Location Based Garbage Management System with IOT for Smart City

Project ID : 17-100

SRS Document

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(Proposal documentation submitted in partial fulfilment of the requirement for the Degree of Bachelor of Science Special (honors) In Information Technology)

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2nd of May, 2017

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1 Introduction

1.1 Purpose

The purpose of this Software Requirements Specifications (SRS) document is to clearly explain the details of two component of the A Location Based Garbage Management System with IOT for Smart City. This document mainly identifies and analyze the functional and nonfunctional requirements of project strategy enhancer subject to the SMS notification and feedback system and End user application. Information of how this functions interacts with other components will be included with this document. This includes the entry and exit criteria of this document, and the dependencies among functions. This document is intended to give a clear understanding of this particular components of the system, regardless of the reader's expertise. Furthermore, this document describes in detail about the research areas that are involved in the project and dependencies assumption made for implementation and technologies, which are going to use to implement the system respect to two function above mention. There are other SRS documents and one Design document which describe the other side of the Location Based Garbage Management System with IOT for Smart City project.

1.2 Scope

Location Based Garbage Management System with IOT for Smart City has several major components, but this document will primarily focus on main two functions which are SMS notification and feedback system and end user application. The other major components will be explained in three other documents with each document focusing on one of the major components. For development purposes we have decided to build two separate applications for the workforce and the user. After the two applications have been developed we hope to merge them into one final application. In this document mainly focus on end user application. This application is built for users those who going to use our system. This application will help to manage their garbage efficiently. This document will discuss what the main functionality it has and how android will be used to develop this application.

Another aspect of the project is SMS notification and feedback system. In here also there are two separate part which are SMS notification system and feedback system for end users and SMS notification for workforce staff. Since our project is interact with lot of people this will explain how to manage users and staff. Also this will explain how to use crowd sensing to manage data efficiently that gather form people. And also explain User participation, Data sensing quality, User anonymity and how these crowd sensing aspect will improve our project.

1.3Definitions, Acronyms, and Abbreviations

SNFS	SMS notification and feedback system
HAL	hardware abstraction layer
CTS	compatibility test suite
IOT	Internet Of Things
Author	Project members
LRU	Last recently Use
HTTP	Hypertext Transfer Protocol
CSS	Cascading Style Sheets
PHP	Personal Home Page
UI	User Interface

1.4 Overview

Following content describes the overview of A Location Based Garbage Management System with IOT for Smart City project and its workflow.

The section one gives the brief description about the overall project mentioning the important points and what is the expected outcome of the project. Reference materials can be found in last section, which are mostly referenced to this document.

In Section 2, it gives an idea about the overview of the functionality of project. It describes the informal requirements, hardware, software and Graphical User Interfaces and other dependencies in this section. It will be context to the technical requirement specification, which is addressed in the next section.

The section 3 is intended for the developers of the project and the functionalities, interfaces are further described in technical terms. Non-functional requirements are also described in the later part of section 3.

Objective of end user application is to provide better service to customers. This application also has the functionality to view all the bin locations and their fill levels through the given map. But the main function is to provide a route to the nearest available bin.

Route calculation will be doing in server and route will send to android application .Using android application user interface user can view the map via user's android phone.

Other component of this SRS document is SNFS. In this system, we are building two separate account groups for the workforce staff and end users.

For the working staff we will send a SMS in following manner.

When garbage bin fill level is 80%, it will send a SMS to relevant the cleaning member with the garbage bin location and garbage bin id by telling this garbage bin is 80% filled.

When the garbage bin is 100% filled, it will send a SMS to the relevant cleaning member by telling that the bin has to be cleaned immediately.

For the end user we are building simple web interface. Which can send SMS to citizen to inform about our news etc. If there is a breakdown going on and our service is not available days or hours, we can inform citizen for their convenience.

Also by accessing the web, interface users can give feedback for our system. Etc.: if in a certain area, garbage is not being managed properly or a certain garbage bin is not working properly. These systems will improve the communication between users and our system to provide a better service. To do this crowd sensing will be use and how to manage this stagey to improve our project.

2. Overall Descriptions

Proper waste management is a basic requirement in any kind of an environment. Usually cleaning in these environments are done in the morning and the afternoon. If you take an urban city like Colombo usually there are about 1,200,000 to 1,500,000 [1][2] employees heading for their workstations every morning. For all those people there are just not enough garbage bins available. On streets of urban cities, hundreds of people are passing the same location around one minute. Around 95% [3] of people are carrying food covers, polythene bags and plastic bottles.
This project is develop for smart city. That is means we have to deal and mange huge crowd. To do this crowd sensing [4] will be use. crowd sensing, is a technique where a large group of individuals having mobile devices capable of sensing and computing (such as smartphones, tablet computers, wearable's) collectively share data and extract information to measure, map [7], analyze, estimate or infer. To this SNFS will be develop. In SNFS, there is simple web interface to gather information from those who use our system. In addition, users can send SMS to our system by telling what are the things that need to improve in our system, what the vulnerabilities. By getting those data our system can be improve efficiently and user friendly. In crowd sensing there are three methods that need to consider before gather data. Those are

- User participation
- Data sensing quality
- User anonymity

2.0.1 User participation

SNFS systems typically involve a very large number of users or crowd sensors in the sensing tasks by collecting and sending local data obtained through their sensor-enabled mobile devices to our databases. The performance and usefulness of such sensor networks heavily depends on the crowd sensor's willingness to participate in the data collection process.

2.0.2 Data sensing quality

In SNFS systems, there is no control over the crowd sensors and hence, we cannot control their behavior or assume they will be equally honest. Therefore, the overall quality of the sensor readings may deteriorate if counterfeit data is received from malicious users. Then, the obvious question is how to validate the sensing data that crowd sensors provide to the system. Hence, data that comes to our system need to be validate and store in databases. MUSQL will use as a database for our system. After that, these data can be use respect to users needed.

2.0.3 User anonymity

An important aspect of MCS scenarios is the collection of potentially sensitive information pertaining to individuals. To do this we have to keep track of users those who send data to our system frequently and those who are not.

According to data that we gather from our SNFS, Author can do changes in future to end user application and it will affect other functions. In end user, application has following functions.

It has view all the bin locations and their fill levels through the given map.

Users can easily find what the bins available to their usage are. How we are going to place garbage bins, what ate the changes that we can do in map which shown in android application can be change decide using data that we collect from our SNFS system.

But the main function is to provide a route to the nearest available bin. This route is calculated by considering the GPS [7] 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. By using this function user can find nearest bin to his location. This function will help to user to save his time and energy

Currently end user application will develop using android studio, which will support all android versions. Following chart will show the data about the relative number of devices running a given version of the Android platform. [6]

Version	Codename	API	Distribution
2.3.3 - 2.3.7	Gingerbread	10	0.9%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	0.9%
4.1.x	Jelly Bean	16	3.5%
4.2.x		17	5.1%
4.3		18	1.5%
4.4	KitKat	19	20.0%
5.0	Lollipop	21	9.0%
5.1		22	23.0%
6.0	Marshmallow	23	31.2%
7.0	Nougat	24	4.5%
7.1		25	0.4%

According to chat, most of people are using marshmallow. According to detail that we gather from our SNFS, we can further develop and upload further new versions of end user application.

2.1 Product perspective

There are lot of garbage management project are going on. In those project lot of people forces on garbage recycling but very less people focus on how to manage garbage properly within a country or with in smart city. As per literature review we did, there are no such system similar to what we are going to build called A Location Based Garbage Management System with IOT for Smart City. There are some research focus only to build a smart trashcan; others try to develop only application and feeding routing to garbage collection trucks for garbage collection purpose. [8][9] None of them is perfective. However, when it comes our system this will cover all areas of garbage management. How to build smart garbage bin will be explain in design document. Creating web service and how to manage database for our system will be explain in other SRS and other two SRS will be explain how to manage users by developing end user and work force application. All to gather we are developing and perfect system for garbage management.

2.1.1 System interfaces

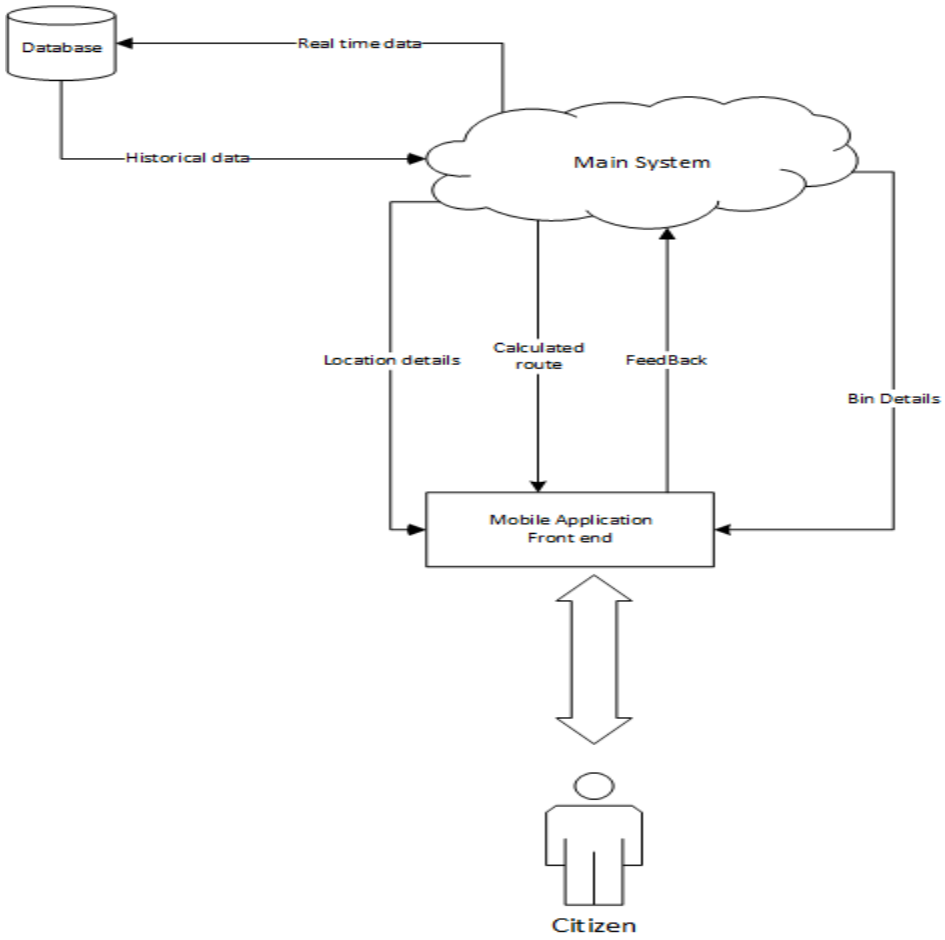

Figure 2.1.1.1: System Interface diagram

Author is going to design few system interfaces to gather the data, manipulate, and provide system endpoints to distribute the transformed data for route calculation Processor and keep service management. We have two data sources. One is live data which coming from garbage bins. Other data source is data, which we previously gather from our bins. Those data will be store in our SQL [10] databse. Those data will be added to route calculation algorithm and calculate best route for working staff and end users.

In addition, to provide better service this project has two-notification function which users can notify us using our web site and sending SMS to or system. To provide better service to

customers, notification system will send SMS to cleaning staff when bin level reach to 80% and 100%.

2.1.2 User interfaces

End user application and SNFS system has many interfaces'. By providing these interfaces, users and management can use this system very easily.

2.1.2.1 Login interfaces

Users must log in to system by using their user name and password. Users those who are not register to our system can register by clicking register button.

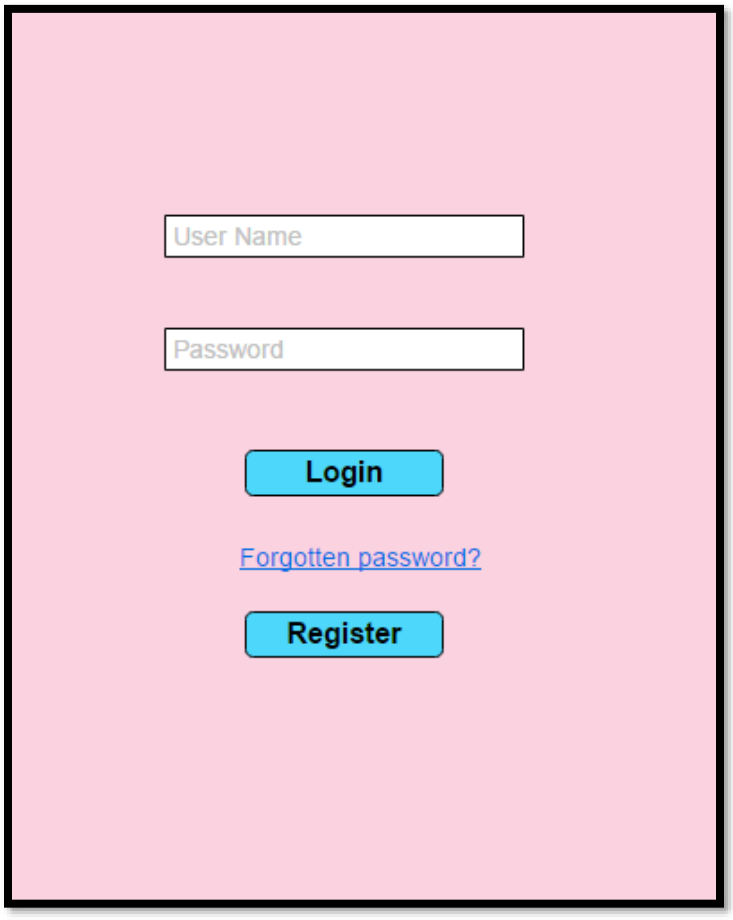

Figure 2.1.2.1.1: Login Interface

2.1.2.2 Menu Interface

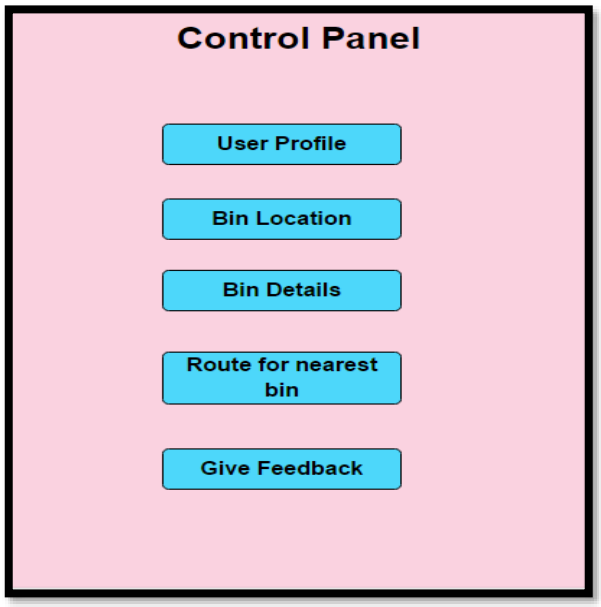

Figure 2.1.2.2.1: control panel

Users can select which service they need using this interfaces.

2.1.2.3 Feedback interface

Users can send feedback to our system by using following interfaces.

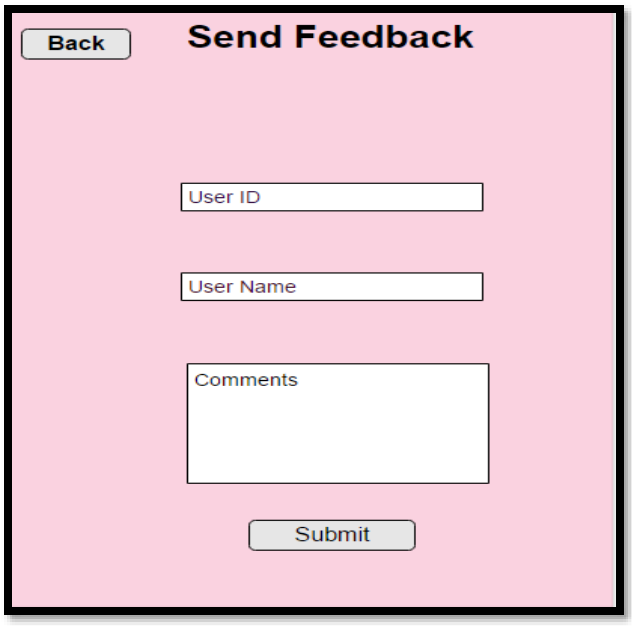

Figure 2.1.2.3.1: Feedback interface

2.1.2.4 Bin details/location details

Figure 2.1.2.4.1:Bin detail

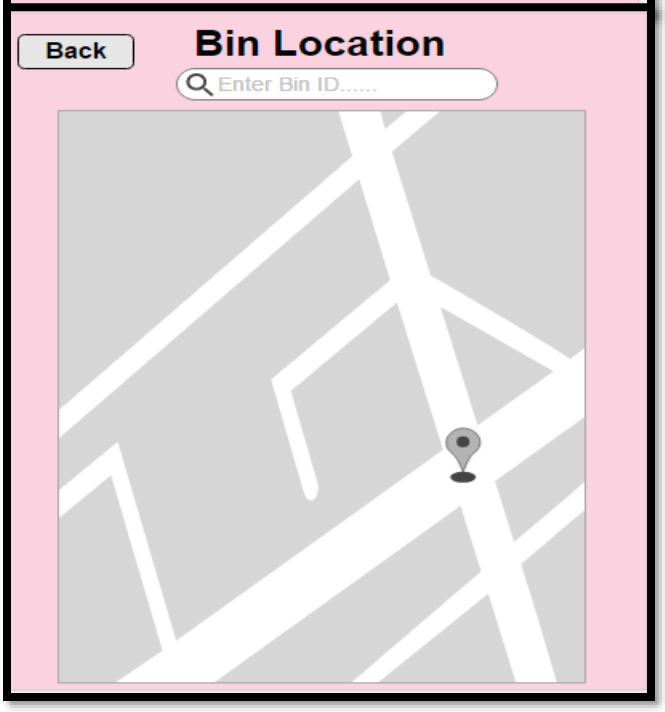

Figure2.1.2.4.2: Bin location

Users can view bin location details by bin location interface. And bin detail interface will show all bin details.

2.1.2.5 Admin user interfaces

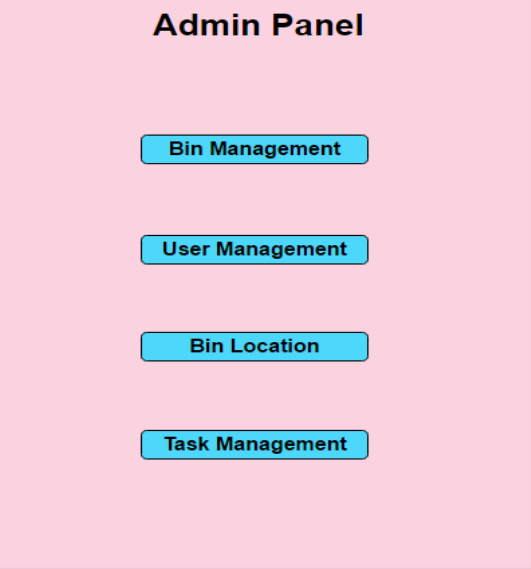

Figure 2.1.2.5.1: Admin panel

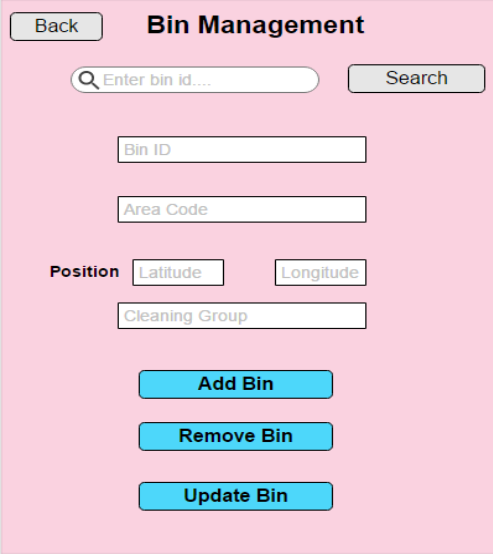

Figure 2.1.2.5.2: Bin Management

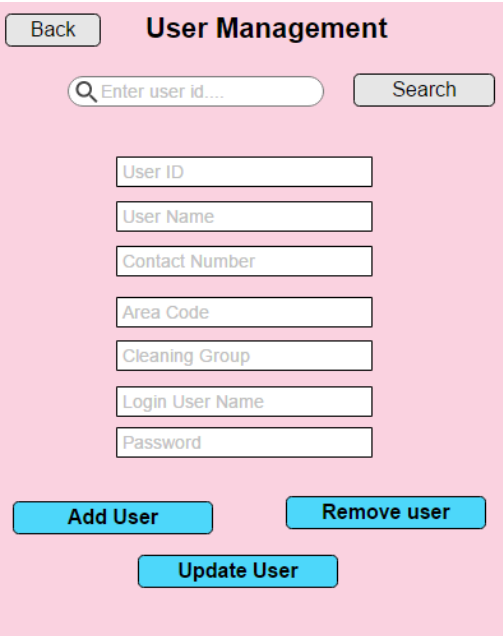

Figure 2.1.2.5.3: User management

Using these interfaces admin can do several task like add bins, remove bins.

2.1.3 Hardware interfaces

Since we are using android for develop end user application there will be HAL. The hardware abstraction layer (HAL) provides a standard method for creating software hooks between the Android platform stack and your hardware. The Android operating system is also open source, so you can contribute your own interfaces and enhancements. It is recommended to use smart phone, which is support android os.

For our notification system there will be we interface for give feedback to this it is recommended smart phone or any device which an access to WWW and any mobile phone which can send SMS to our system.

2.1.4 Software interfaces

Since we are developing android application, we need different android API, which install in android studio. Also for our web base notification system, I am planning to distribute the necessary .NET version with the installation of the designer client. For data store purpose we are using most popular Open Source SQL database management system, which is developed, distributed, and supported by Oracle Corporation.

2.1.5 Communication interfaces

We are developing this project for smart city. We are assuming Wi-Fi is available in smart city. Wi-Fi is communication media to pass data in between trashcan and our system. To access to our web site there must be device, which has internet access. For notification, system there must be GSM module. Mobile phone will be used for this. Those are the major communication interface, which we have identified for A Location Based Garbage Management System.

2.1.6 Memory constraints

The memory constraints that we have concerned so far are already within most of the people in society. Since we have web application, it is recommended to have device, which have enough memory to access internet.

2.1.7 Operations

The intended user groups for A Location Based Garbage Management System with IOT for Smart City system are citizen in smart city. Author are assuming that they have basic knowledge of handling smart phone. After implementing system, by doing lectures tutorials citizen can be guide through our system. Any citizen who willing to use our system has to register in our end user application. After successfully register user can log in to end user application. And simply users can use android application by getting there services what they need like getting bin details, calculate the route to nearest bins.

Users can use same login to enter our web site. After successfully login user can send feed back to our management. Also there are many other features that users can use. Those who not familiar with our web service can send SMS to our management by sending SMS to service number.

2.1.8 Site adaptation requirements

Users can simply download and install our android application and after that they can register with our system. After successfully register users can login to android application and web site using same username and password and get their services.

2.2 Product functions

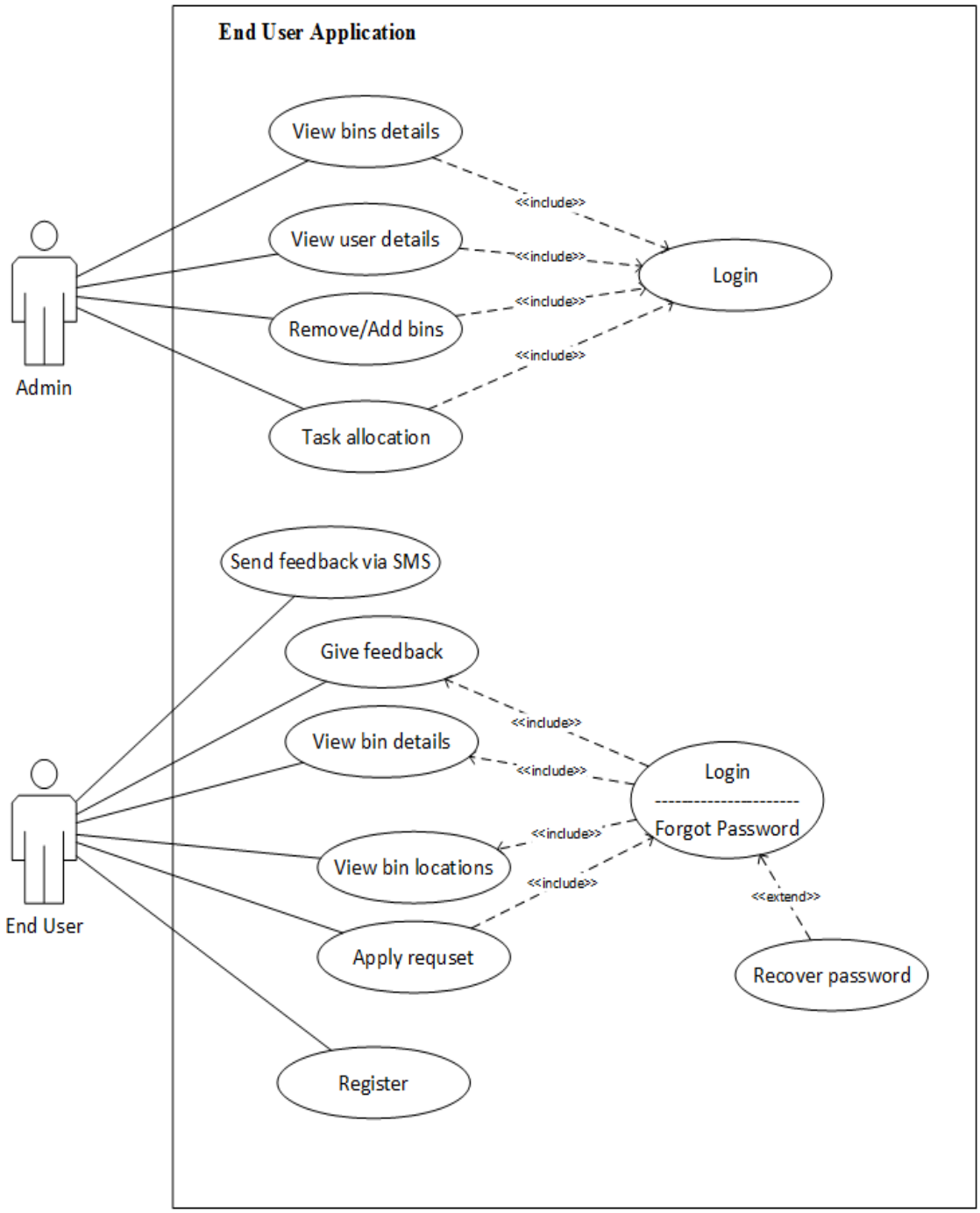

Figure 2.2.1: Use case diagram

Use case name	End user registration
Description	User should be able to Register to system
Pre-condition	End user application must install in users smart phone
Primary user	Citizen
Main flow of events	1. Open application 2. Fill the form by providing details

Use case name	Give feedback
Description	Give feedback about custom service and vulnerabilities of system
Pre-condition	Login to android application or web site
Primary user	Citizen
Main flow of events	1. login to android application or website 2. go to feedback section 3. write feedback

Use case name	Send SMS
Description	User must send feedback and any immediate changes that need to done
Pre-condition	User must have mobile phone which can send SMS to our service number
Primary user	Citizen
Main flow of events	Send SMS via mobile phone

Use case name	View map detail/ view bin location
Description	User should be able to view all available bins within his area and bin location
Pre-condition	Users must be login to system
Primary user	citizen
Main flow of events	1. login to system 2. Request available bin within area by clicking view map detail button

Use case name	View user detail
Description	Admin must able to view all users and there details
Pre-condition	Admin must login his admin account Using his password and user name
Primary user	Admin
Main flow of events	Login to system and view detail

Use case name	Add and remove bins from map
Description	Admin can add new bins to map as well as admin can remove bins from map
Pre-condition	Admin must login to system
Primary user	admin
Main flow of events	1. Admin login to system 2. Go to map 3. Click the bin that need to change and do necessary changes

Use case name	Task allocation
Description	Admin can allocate special task to cleaning staff
Pre-condition	Admin must be login to system
Primary user	Admin
Main flow of events	1. Login to system 2. View cleaning staff details 3. Select certain users 4. Allocate task

2.3 User characteristics

There are two types of users who are interacting with the system.

Users of the mobile application

1. System administrators
2. Citizen

Must have a basic Smartphone knowledge such as connecting to Wi-Fi and downloading applications from the play store. This application targets the common people rather than a particular group of people.

2.4Constraints

2.4.1General constraints

Feedback that we gather from our customers (citizen) must be reliable information.

2.4.2 Software constraints

The application is operating system dependent and should be running only on Android Powered Smart Phones.

2.5 Assumptions and dependencies

One assumption about the product is that the GPS components in all Android smartphones work in the similar manner. Another assumption about the product is that it will always be used on mobile phones that have enough performance. If the smartphones have different interfaces to the GPS. Smart city must have WIFI enable all the time.

2.6 Apportioning of requirements

This section describes the order of the fulfillment of the requirements of the system.

2.6.1 Essential requirements

1. Using GPS mobile can detect its exact location.
2. Bin must send fill level data all the time.

2.6.2 Desirable requirements

These requirements are not forced to develop but hope to develop in future releases. Push notification to unregistered users.

1. Provide tutorial and lectures about how this system will work.
2. Send feedback to our system

3. Specific requirements

3.1. External interface requirements

3.1.1. User interfaces

The user interface for the software shall be compatible to Kit Kat android version or above. The user interface shall be implemented using Android Studio

Web application associates with one main functions. Those function can be define as Login to the web application and send feedback and any other detail about our system.Etc functions that need to change.

In order to perform this functions an authorized user has to login to the web application. First user has to provide the particular URL to the web application then Login Page is displayed. After that user can log in to the web application by providing valid user name and password if user name and password is not valid error message is generated and logging will be restricted. Same user name and password will use for the android application. This function only can be performed by an authorized user after successfully log in to the web application.

3.1.2. Hardware interfaces

Since the application must run on the mobile, all the hardware shall require to connect internet hardware interface for the system. As for e.g. Access points, WIFI

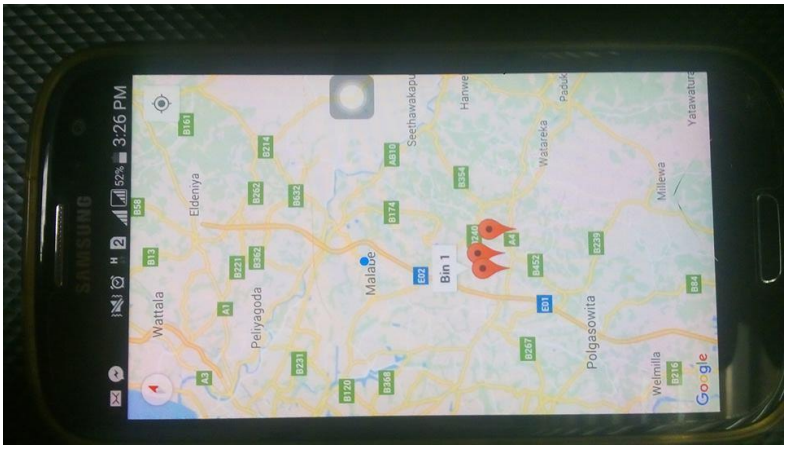

Figure 3.1.2.1: Hardwar interface

3.1.3. Software interfaces

For this system, there are few external interfaces.

1. MYSQL for database access
2. Android studio for android development
3. Lamp server for hosting purpose

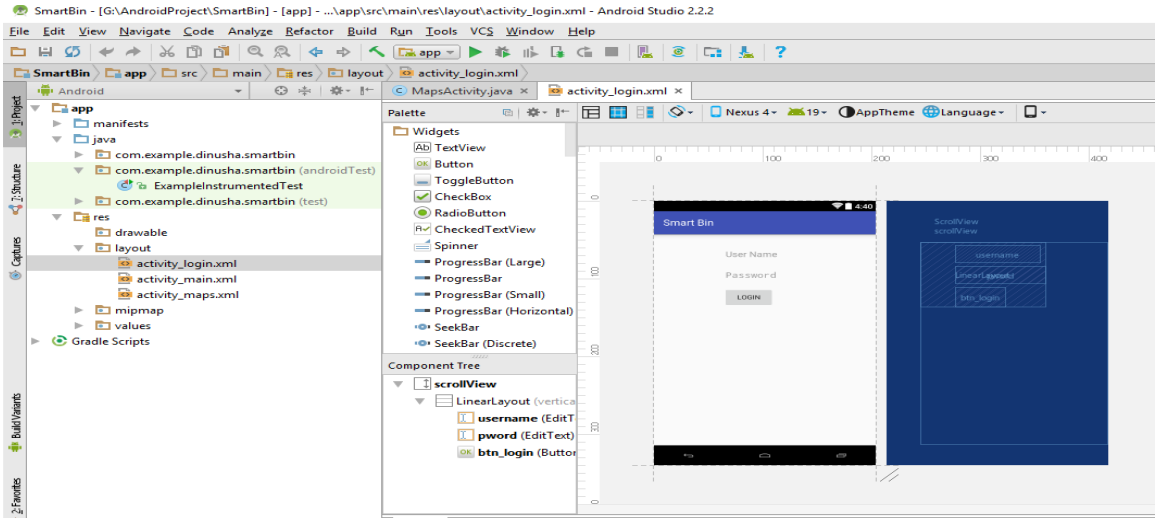

Figure3.1.3.1: Android studio interface

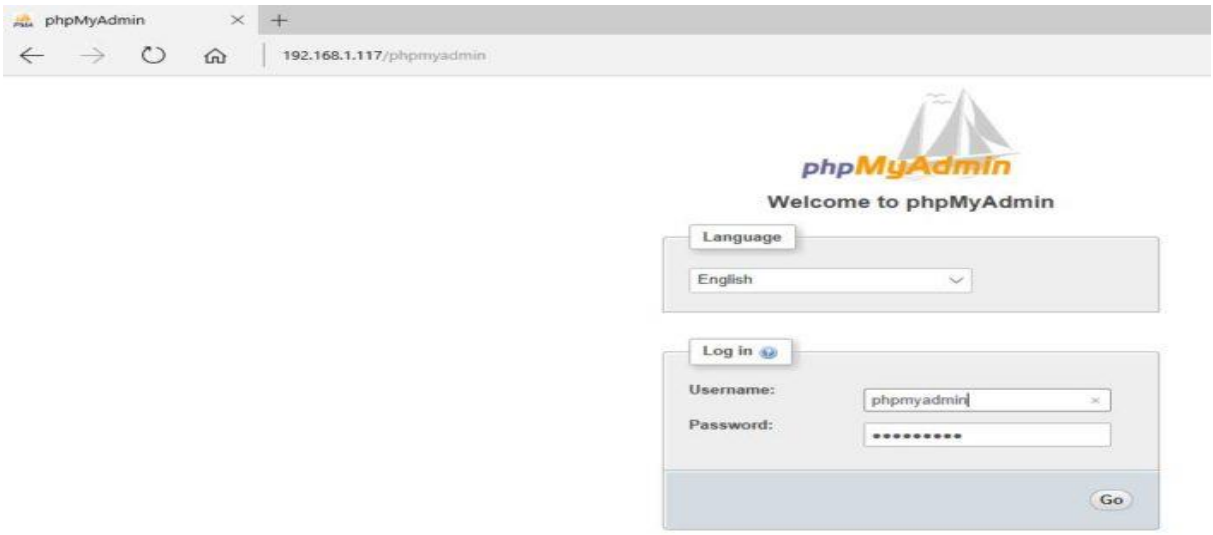

Figure 3.1.3.2: Php my admin login

3.2 Classes/Objects

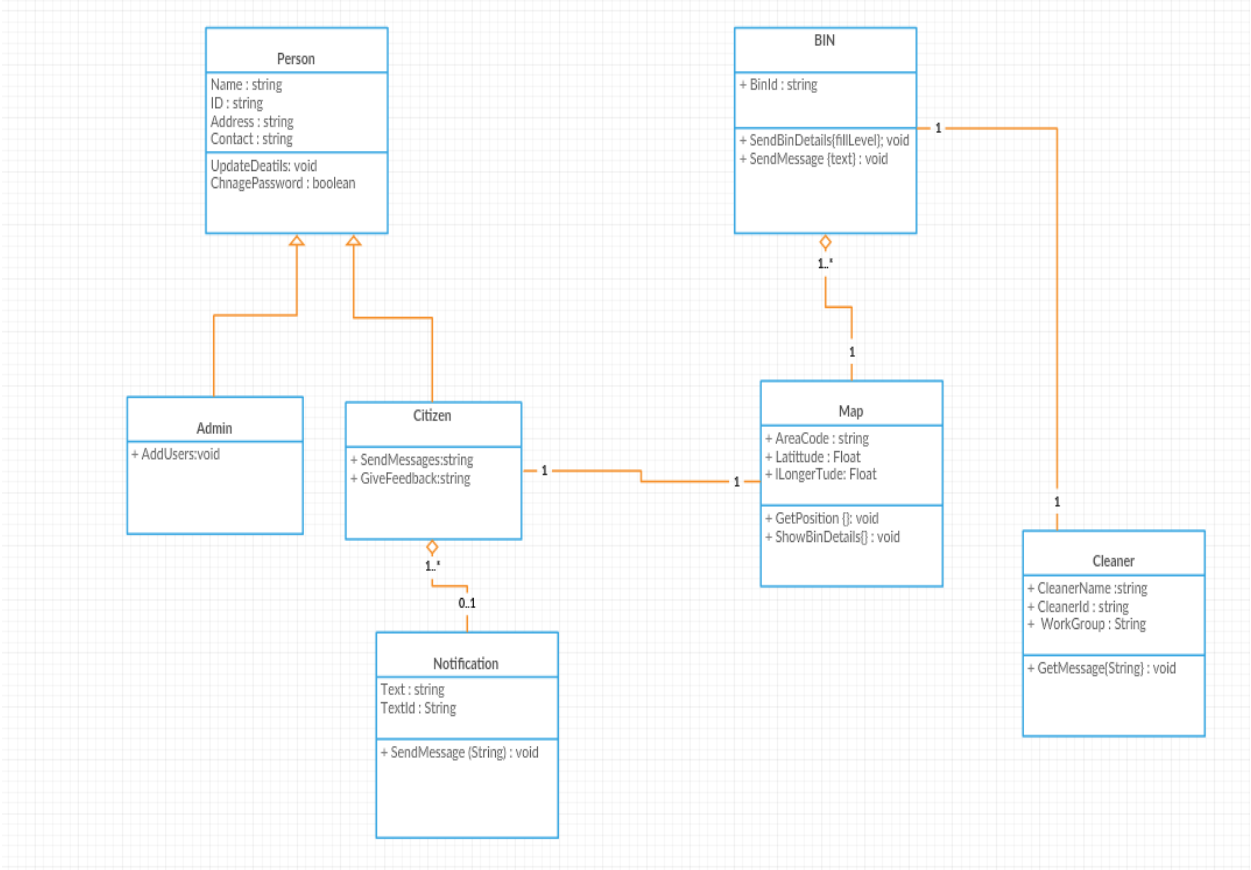

Figure 3.2.1 class diagram

3.3 Performance requirements

- The application shall not use more RAM-125MB memory
- The application storage shall not exceed-170MB
- The application shall run Android OS version –KitKat or above that.
- The application shall run on CPU-Quad core -1.5GHz or above
- Cache technology-LRU (Least recently used) which is the default caching technology in Android.

3.4 Design constraints

- Many Android powered smartphone run different versions of the Android operating system to increase the number of user who use the application the application should be developed using Android Kitkat(version 4.4.2)
- Since the application is developed for android smartphones customized Java and XML languages would be used with relevant API which can provides end user application basic functionality. The application would be developed using Android Studio Emulator.
- Future plans for extending or enhancing the software-The software is limited to Android running smartphones in future it would be developed for other mobile Operating system as well such as Microsoft mobile OS, Apple IOS etc.
- To build web base notification system HTTP, PHP, CSS will use.

3.5 Software system attributes

3.5.1 Reliability

Reliability is an Ability of a computer program (android application) to perform its intended functions and operations in a system's environment, without experiencing failure (system crash). Reliability is measured as the probability that a system will not fail and that it will perform its intended function for a specified time interval. Thus system should be reliable enough because it has to produce accurate suggestions.

3.5.2 Availability

The system could be accessed whenever in in need. App must be available do download any time.

3.5.3 Security

Location Based Garbage Management System with IOT for Smart City will not require any sensitive data of the users, but general security should be maintained in the system such as authentication.

3.5.4 Maintainability

Updates must be available for the user time to time. There is no maintainability requirements from the user’s side but management will handle the necessary updates when required.

3.6 Other requirements

A database should be maintained by the system in order to store the knowledge base which will be used for garbage management. This database may not have a predefined structure of tables, because complex events will be the data which will be stored.

4 Supporting information

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