

# Location Based Garbage Management System with IOT for Smart City

## Project Proposal

Project ID : 17-100



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# Introduction

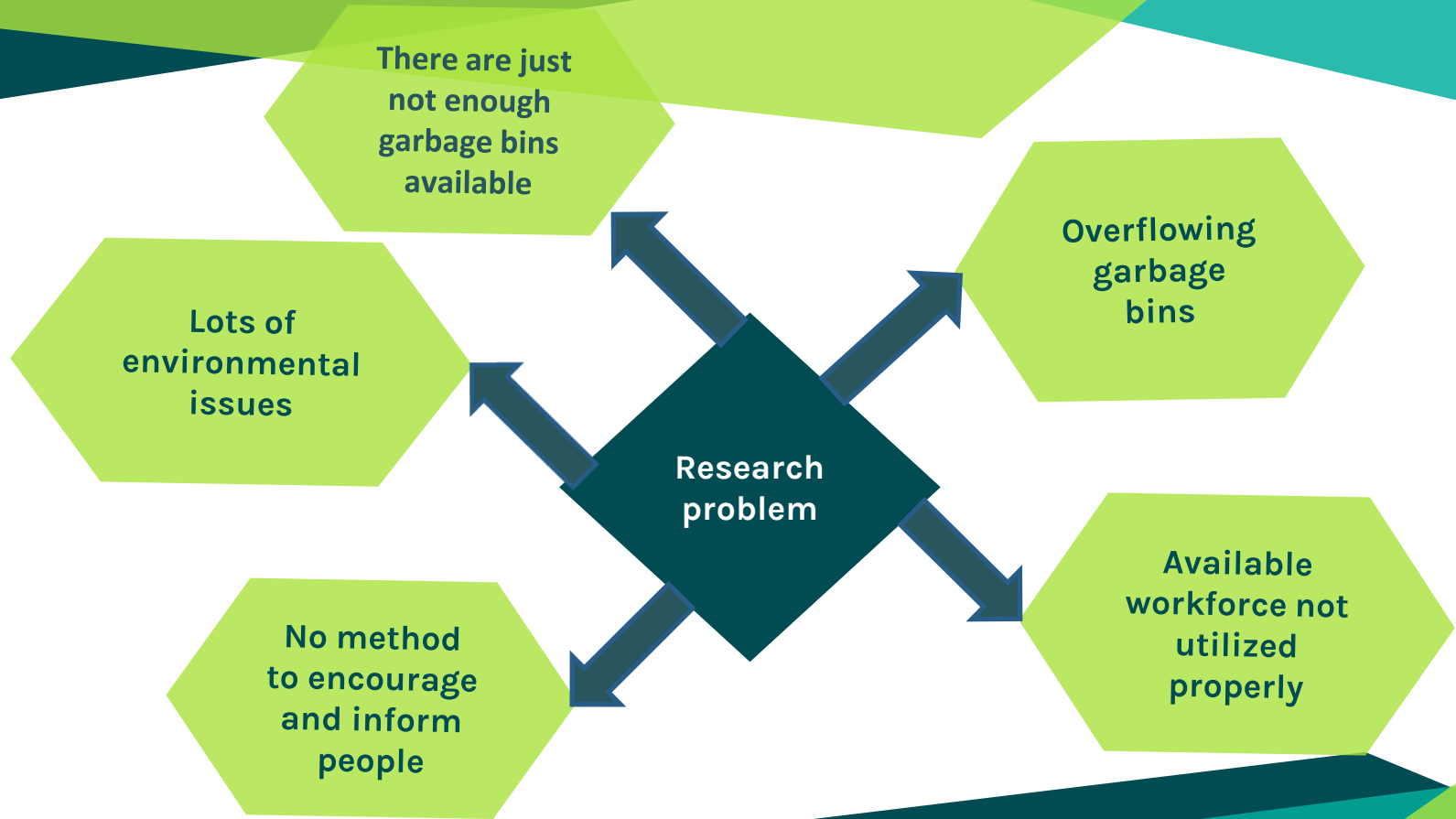
Proper waste management is a basic requirement in any kind of an environment.

With the implementation of smart cities such a system is essential, since the methods used by the current governments is not effective.

We're proposing a system that will be

- ☐ User Satisfactory
- ☐ Environmentally Effective
- ☐ Socially Acceptable
- ☐ Economically Affordable

# Research problem



# Research gap

Implementation	Feature 1	Feature 2	Feature 3
<b>Smart Bin Implementation for Smart Cities (2015)</b>	Fill levels via SMS	Real time bin level indicator	Real-time dashboard along with a time series graph
<b>Cruisers: A Public Automotive Sensing Platform for Smart Cities (2016)</b>	Garbage collecting trucks are used as host automobiles to accommodate sensors	3G cellular communication network is used to wirelessly deliver sensed data	Java program to control sensor nodes

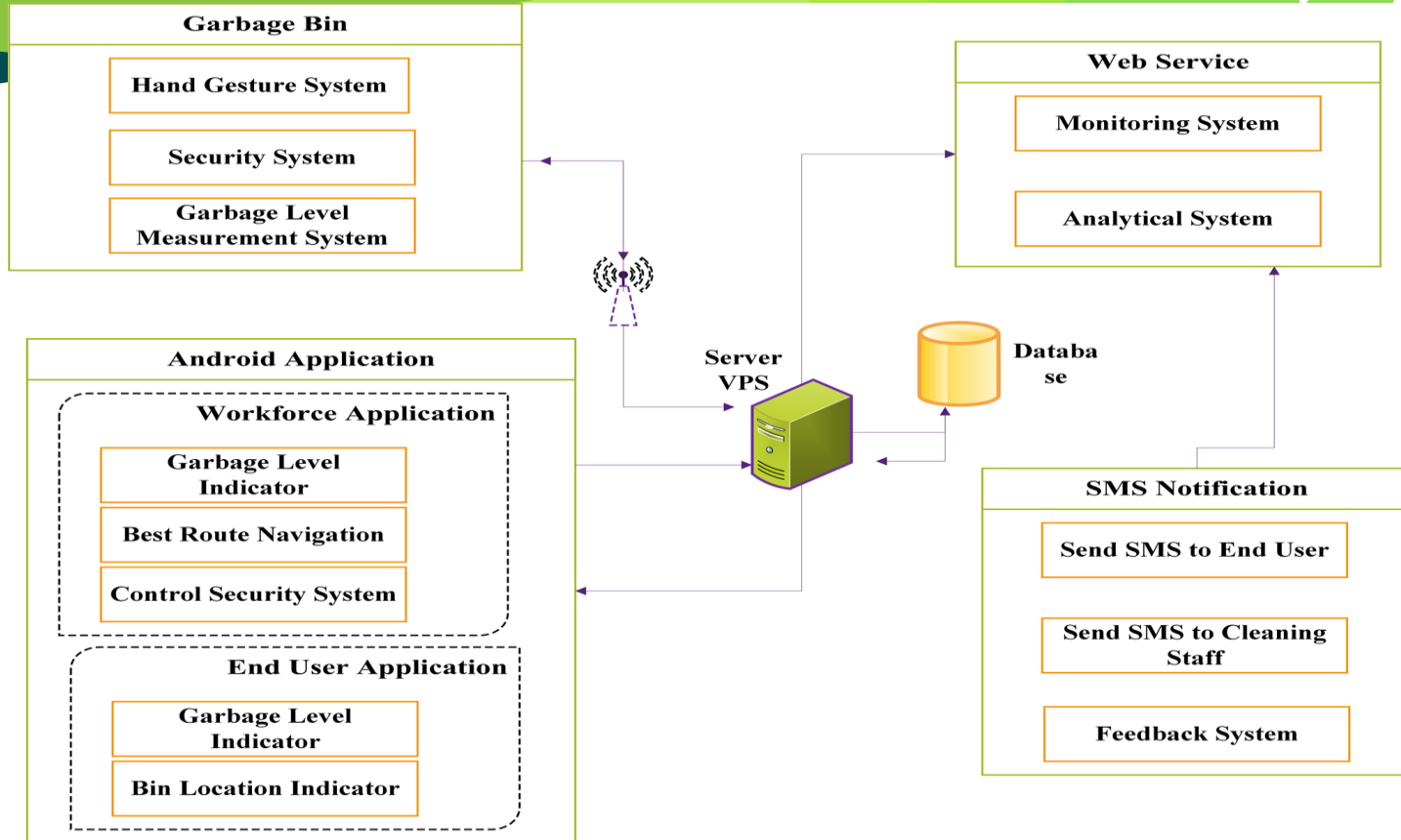
## Research gap con ....

Implementation	Feature 1	Feature 2	Feature 3
<b>IOT Based Smart Garbage alert system using Arduino UNO (2016)</b>	Checking garbage bin levels and sending it to the municipal council	Use RFID Tag to confirm that cleaning is done	An Android application is developed and linked to a web server to send the alerts and remote monitor worker progress
<b>Top-k Query based Dynamic Scheduling for IoT-enabled Smart City Waste Collection (2015)</b>	City is divided into zones	Use of LCGT's and HCGT's	Uses cloud to collect data



# ***Methodology***

# High-level Architecture





# Setting up the Garbage Bin

All the Processes of the garbage bin are implemented on a Raspberry pi zero Development Board.

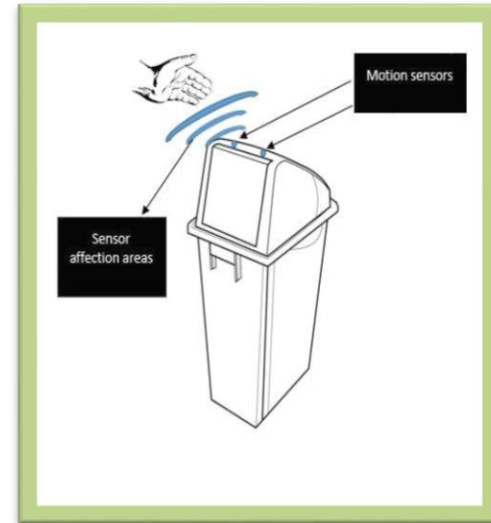
Setting up the garbage bin divided into three main sub-functions

- ❑ Hand Gesture System
- ❑ Measure the Real time Garbage level
  - Data Transfer
  - Bin lock mechanism
- ❑ Security System

# Hand Gesture System

Two motion sensors will be set in front of the bin.  
These sensors will detect a simple hand movement.

When a motion detected, Servo motor will  
Help to open and close the lid.

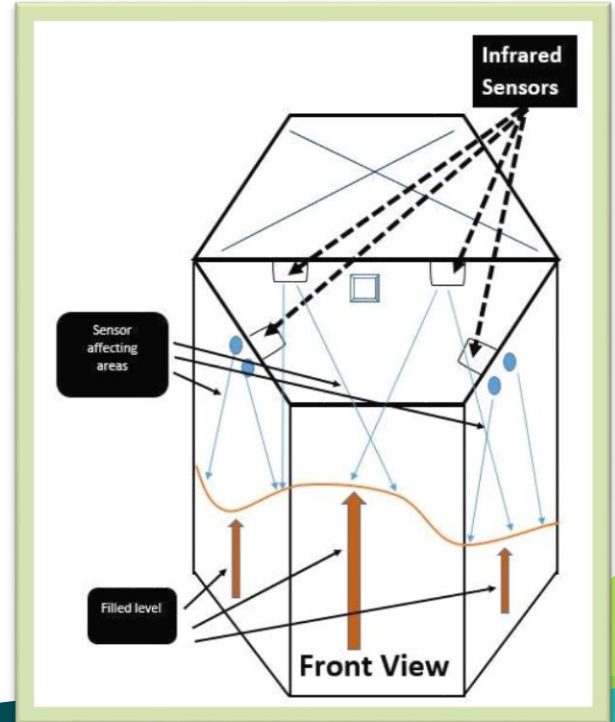


# Measure the Garbage level

Using four infrared sensors an average garbage level will be measured.

Garbage level will be sent through Wi-Fi using ESP8266 Wi-Fi module.

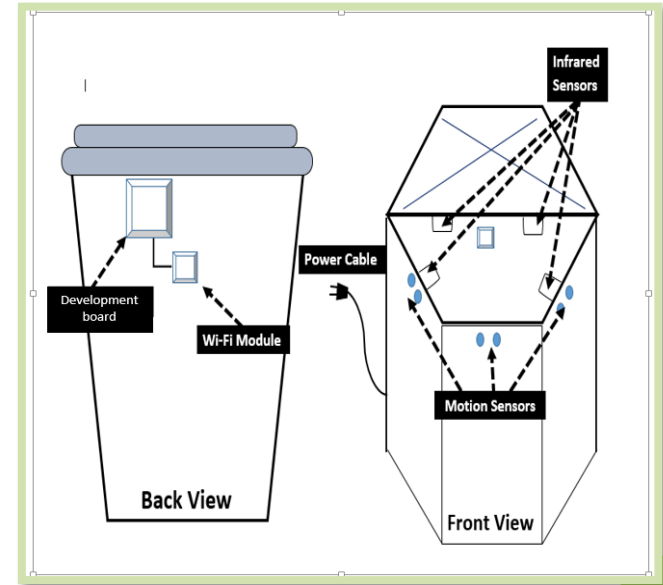
When the garbage level reaches 100% the bin lid will be automatically locked.



# Security System

Since the proposed research is based on location, Garbage bins will have a specific system to alert management of unauthorized movement.

While Workforce staff is cleaning bins, they have a option to disable the sensors until their job is finished



# Web Server and Web Service Setup

## Web Server Setup

- ❑ Setting up VPS
- ❑ Hosting website
- ❑ Installing and setting up Databases

## Web Services

- ❑ Analytical system
- ❑ Generate reports
- ❑ Monitoring system

# Server Service Provider

To select a service provider we considered

- ☐ Google Cloud Console
- ☐ Digital Ocean
- ☐ AmazonAWS

# Server Specifications

OS - Ubuntu Server 16.04 LTS

RAM - 1 GB

Storage - 30GB SSD

Network Bandwidth – 15GB

CPU - 1 vCPUs, 2.5 GHz, Intel Xeon Family

Server location – Singapore

Service Provider - AmazonAWS



**Ubuntu Server 16.04 LTS (HVM), SSD Volume Type** - ami-ee7bca8d

Free tier eligible

Ubuntu Server 16.04 LTS (HVM), EBS General Purpose (SSD) Volume Type. Support available from Canonical (<http://www.ubuntu.com/cloud/services>).

Root device type: ebs

Virtualization type: hvm

# Software to be Used

Software	Task
Puttygen	To create private key
Putty	SSH connect to the server
WinSCP	FTP client to transfer files
LAMP server	Package includes : Apache web server
	: MySQL database
	: PHP language



# Purpose of the Website

- ❑ Real time monitoring system
- ❑ Display analyzed data
- ❑ Manage Workforce
- ❑ Get notifications on bin levels
- ❑ Feedback and news update system for users



# Types of Users

## Normal User

- View real-time bin details
- Give Feedback
- Request bins on specific locations
- Receives system news and updates

## Management User

- View real-time bin details
- Track workforce progress
- Add, remove and update bin details.
- Get monthly, annual reports.
- Manage normal users



# Purpose of Webserver

- ❑ Receive real-time bin updates and store them in the database
- ❑ Feed Real-time data to monitoring system
- ❑ Analyze stored bin levels and display them in the analytical system
- ❑ Calculate routes for Workforce and Client applications
- ❑ Manage bin security alerts
- ❑ Enable/disable security system
- ❑ Manage user feedback
- ❑ Generate reports

# Android Application Development

While in the development stage two separate applications will be developed for the workforce and the user. After the two applications have been developed, the two apps will be merged together to form one final application

## Workforce Application

- Real-time level and bin location
- Route calculation
- disabling/re-enabling security system



# Real time levels & Bin location

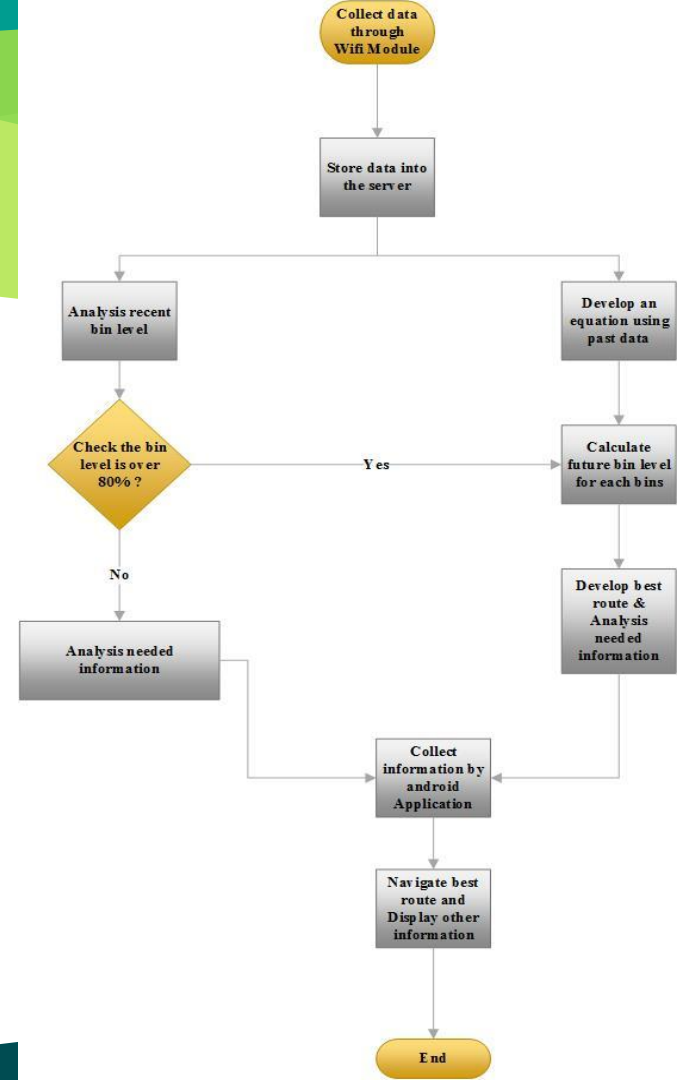
The map shows all the bins that are placed throughout the city. The cleaner can access each bin to get all the specific information about the bin like real time level, history of fill levels, etc.



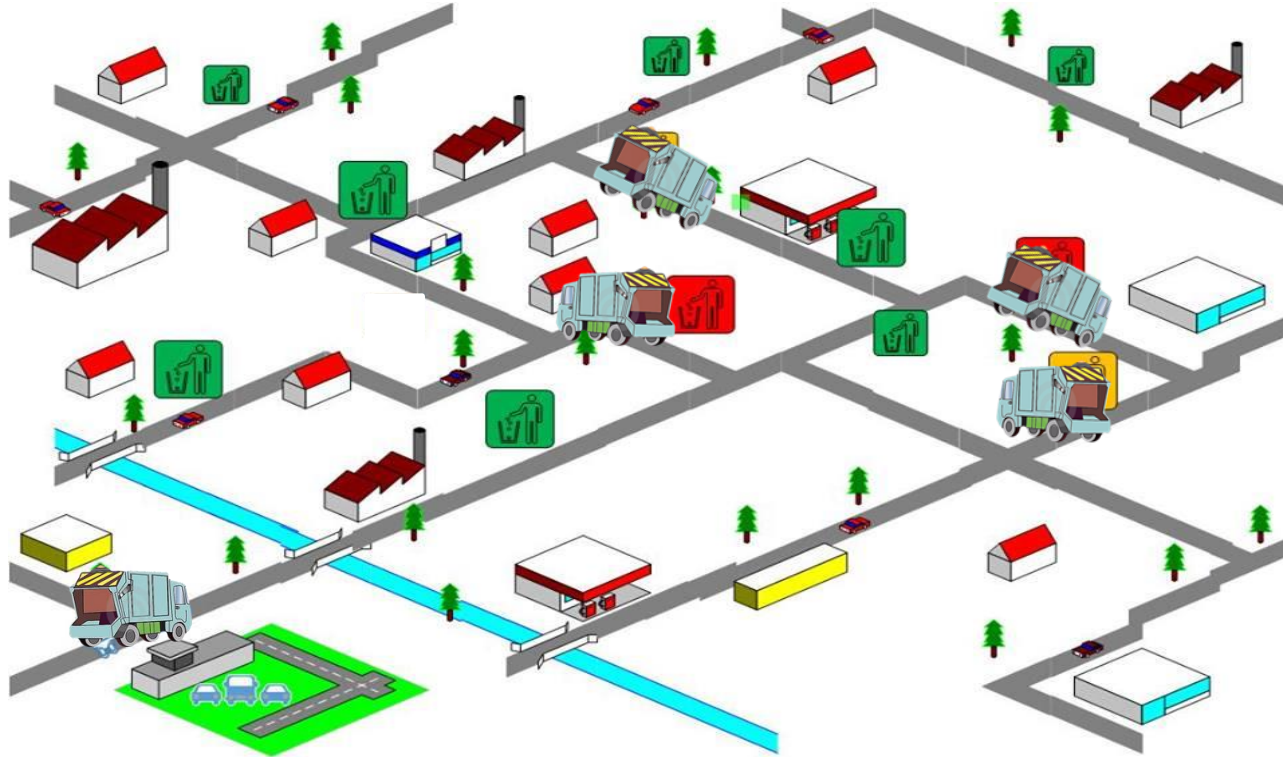
## Route calculation

When a certain bin reaches 80% fill level the cleaner receives the best route calculated to the that bin from the base station. This route is calculated taking into consideration some other bins that will be filled in a certain period of time in the future. These extra bins will be added as waypoints into the route.

# Route Calculation Flow Chart



# Workforce Route Navigation





# Disabling and Enabling Security System

As mentioned earlier the bin have a security system that is enabled when its placed in the city.

When a cleaner has to clean a bin, the security system has to be disabled in order to do so.

This function enables the cleaner to disable the security system at the start and re- enable it when the cleaning is finished using the application.



# End user application

This application has the following functionality

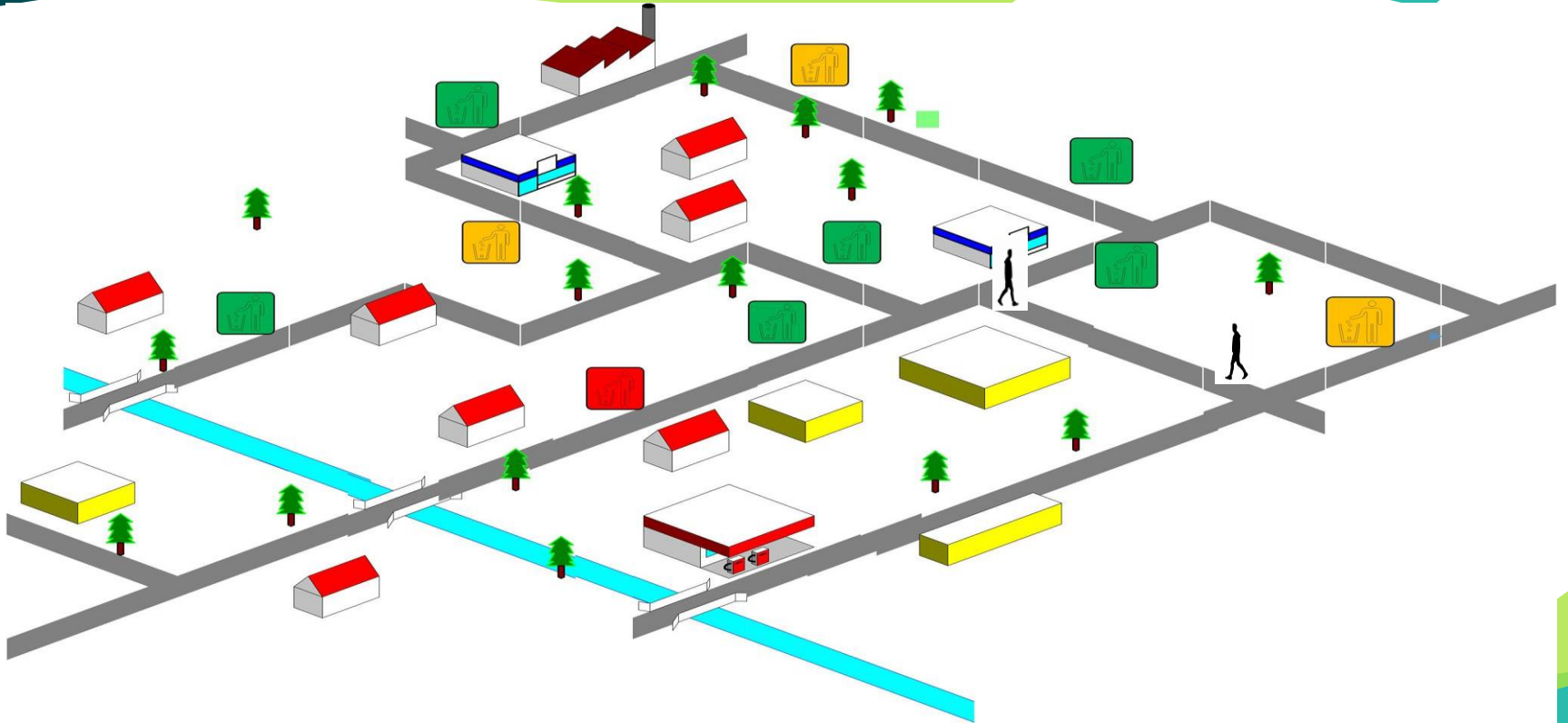
- Bin location detail visualizer
- Bin navigator



## End user application con....

- ❑ Bin location detail visualizer : This application has the functionality to view all the bin locations and their fill levels through the given map.
- ❑ Bin Navigator : This provide a route to the nearest available bin. This route is calculated by considering the GPS location of the user. The best route from the current location to the nearest available bin is provided in the map provided in the application.

# End user application con...



# SMS Notification System

- ❑ Sending SMS to cleaners and administrators, when a bin gets 80% and 100% full.
- ❑ Develop a web interface to get feedback from users.
- ❑ Inform system news and updates to users.
- ❑ A system for users to request bins on specific locations or report malfunctions.
- ❑ Ultimately provide better communication system



# Work Allocation

Member	Main Function	Research Component
G.S.B. Dabarera	Garbage Bin Setup and Management	Build an efficient IoT module with low power consumption
R.K.R. Ranaweera	Web Services	Build an API that analyzes and utilize collected data in an optimized manner.
P.G.D.M. Perera	Workforce Application	Build an efficient route calculation algorithm.
P.A.V.D.R. Panangala	End User Application & Notification/ Feedback System	Crowdsourcing. Build an effective communication platform.

# Gantt chart

ID	Task Name	Start	Finish	Duration	Q1 17			Q2 17			Q3 17			Q4 17	
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1	Project Topic Selection	1/5/2017	2/3/2017	22d											
2	Literature Reviews	1/20/2017	3/15/2017	39d											
3	Project Pre-Assessment	2/13/2017	2/15/2017	3d											
4	Project Charter Submission	3/3/2017	3/6/2017	2d											
5	Project Proposal Report	3/10/2017	3/17/2017	6d											
6	Project Proposal Presentation	4/3/2017	4/7/2017	5d											
7	Design Basic Structure of Trash Can	3/24/2017	4/3/2017	7d											
8	Gather information & Select Suitable Sensor	3/24/2017	4/6/2017	10d											
9	Buy Required Material	4/4/2017	4/21/2017	14d											
10	Develop Basic Structure of Trash Can	4/10/2017	4/25/2017	12d											
11	Develop Workforce Android App	3/31/2017	9/14/2017	120d											
12	Develop End User Android App	3/31/2017	9/14/2017	120d											
13	Web Server Setup	4/10/2017	4/21/2017	10d											
14	SRS Document	4/11/2017	4/25/2017	11d											
15	Configure Development Board	4/19/2017	4/27/2017	7d											
16	Individual Sensors & WiFi Module Configure	4/28/2017	5/26/2017	21d											
17	Configure Local Database	5/10/2017	5/18/2017	7d											
18	Upload Sensor's Data to Server	5/26/2017	6/5/2017	7d											
19	Design & Develop Web Application	5/1/2017	9/15/2017	100d											
20	Develop Algorithm For Route Calculation	6/20/2017	8/14/2017	40d											
21	Calculate shortest route to available bins	6/9/2017	8/3/2017	40d											
22	Progress presentation (50%)	6/27/2017	6/30/2017	4d											
23	Configure Hand Gesture System	8/1/2017	8/9/2017	7d											
24	Develop SMS Notification System	8/10/2017	8/23/2017	10d											
25	Develop Security Management	8/15/2017	9/11/2017	20d											
26	Progress Presentation (90%)	9/5/2017	9/13/2017	7d											
27	Hosting Web Site on VPS	9/14/2017	9/22/2017	7d											
28	Migrate Local Database to VPS	9/14/2017	9/22/2017	7d											
29	Integrate all sub Systems	9/22/2017	10/31/2017	28d											
30	Testing and Fixing bugs	3/31/2017	10/31/2017	153d											
31	Final Report (draft)	5/1/2017	10/4/2017	113d											
32	Final Report (draft) – Feedback Submission	10/20/2017	11/24/2017	26d											
33	Final Presentation	11/20/2017	11/24/2017	5d											
34	Viva	11/20/2017	11/24/2017	5d											
35	Research Paper	7/3/2017	8/18/2017	35d											

\* Indicates the current position

# Budget

Description	No. Of Items	Cost per Item	Total
Garbage Container	1	Rs.2000.00	Rs.2000.00
Raspberry pi zero	1	Rs.500.00	Rs.500.00
Motion Sensor	2	Rs.250.00	Rs.500.00
Infrared Sensor	4	Rs.180.00	Rs.720.00
Server(VPS)	1	Rs.600.00	Rs.600.00
Servo motor	1	Rs.350.00	Rs.350.00
Wi-Fi Module	1	Rs.270.00	Rs.270.00
Sub total			Rs.4940.00
Additional Expenses			Rs.2000.00
Grand Total			Rs.6940.00



# Testing and Evaluation

Building

Testing

Implementing

- ❖ The proposed system has to follow a set of testing phases to check the quality of the system.
- ❖ This will help to evaluate the system of various aspects:
  - Accuracy
  - Efficiency
  - User friendliness
- ❖ During the initial stages in the testing phase each and every group member carries out an individual testing on each single task completed.
- ❖ After each successful completion on the unit testing on each task, each and every component is integrated.
- ❖ Then an integration testing is performed, which will ultimately eliminate the integrated errors.

# Testing and evaluation con....

There is a testing phase when a system is initially setup in a city

In the 1st week

- ❑ bins are placed on specific locations, data is collected and analyzed
- ❑ the collected data is taken as past data to calculate routes

In the 2nd week

- ❑ garbage trucks are implemented with routes
- ❑ Feedback system for citizens is implemented



Then the system is evaluated by the managers for the implemented city.

# Commercialization

This project is implemented for government and private sector.

After implementing on these sectors, a value is going to be placed on the system.

This value is going to be the eventual demand for the system.



# Thanks!

Any questions?