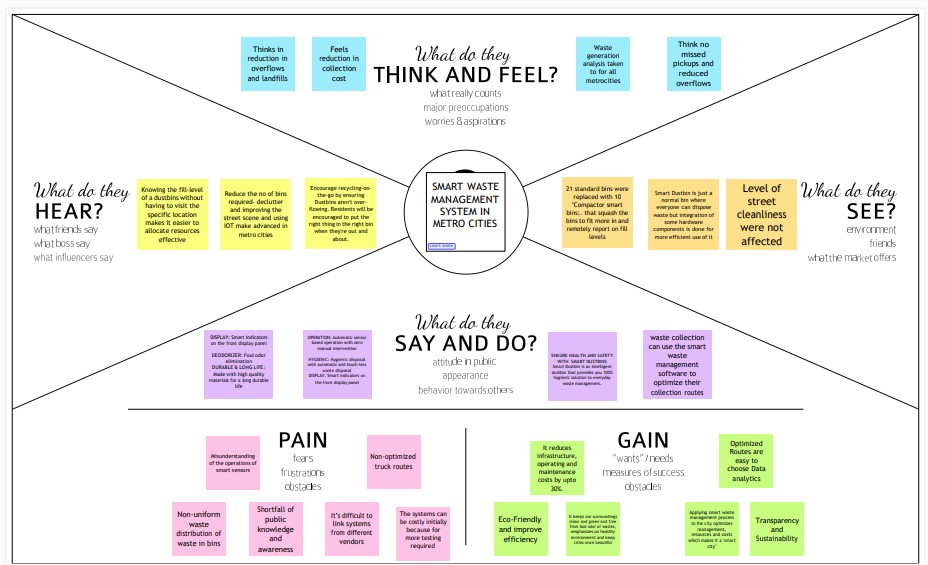
**2.3 Problem Statement**

A big challenge in the urban cities is solid waste management. The garbage collecting authority in traditional waste management system doesn't know about the level of garbage in dustbin, if the dust bins gets full by garbage then it gets overflowed as well as spelled out from the dustbin leading to unhygienic condition in cities. People throw garbage on that dustbin which is already overflowed. Sometimes due to unclean garbage bins bad smell arises also toxic and unhygienic gases are produced which is way to support to the air pollution and to some harmful diseases which are easily spreadable. It is very bad look of the city. Use of traditional system result in inefficient and time and money spending system.

**3. Ideation and Proposed Solution**

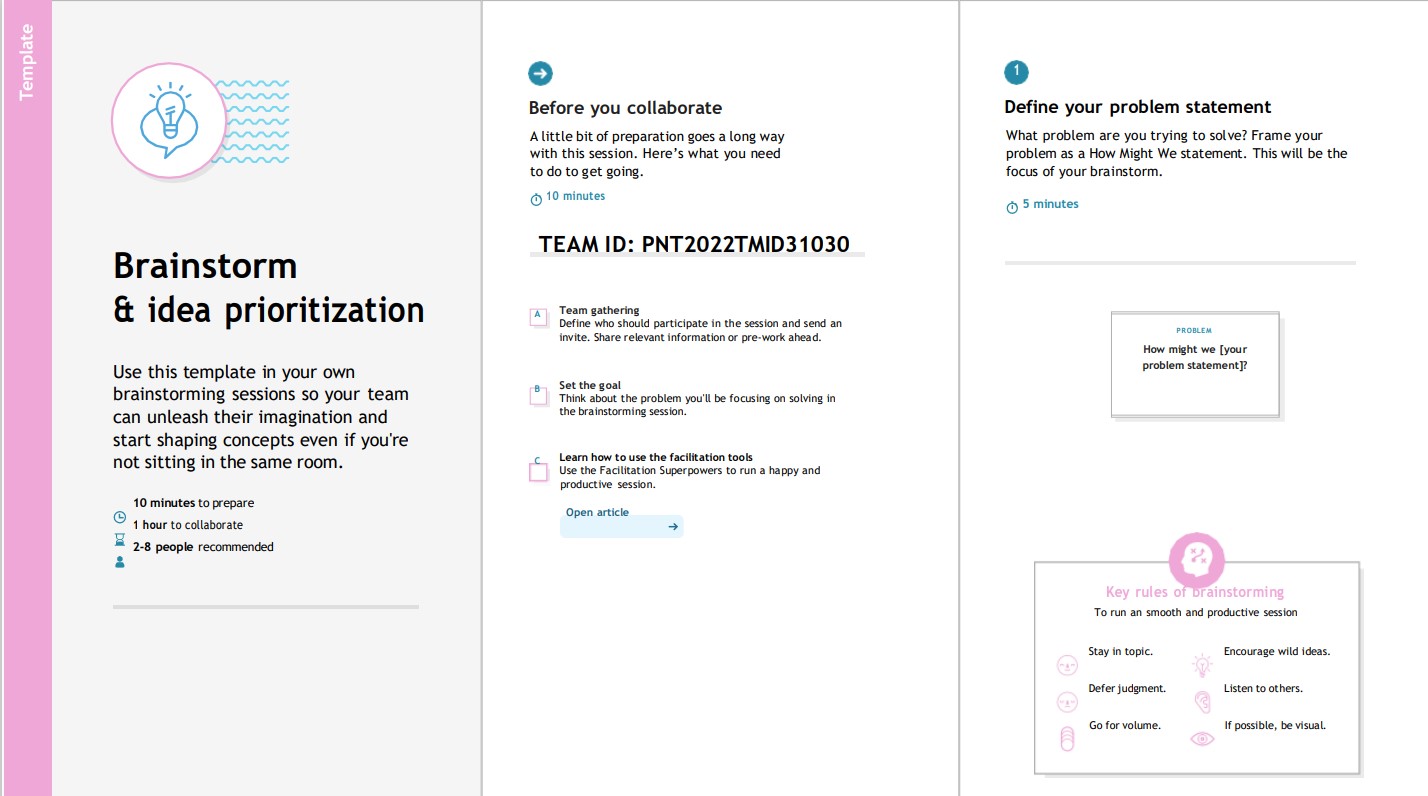
The projected system summary for this system. Solid waste management may be loosely categorized as segregation, collection, and transportation The server will collect the info and store them solely a database. This data will be analyzed and displayed on 2 completely different dashboards that may be accessed by the personnel and clients Using data analytics, reports will be generated which may be monitored by the admins through the admin dashboard. Based on the data collected, garbage trucks can be given routes generated through numerous algorithms and google maps API to expeditiously route through all necessary garbage bins and at last reach the merchandising site.

**3.1 Empathy Map Canvas**

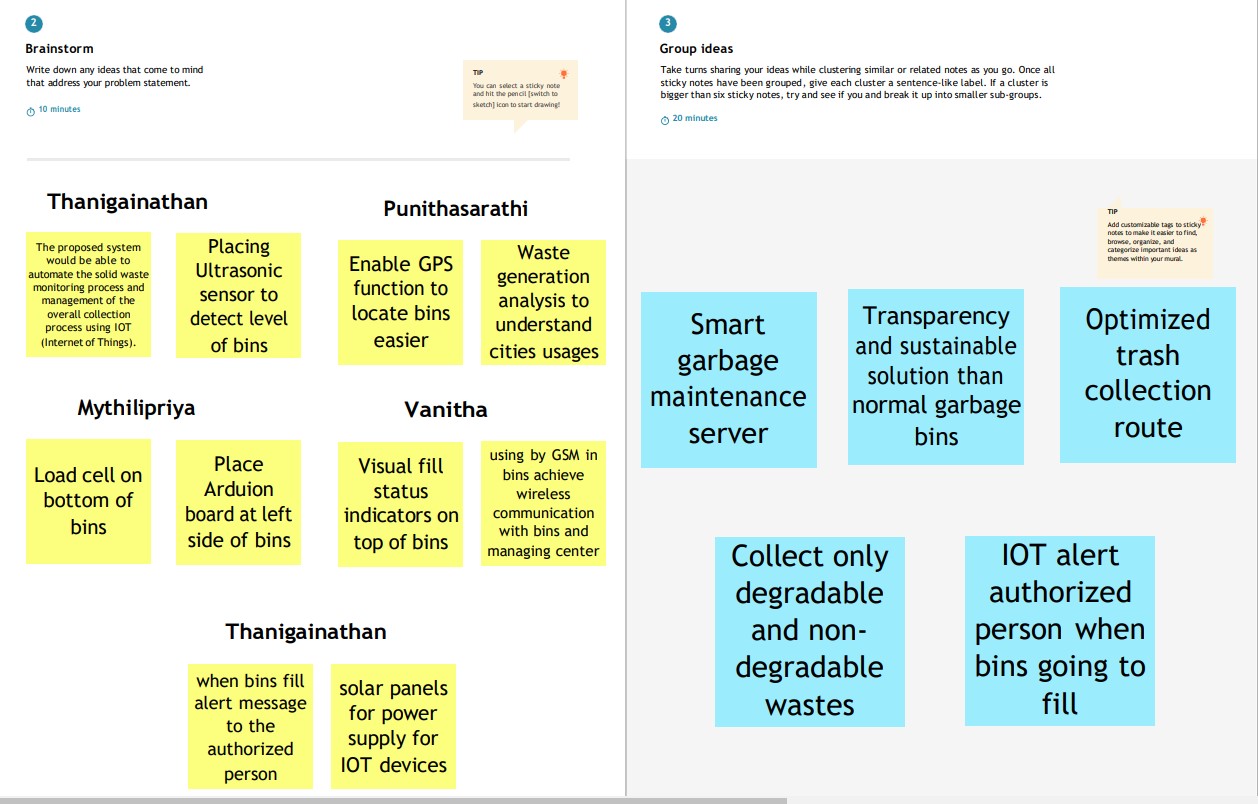


**Empathy Map**

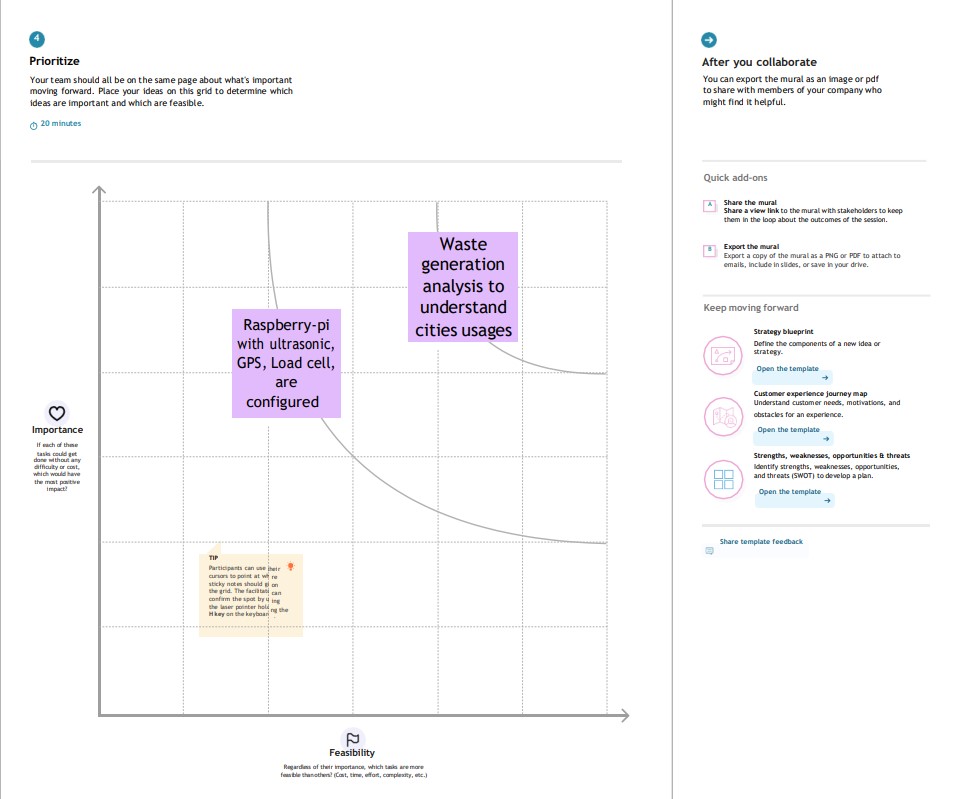
**3.2 Ideation and Brainstorming**

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**Ideation Phase 1**

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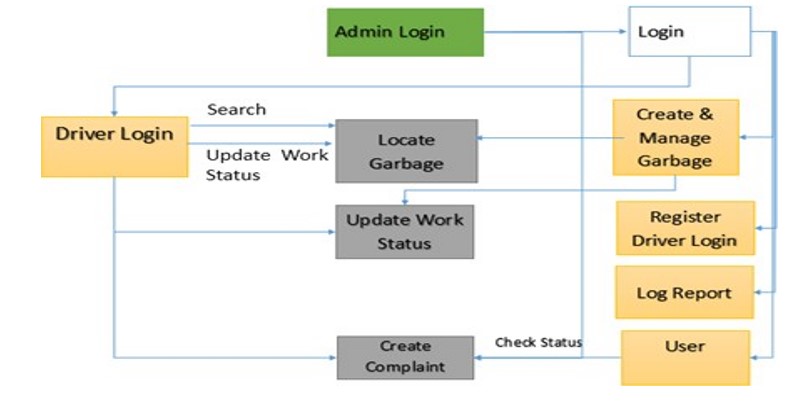
**Ideation phase 2**

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**Ideation Phase 3**

**3.3 Proposed Solution**

To avoid pollution and improper disposal of waste, ‘cleanv' which is a waste management system is proposed in this paper. In the proposed system, there will be features such as; ability to report irresponsible waste disposal, connect with waste collection companies, specification of waste disposal areas within a given locality and ability of waste collection companies to connect with recycling companies. This will help in the effective and efficient management of waste and conservation of the environment.

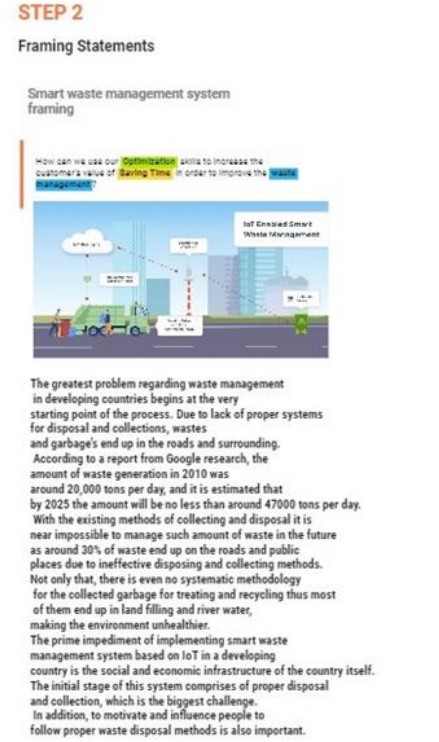


**Proposed System**

**3.4 Problem Solution fit**

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**Problem solution fit step 1**

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**Problem solution fit step 2**

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**Problem solution fit step 3**

**4. Requirement Analysis**

The following are the functional and non functional rerquirements of smart waste management system.

**4.1 Functional Requirements**

**1. Detailed bin inventory**

All monitored bins and stands can be seen on the map, and you can visit them at any time via the Street View feature from Google. Bins or stands are visible on the map as green,orange or red circles. You can see bin details in the Dashboard – capacity,waste type, last measurement, GPS location and collection schedule or pick recognition.

**2. Real time bin monitoring**

The Dashboard displaysreal-time data on fill-levels of bins monitored by smart sensors. In addition to the % of fill-level, based on the historical data, the tool predicts when the bin will become full, one of the functionalities that are not included even inthe bestwastemanagement software.Sensors recognize picks as well;so you can check whenthe bin was last collected.With realtime data and predictions, you can eliminate the overflowing bins and stop collecting half-empty.

**3. Expensive bins**

We help you identify bins that drive up your collection costs.The tool calculates a rating for each bin in terms of collection costs. The tool considers the averagedistance depobin- discharge in the area. The tool assigns bin a

 rating(1-10) and calculates distance from depo-bin discharge.

**4. Adjust bin distribution**

* Ensure the most optimal distribution of bins.
* Identify areas with either dense or sparse bin  distribution.
* Make sure all trash types are represented with in a stand.
* Based on the historical data, you can adjustbin capacity or location where necessary.

**5. Eliminate unefficient picks**

Eliminate the collection of half-empty bins. The sensors recognize picks. By using real-time data on fill-levels and pick recognition, we can show you how full the bins you collect are. The report shows how full the bin was when picked. You immediately see any inefficient picks below 80% full.

**4.2 Non Functional Requirements**

1. **Usability**

IOT device verifies that usability is a special and important perspective to analyze user requirements, which can further improve the design quality. In the design process with user experience as the core, the analysis of users’ product usability can indeed help designers better understand user's potential needs in waste management, behavior and experience.

1. **Security**
   * Use a reusable bottles.
   * Use reusable grocery bags.
   * Purchase wisely and recycle.
   * Avoid single use food and drink containers.

**3. Reliability**

Smart waste management is also about creating better working conditions for waste collectors and drivers. Instead of driving the same collection routesand servicing empty bins, waste collectors will spend their time more efficiently, taking care of bins that need servicing.

1. **Performance**

The Smart Sensors use ultrasound technology to measure the fill levels (along with other data) in bins several timesa day. Using a variety of IoT networks( (NB-IoT,GPRS), the sensors send the data to sensors Smart Waste Management Software System, a powerful cloud-based platform, for data-driven daily operations, available also as a waste management app. Customers are hence provided data-driven decision making,and optimization of waste collection routes, frequencies, and vehicle loadsresulting in route reduction by at least 30%.

1. **Scalability**

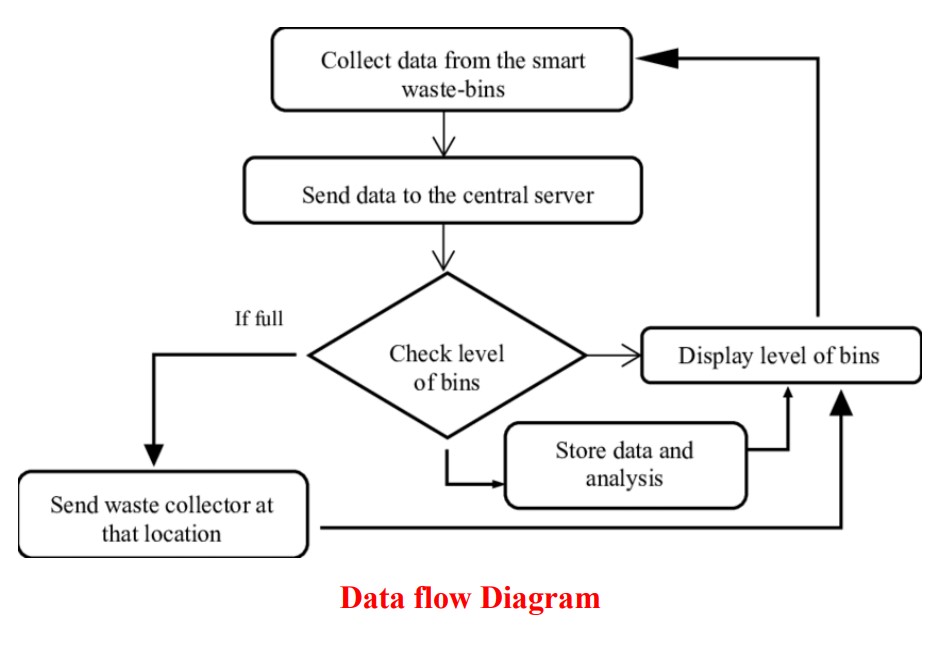
Using smart waste bins reduce the number of bins inside town , cities because we are able to monitor the garbage 24/7 more cost effect and scalability when we moves smarter.

**5. Project Design**

Changing from one approach to another has always proven to be difficult in most scenarios. For the waste management system it will be difficult for users to embrace it due to fears of high technicality needed to use the system.

**5.1  Data Flow Diagram**

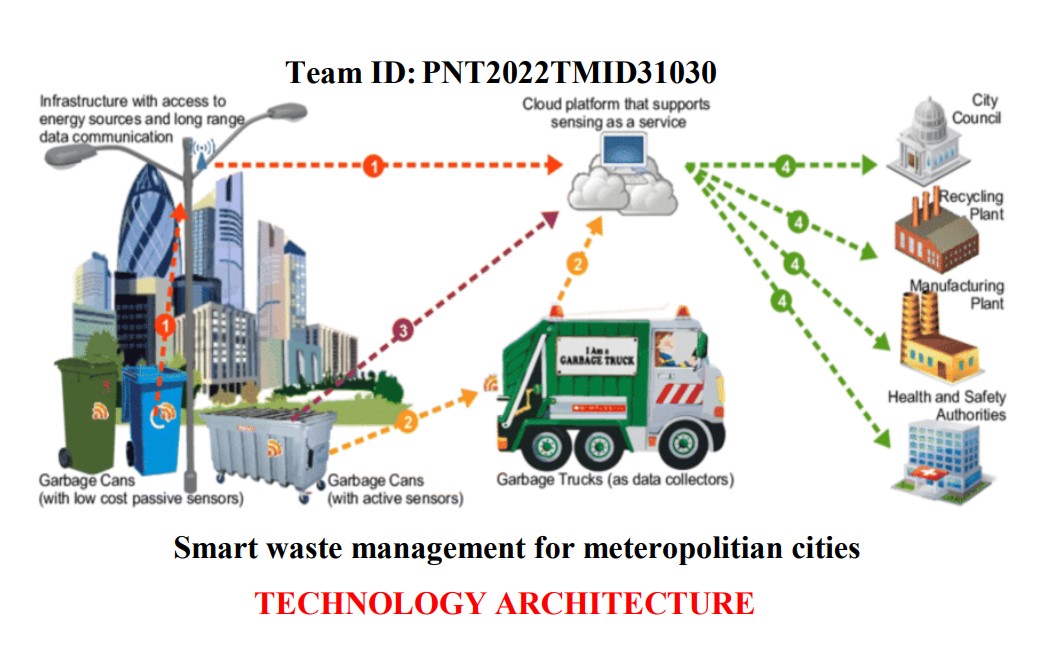
* A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system.
* A neat and clear DFD can depict the right amountof the system requirementgraphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.
* 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.**



**5.2 Solution and Technical architecture**

**Table-1 : Components & Technologies:**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No** | **Component** | **Description** | **Technology** |
| **1.** | User Interface | Web Portal | HTML,CSS,NodeRed,  Javascript.o r on |
| **2.** | Application Logic-1 | To calculate the distance of dreck and show the real time level in web portal , information getting viaultra sonic sensorand  the alert message activate with python script to web portal. | Ultrasonic sensor/ Python. |
| **3.** | Application Logic-2 | To calculate the weight of the garbage and show the real time weight in web portal, this info getting via load cell and the alert message activate with python to  web portal. | Load cell/Python. |
| **4.** | Application Logic-3 | Getting location of the Garbage. | GSM / GPS. |
| **5.** | Cloud Database. | Database Service on Cloud | IBM DB2, IBM  Cloudant etc. |
| **6.** | File Storage | File storage requirements | Github,Local file system. |
| **7.** | External API- 1. | Firebase is a set of hosting services for any type of application. It offers NoSQL and real-time hosting of databases,  authentication, and notifications, such as a real-time communication  communication server. | Firebase. |
| **8.** | Ultrasonic Sensor | To throw alert message when garbage is getting full. | Distance Recognition Model. |
| **9.** | Infrastructure (Server / Cloud) | Application Deployment on LocalSystem / Cloud  Local Server Configuration:localhost Cloud Server Configuration:  localhost,Firebase. | Localhost,Web portal. |



**5.3 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 truckof the location and rubbish ID. | I can handle the waste collecti-on. | High | Sprint-1 |
| Truck Driver | Login | USN-3 | As a Truck Driver, I'll follow Co Admin'sinstruction toreach the filled  garbage. | I can take the shortest path to reach the waste  filled routespecified. | Medium | Sprint-2 |
| Local Garbage Collector | Login | 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 | I can collect the trash,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 |

**6. Project planning and scheduling**

**6.1 Sprint planning and estimation**

|  |  |  |
| --- | --- | --- |
| **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 andprioritize 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 OCTOBER2022 |
| **Functional Requirement** | Prepare the functional requirement document. | 8 OCTOBER2022 |
| **Data FlowDiagrams** | Draw the data flow diagrams and submit for review. | 9 OCTOBER2022 |
| **Technology Architecture** | Prepare the technology architecture diagram. | 10 OCTOBER2022 |
| **Prepare Milestone & Activity List** | Prepare the milestones &activity list of the project. | 22 OCTOBER2022 |
| **Project Development - Delivery of Sprint-1, 2, 3 &4** | Develop & submit the developed codeby testing it. | 17 NOVEMBER 2022 |

**6.2 Sprint Delivery Schedule**

**Product Backlog , Sprint Schedule and Estimation**

Use the below template to create product backlog and sprint schedule

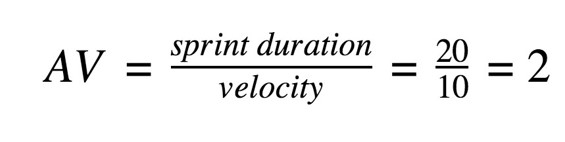
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sprint** | **Functional Requirements (Epic)** | **User Story Number** | **User Story/ Task** | **Story**  **Points** | **Priority** | **Team Members** |
| Sprint-1 | Login | USN-1 | As a Administrator, I need to give user id and passcode for ever workers over there in municipality | 10 | High | Thanigainathan |
| Sprint-1 | Login | USN-2 | As a Co-Admin, I’ll control the waste level by monitoring them via realtime web portal. Once the filling happens, I’ll notifytrash truck with  location of bin with bin ID | 10 | High | PunithaSarathi |
| Sprint-2 | Dashboard | USN-3 | As a Truck Driver, I’ll follow Co-Admin’s Instruction to reach thefilling bin in short roots  and savetime | 20 | Low | Mythilipriya |
| 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, anddeliver it to Landfills | 20 | Medium | Vanitha |
| Sprint-4 | Dashboard | USN-5 | As a Municipality officer, I'll make sure everything is proceeding as planned and  without any problems | 20 | High | Thanigainathan |

**Project Tracker, Velocity & Burndown Chart:**

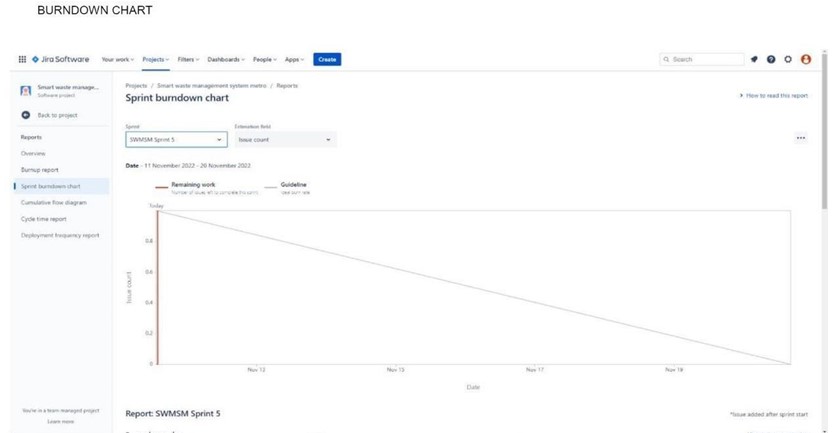
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sprint** | **Total Story Points** | **Duration** | **Sprint Start Date** | **Sprint End Date (Planned)** | **Story Points**  **Completed (as on Planned End Date)** | **Sprint Release Date (Actual)** |
| Sprint-1 | 20 | 6 Days | 24 Oct 2022 | 29 Oct 2022 | 20 | 29 Oct 2022 |
| Sprint-2 | 20 | 6 Days | 31 Oct 2022 | 05 Nov2022 | 20 | 05 Nov2022 |
| Sprint-3 | 20 | 6 Days | 07 Nov  2022 | 12 Nov2022 | 20 | 12 Nov2022 |
| Sprint-4 | 20 | 6 Days | 14 Nov 2022 | 19 Nov2022 | 20 | 19 Nov2022 |

**Velocity:**

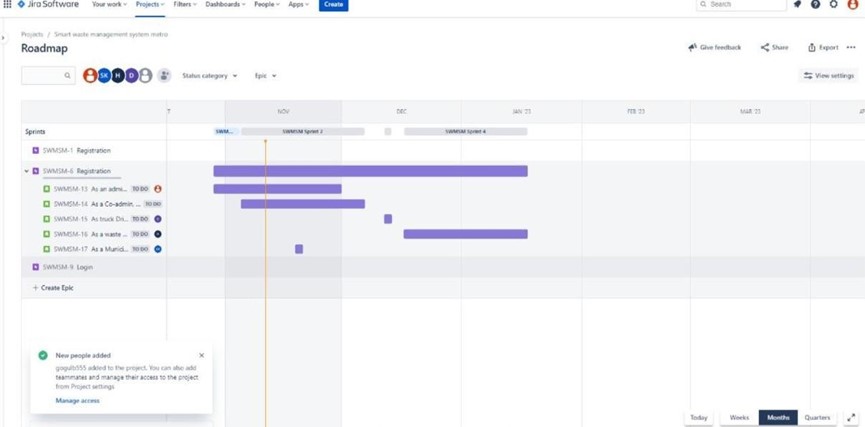
Imagine we have a 10-day sprint duration, and the velocityof the team is 20 (points per sprint). Let’s calculate the team’s average velocity (AV) per iteration unit (story points per day)



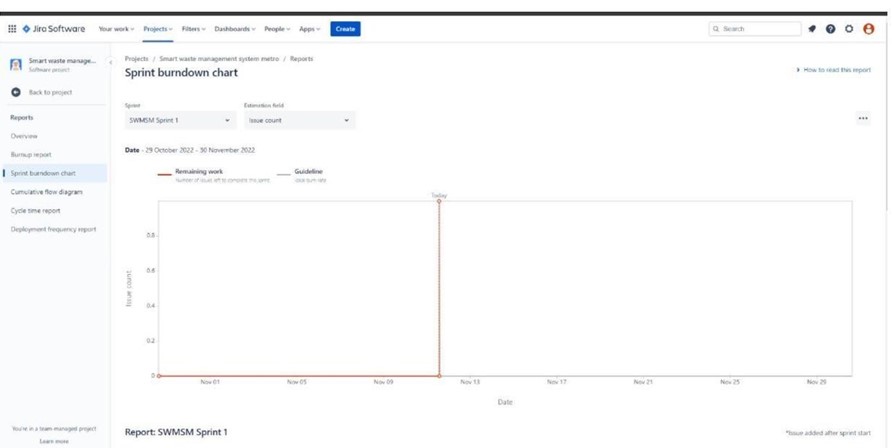
**6.3 Reports from JIRA**



**Screenshot 1**

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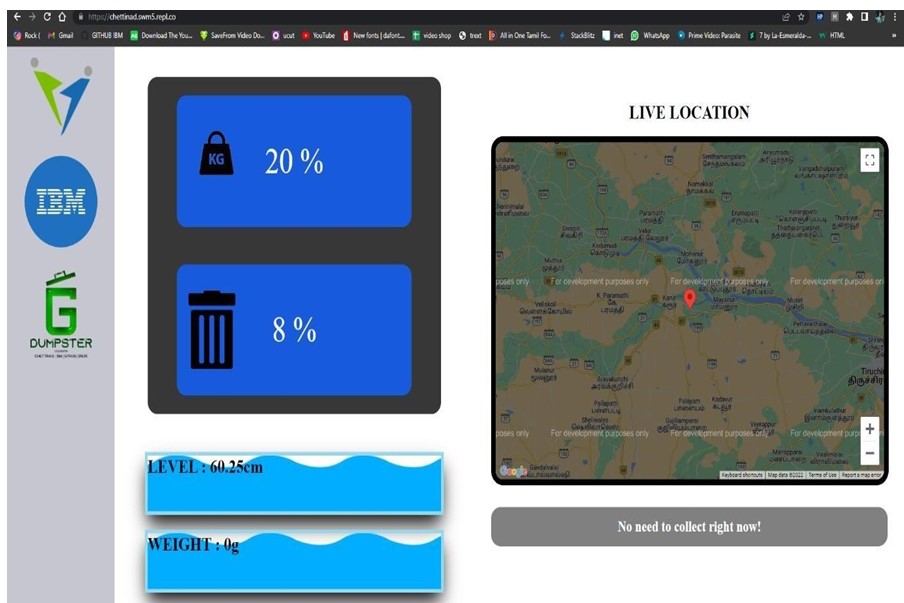
**Screenshot 2**

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**Screenshot 3**

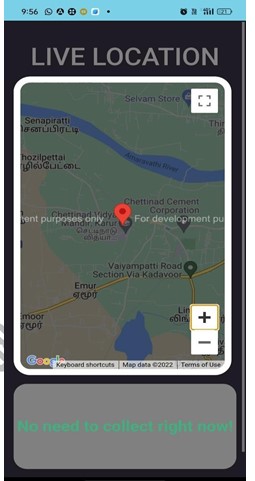
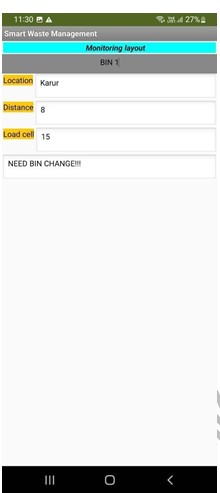
**7. Coding and Solutioning**

**7.1 Feature 1- LOCATION TRACKER**

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**Location Tracker**

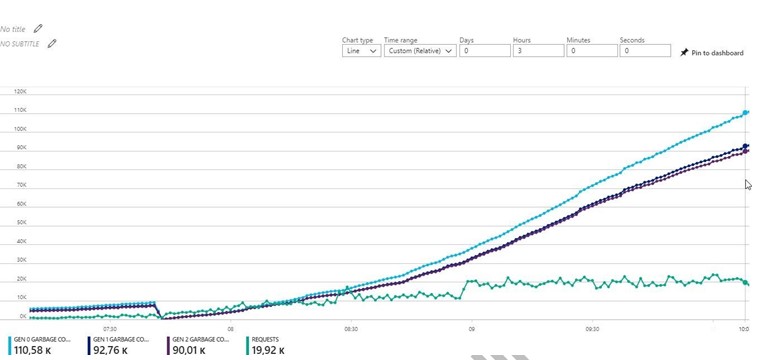
**7.2  Feature 2- LIVE UPDATE ON COLLECTED DATA**

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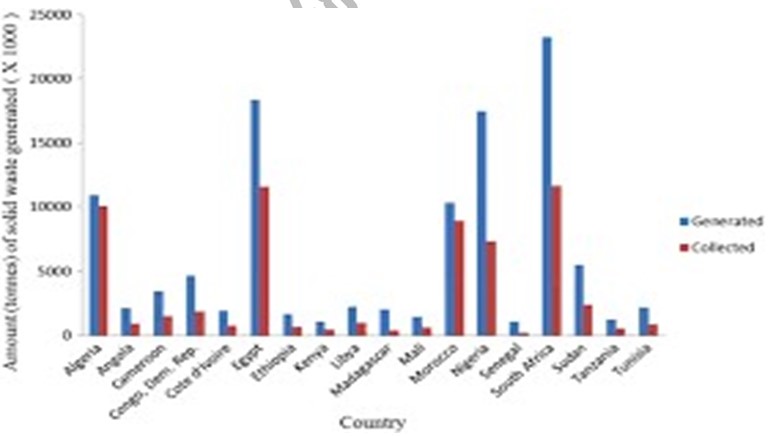
**Live Location Update**

**8. Results and Testing**

**8.1 Performance Metrics**

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**Screenshot 1**

****

**Screenshot 2**

**9. Advantages and 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 SmartWaste Management system that is more effectivethan 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, offeringintelligent 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 wouldencourage the involvement of residents or end users, makingthe 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**

**Source code**

**Main.py**

|  |
| --- |
| c = 1 |
| import time |
| for i inrange(1,2): |
| while True: |
| if c == 1: |
| import distance |
| d=distance.distancesensor() |
| c = 2 |
| elif c == 2: |
| import load |
| w = int(load.loop()) |
| c = 3 |
| else: |
| import database as db |
| if w < 5000 and w > 4000: |
| load = "90 %" |
| elif w < 4000 and w > 3000: |
| load = "60 %" |
| elif w < 3000 and w > 100: |
| load = "40 %" |
| else: |
| load = "0 %" |
| if d > 30: |
| distance = "90 %" |
| elif d <30 and d >20: |
| distance = "60 %" |
| elif d < 20 and d > 5: |
| distance = "40 %" |
| else: |
| distance = "7 %" |
| if load == "90 %" or distance == "90 %": |
| m = "Risk Warning: Dumpster poundage getting high, Time to collect :)" |
| elif load =="60 %" or distance == "60 %": |
| m ="dumpster is above60%" |
| else : |
| m = "        " |
| print("data pushed") |

**Load.py**

|  |
| --- |
| import  time |

|  |
| --- |
| # HOW TO CALCULATE THE REFFERENCE UNIT |
| # To set the reference unit to 1. Put 1kg on your sensor or anything you have and know exactlyhow much it  weights. |
| # In this case, 92 is 1 gram because, with 1 as a reference unit I got numbers near 0 without any weight |
| # and I got numbers around 184000 when I added 2kg.So, according to the ruleof thirds: |
| # If 2000grams is 184000then 1000 gramsis 184000 / 2000 =92. |
| hx.set\_reference\_unit(113) |
| #hx.set\_reference\_unit(referenceUnit) |
| hx.reset() |
| hx.tare() |
| print("Tare done!Add weight now...") |
| # to use both channels, you'll need to tarethem both |
| #hx.tare\_A() |
| #hx.tare\_B() |
| def loop(): |
| try: |
| # These three linesare usefull to debugwether to use MSB or LSB in the readingformats |
| # for thefirst parameter of "hx.set\_reading\_format("LSB", "MSB")". |
| # Comment the two lines "val = hx.get\_weight(5)" and "print val" and uncomment these three lines to see what  it prints. |
| # np\_arr8\_string = hx.get\_np\_arr8\_string() |
| # binary\_string = hx.get\_binary\_string() |
| # print binary\_string + " "+ np\_arr8\_string |
| # Prints the weight. Comment if you're debbuging the MSB andLSB issue. |
| val = hx.get\_weight(5) |
| print(val) |
| return val |
| # To get weightfrom both channels (if you haveload cells hookedup |
| # to both channel A and B), do something likethis |
| #val\_A = hx.get\_weight\_A(5) |
| #val\_B = hx.get\_weight\_B(5) |
| #print "A: %s B: %s" % ( val\_A,val\_B ) |

|  |
| --- |
| hx.power\_down() |
|  |
| hx.power\_up() |
| time.sleep(0.1) |
| except (KeyboardInterrupt, SystemExit): |

D**istance.py**

|  |
| --- |
| import RPi.GPIO as GPIO |
| import time |
| def distancesensor(): |
| try: |
| GPIO.setmode(GPIO.BOARD) |
| GPIO.setwarnings(False) |
| PIN\_TRIGGER = 23 |
| PIN\_ECHO = 33 |
| GPIO.setup(PIN\_TRIGGER, GPIO.OUT) |
| GPIO.setup(PIN\_ECHO, GPIO.IN) |
| GPIO.output(PIN\_TRIGGER, GPIO.LOW) |
| time.sleep(2) |
| GPIO.output(PIN\_TRIGGER, GPIO.HIGH) |
| time.sleep(0.00001) |
| GPIO.output(PIN\_TRIGGER, GPIO.LOW) |
| while GPIO.input(PIN\_ECHO)==0: |
| pulse\_start\_time = time.time() |
| while GPIO.input(PIN\_ECHO)==1: |
| pulse\_end\_time = time.time() |
| pulse\_duration = pulse\_end\_time  pulse\_start\_time |
| global distance |
| distance = round(pulse\_duration \* 17150, 2) |
| print(distance) |
| return distance |

W**ebpage coding**

Index.html

<!DOCTYPEhtml>

 <html>

<head>

<link      rel="stylesheet"     href="[https://cdn.jsdelivr.net/npm/bootstrap@4.3.1/dist/css/bootstrap.min.css](https://cdn.jsdelivr.net/npm/bootstrap%404.3.1/dist/css/bootstrap.min.css)"                 integrity="sha384- ggOyR0iXCbMQv3Xipma34MD+dH/1fQ784/j6cY/iJTQUOhcWr7x9JvoRxT2MZw1T" crossorigin="anonymous">

<meta charset="utf-8">

<meta name="viewport" content="width=device-width">

<title>Garbage Management System</title>

<link rel="icon" type="image/x-icon" href="/Images/DUMPSTER.png">

<link href="style.css" rel="stylesheet" type="text/css" />

<script src="https://[www.gstatic.com/firebasejs/8.10.1/firebase-app.js](http://www.gstatic.com/firebasejs/8.10.1/firebase-app.js)"></script>

<scriptsrc="https://[www.gstatic.com/firebasejs/8.10.1/firebase-database.js](http://www.gstatic.com/firebasejs/8.10.1/firebase-database.js)"></script>

<script>

var firebaseConfig =

{

apiKey: "AIzaSyB9ysbnaWc3IyeCioh-aJQT\_UCMd5CBFeU", authDomain: "fir-test-923b4.firebaseapp.com",

databaseURL: "https://fir-test-923b4-default-rtdb.firebaseio.com", projectId:"fir-test-923b4",

storageBucket: "fir-test-923b4.appspot.com", messagingSenderId: "943542145393",

appId: "1:943542145393:web:9b5ec7593e6a3cbd7966d0", measurementId: "G-BN7JNX1Q7B"

};

</head>

firebase.initializeApp(firebaseConfig)

</script>

<scriptdefer src="database.js"></script>

<body style="background-color:#1F1B24;">

<scriptsrc="map.js"></script>

</div>

</div>

<div id="map\_container">

<h1 id="live\_location\_heading" >LIVELOCATION</h1>

<div id="map"></div>

<div id="alert\_msg">ALERT MESSAGE!</div>

<center><a href="https://goo.gl/maps/G9XET5mzSw1ynHQ18" type="button" class="btn btn-dark">DUMPSTER</a></center>

<script

src="https://maps.googleapis.com/maps/api/js?key=AIzaSyBBLyWj-

3FWtCbCXGW3ysEiI2fDfrv2v0Q&callback=myMap"></script></div>

</body>

</html>

**Database.js**

const cap\_status = document.getElementById('cap\_status'); const alert\_msg= document.getElementById('alert\_msg');

var ref = firebase.database().ref();

ref.on("value", function(snapshot)

{

snapshot.forEach(function (childSnapshot) { var value = childSnapshot.val();

const alert\_msg\_val = value.alert;

const cap\_status\_val = value.distance\_status;

alert\_msg.innerHTML= `${alert\_msg\_val}`;

});

}, function (error) { console.log("Error: "+ error.code);

});

**GITHUB LINK:**

[**https://github.com/IBM-EPBL/IBM-Project-49144-1660816340**](https://github.com/IBM-EPBL/IBM-Project-49144-1660816340)

**DEMO LINK:**

[**https://youtu.be/RVoHUWsUEo8**](https://youtu.be/RVoHUWsUEo8)