AMERICAN INTERNATIONAL UNIVERSITY - BANGLADESH

Software Requirement Specifications for

Smart Garbage Kiosk

Software Documentation and Tools [MScCS]
Department of Computer Science

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Contents

1 Introduction

1.1 Purpose

Bangladesh is the eighth most populous country and most densely populated country in the world. As a developing country, Bangladesh faces a huge waste management problem, caused by different human activities like industrialization, urbanization, improving living standards etc. There is an increasing rate of waste generation in Bangladesh and it is projected to reach 47, 064 tonnes per day by 2025. The Waste Generation Rate (kg/cap/day) is expected to increase to 0.6 in 2025. A significant percentage of the population has zero access to proper waste disposal services, which will in effect lead to the problem of waste mismanagement.[1] Urban population and industrialization have also been increasing rapidly and these are creating a serious hassle on our natural resources, which is a big challenge for sustainable development. Much of the country, specially the metropolitan cities are facing the impact of urbanization, as a growing population houses itself in a limited area, leading to a severe pressure on infrastructure facilities at all levels. One of the main issues faced by the city today is the tendency of a large amount of population to litter garbage here and there. The total City corporations and municipalities are continuously trying to stop this act by increasing dustbins and garbage bins in various public places, but despite the effort, the total waste collection rate in major cities of Bangladesh such as Dhaka is only 37%[2], which is far from ideal. It is evident that the public interest in these efforts are quite low. This result can be attributed to lack of knowledge and incentives on the people's part. Lack of knowledge can be solved by holding workshops and undertaking projects that motivates general public to refrain from littering, but the latter requires an innovative approach. One such approach is to give people incentives to throw their trash in garbage bins so that people become encouraged and motivated to do so. These incentives might include money and offers among other things. Therefore, the purpose is to build a smart garbage disposal system with kiosk where people can dispose their trash in exchange of compensations such as money and offers. If implemented properly, general public should become more interested to use these facilities more frequently, thereby reducing litters. Smart Garbage Kiosk can help the society to get rid of all the garbages effectively and efficiently. This Smart Garbage Kiosk can provide both money and coupons for the provider in exchange of implementing the garbage kiosk. It is an innovative solution which will provide both social service and business. Thus it can be called a Social Business System with immense opportunities.

The purpose of this document is to specify the requirements and preview some elements of the analysis model of the program of the Smart Garbage Kiosk. The document also contains the overall product description including the product perspective, system features and their descriptions, data dictionary, details of required interfaces and the required quality attributes. This document will allow all involved parties to be clear on the goals of the system. Furthermore, it allows for saving time on communications, minimizing development efforts, feedback from customers, eliminating task duplication's, facilitating transfer to a new environment, breaking down issues into parts, serving as the key document to verify the validation and testing process and acting as a reference to help identify deficiencies and process flaws in the future.

1.2 Document Conventions

Bold face and indentation is used on general topics and specific points of interest. The remainder of the document will be written using the standard font, Times New Roman.

	Font	Style	Size
Heading	Times New Roman	Bold	16
Sub-Heading	Times New Roman	Bold	14
Others	Times New Roman	Regular	12

1.3 Project Scope

This program offers a complete and easy way to organize different sets of waste; separating them by types and categorizing them to use them in an appropriate way to make money or coupon. The current scope of the project is only for the capital of the Bangladesh, Dhaka. This can be increased further if the project is successful within Dhaka. Main scope of the project to be emphasized on are :

- Categorization of product
- Focus on business and social service
- User can put anything inside the kiosk as garbage, as long as within size restrictions
- User can collect points by throwing garbage.
- User can collect money in terms of point achieved by him/her.
- The points will be generated by the kiosk according to the volume of the waste material.
- The unique user will be recognized by face of the user.

Smart Garbage Kiosk is not meant be:

- Used in places with low population
- Used in isolated locations
- Used in places with no power or network connectivity
- Used inside residential or commercial spaces

1.4 References

1 Alamgir, Muhammed, and Amimul Ahsan. "Municipal solid waste and recovery potential: Bangladesh perspective." Journal of Environmental Health Science Engineering 4.2 (2007): 67-76.

2 `https://en.wikipedia.org/wiki/Waste_management_in_Bangladesh`

3 `http://www.washington.edu/news/2012/04/19/dirty-to-digital`

4 `http://www.theregister.co.uk/2008/01/28/hundred_percent_face_recognition_claim/`

2 Overall Description

2.1 Product perspective

The following SRS contains the detail product perspective from different stakeholders. It provides the detail product functions of Smart Garbage Kiosk with user characteristics permitted constraints, assumptions and dependencies and requirements subsets.

The Smart Garbage Kiosk provides simple mechanism for users to earn money in exchange of garbage.
The following are the main features that are included in Smart Garbage Kiosk:

- Cross platform support: Offers operating support for most of the known and commercial operating systems.
- User account: The system allows the user to access their accounts in the system and provide features of viewing account details via the website
- Number of users being supported by the system: Though the number is precisely not mentioned but the system is able to support one user at a time in a single kiosk.
- Search: search is simply local search engine based on keywords. [Administrator via website]
- Discussion Forum: Provides users with a platform to discuss and help each other with their problems
- Ticketing system: Allows user to submit his issue to the admin in case his problems are not solved by FAQs and discussion forums.
- FAQs section: Frequently asked section contain answer of problem which user frequently faced.

2.1.1 Entrepreneurial Idea

Our System will provide money/coupons/offers toward people who will through waste product to the kiosk. The kiosk will be able to check if any user is recognized by the database or not. The system can check and identify each waste the user enters by the type of the waste. The System can check the waste with a enhanced image recognition system with artificial intelligence by which it can understand what type of waste product is it. The system can recognize known product type with an algorithm. The system can separate from a known waste and unknown waste and then a crusher machine crushed them all. The system can weight the waste of known product and generate point in respect of the user. A database is used to maintain points and users. The system will maintain a point table for known product type. The system can calculate the volume of the waste with a volume measurement light curtain sensor. According to volume and recyclable product the system can generate points. If a single user can obtain a minimum amount of point (50 points) then he/she can withdraw money from kiosk. The point calculation is based on 1 cubic foot equals to 5 points and per recyclable products the system will generate 0.5 point. Where 1 point equals to 1 BDT. With the website of the system any user can give advertisements on the kiosk and pay with online payment system for the advertisements in the screen of kiosk. For this user have to register. Any time that user can login in his account and can change his advertisement plan or advertisement area if his advertisement is not already live. In future he can give any other advertisement using the same account. To give advertisement user have to choose an area/kiosk no, have to upload a video and advertisement duration. User will also be able to check how long his advertisement was live. In short this system will give new businessmen a huge opportunity to promote their business with a very low amount of cost. Advertisements will be shown on the screen of the kiosk.

2.1.2 Development Areas

Currently for some limitation the system is measuring garbage by their volume. In future we can overcome the problem by using pattern recognition and machine learning. Then it will measure every garbage by their uniqueness and depending on that point will be rewarded. In future we want to construct an underground tunnel, through which garbage will be transferred to a selected area automatically.

2.1.3 Business Idea

The Goal of the system is to support the people with a little amount of money by taking waste material from them in a public place. Advertisement Cost shall be like below.

Advertise Duration	Kiosk Advertise count	Duration (in Days)	Advertise Cost
Less Than 1 minute = 50	Less than 5 = 15	15 Days = 15	Advertise Cost = (Advertise Duration * Kiosk Advertisement Count * Duration) BDT
Less Than 2 minutes = 70	Less than 10 = 7	30 Days = 25	
Less Than 5 minutes = 100	Greater than 10 = 5	90 Days = 80	

So, The total amount of the Advertise revenue would be approximately 12250 BDT per month considering the average values.
$70 * 10 * 25 = 12250$ BDT

And for 30 kiosks throughout The Dhaka City , The advertisement revenue would be $(12250 * 30) = 3,67,500$ BDT

However, The Development of the Kiosks will cost following:-
Development Cost : BDT 15,00,000 BDT (The whole system)
Kiosk Making Cost :

Parts Name	Cost
Raspberry Pi 3 x2	3500 x 2 = 7000 BDT
Light Curtain Sensor	8000 BDT
Robotic Arm	9500 BDT
Touchscreen Monitor	7000 BDT
Kiosk Body	10000 BDT
Power supply	1000 BDT
NIC	1000 BDT
Weight Sensor	1000 BDT
Biometric Sensor	6000 BDT
Camera	2000 BDT
Ultrasonic sensor x 3	100 x 3 = 300 BDT
Other Parts	10000 BDT

So, Total 65000 BDT for a kiosk . So, Total cost for initial cost would be :

$$\begin{aligned} DevelopmentCost &= 15,00,000\ BDT \\ Kioskcost &= 65000 * 30 = 19,50,000\ BDT \\ Installationcost &= 5000 * 30 = 1,50,000\ BDT \\ \textbf{Total Cost} &= 36,00,000\ BDT \end{aligned}$$

Monthly Costing-

$$\begin{aligned} Maintenance &= 77,000\ BDT \\ Internet &= 7,000\ BDT \\ Electricity &= 5,000\ BDT \\ \textbf{Monthly costing} &= 90,000\ BDT \end{aligned}$$

Monthly Revenue $= 12250 * 30 = 36,7500$ BDT
Monthly Earning $= 3,67,500 - 90,000 = 2,77,500$ BDT
Yearly Earning $= (2,77,500 * 12) = 33,30,000$ BDT
First Year $= 33,30,000 - 36,00,000 = -2,70,000$ BDT

2nd year,
Earning $= 33,30,000 - 2,70,000$ BDT
$= 30,60,000$ BDT

Rest of the year,
$= 33,30,000 BDT$

2.2 User classes and characteristics

2.2.1 General Users

General user will use the system to throw garbage in the basket and collect reward.

2.2.2 Administrators

They are the core user of the system . The administrator will be able to view and monitor the whole system in between all the kiosk machines.

2.2.3 Advertisers

The following user will use the system for adding advertisements to the company and pay to the administrator.

2.3 Operating environment

Smart Garbage Kiosk is platform independent and it runs on every platform where a Java Virtual Machine is available (requires a JVM version 1.6 or higher). And the website can be used in any modern web-browser.
It has been tested on -

- Microsoft Windows
- GNU/Linux distributions
- Mac OS X

Hardware requirements of the project -

- Maximum memory usage: 512MB* (by default)
- Disk space needed: 69MB

*it depends on the size of the garbage.
And The Website is tested on -

- Mozilla Firefox
- Google Chrome
- Microsoft Edge

2.4 Design and implementation constraints

The challenges in developing the product include processing of waste materials and offloading end-user requests from the primary kiosk to peers based on cost, performance and load. Due to the proprietary nature of existing waste, limited information about response time or service cost is typically available from individuals, and load balancing control is retained by an individual raspberry pi within its own servers. Therefore, request-redirections must occur over distributed sets of servers belonging to multiple server or clients, without the benefit of the full information available, as in the single provider case. Moreover, an implementation model for the product enabling server peering could be based on a complex combination of attributes such as Web server responsiveness or load, expected network delay, or geographic location. Several of these potential attributes vary over time and there is no single repository for listing the value of attributes such as geographic location or expected delay for all Internet-connected systems. It is anticipated that the values used in a server-client peering implementation model are likely to be based on heuristics.

The application is constrained by the system interface to the internet within the cluster system. Since there are multiple system and multiple web browsers, the web interface will most likely not be the same for every one of them. Also, there may be a difference between what navigation features each of them provide. The Internet connection is also a constraint for the application. Since the application fetches data from the database over the Internet, it is crucial that there is an Internet connection for the application to function. Both the web portal and the kiosk application will be constrained by the capacity of the database. Since the database is shared between both application it may be forced to queue incoming requests and therefore increase the time it takes to fetch data.

As we use java as our programming language the cluster system would have to run simultaneously between the raspberry pies. The recognition of the recyclable garbage would be added manually in order to be successful of the system. The Separator picker will be able to lift only packages / garbage which is below 500gm.

Everyone, that does or is going to develop or use The Application should agree and fully accept the terms of this kind of license.

CO-1 The system shall be developed in Java and available as an extension on the Java Swing.

CO-2 The system shall be developed using HTML5 for the website.

CO-3 Application development will adhere to the model-view-controller architectural pattern.This pattern serves to separate data (model) and user interface (view) concerns, so that changes to the user interface do not affect the data handling, and that the data can be reorganized without changing the user interface. Adhering to the model-view-controller pattern will decouple data access and business logic from data presentation and user interaction, by introducing an intermediate component: the controller. (raspberry pi host)

CO-4 Variables will be created using camel-case (creating compound words or phrases in which the words are joined without spaces and are capitalized within the compound with the first letter of the variable lowercase)

CO-5 Do not use prefixes to variables such as int, string, etc.

CO-6 In-line documentation for coding, flow-chart and/or diagram – what each module does,who did it and when it was done.

CO-7 Methods, procedures and functions will be sufficiently commented to support maintenance programmers with easily understanding the logic and purpose of the routines.

2.5 Assumptions and dependencies

It is assumed that the hardware designed will work correctly with the third-party operating system and the developed software. Because the device acquires database updates through internet, the customer must have a computer with a internet.
We also assume that The City Corporation will help us to get the place for the kiosk. Along with minimum power supply that the kiosk will need. Therefore, The City corporation cleaner will take off the garbages everyday as they take off garbages from different dustbins now. The system has this dependency on the electricity. If there is no electricity the system will not work.

3 System Features

3.1 User Interaction

3.1.1 Description

In this module the system will interact with the user of the system.

3.1.2 Functional requirements

1. The user shall enter his/her fingerprint in the button provided.
2. The system shall Identify the user with the button provided using fingerprint sensor.
3. The system shall create id if the fingerprint does not exist in database.
4. The system shall show/load id informations based on fingerprint of the button provided.

3.2 Waste Calculation

3.2.1 Description

In this module the system will check the garbage basket and calculate garbage amount.

3.2.2 Functional Requirements

1. The user shall put garbage in the garbage basket provided.
2. The System shall check the volume of the garbage.
3. The System Shall generate points based on the volume of the garbage.

3.3 User interaction after garbage collection

3.3.1 Description

In this module the system will check for user if he wants to take money or take coupon.

3.3.2 Functional Requirements

1. The system shall ask the user what he wants to do with his or her points.
2. The user shall provide his/her desire.
3. The system shall show desired information to the user.

3.4 Advertise

3.4.1 Description

In this module the advertiser can insert ad on the system.

3.4.2 Functional Requirements

1. The system shall show the kiosk list to the advertiser.
2. The advertiser shall select kiosk according to his/her requirements.
3. The advertiser shall pay money with the provided payment gateway.

3.5 Show Data Reports and monitoring

3.5.1 Description

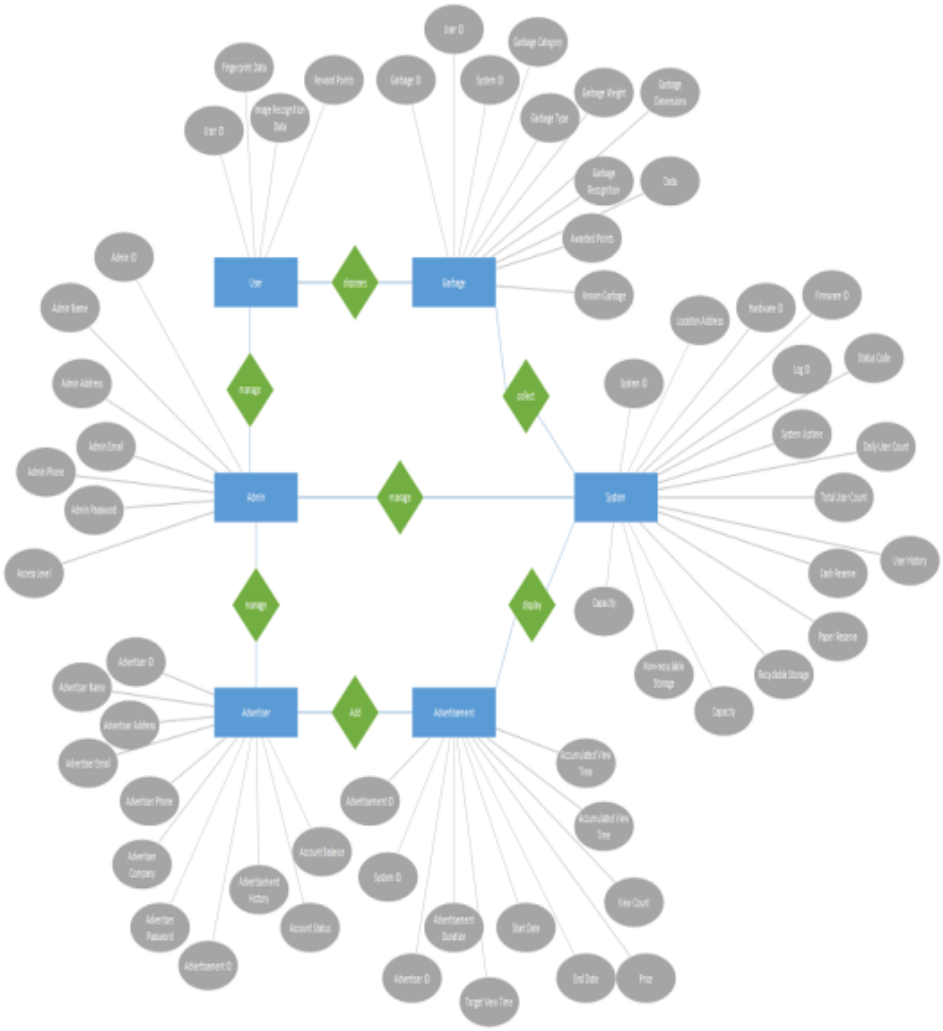
In this module the data reports will be shown to the administrator.

3.5.2 Functional Requirements

1. The System shall show reports regarding user,finance,garbage.
2. The administrator shall see what is the status of each kiosk.
3. The advertiser shall see what is the status of his/ her advertisement

4 Data Requirements

4.1 Logical data model



4.2 Data dictionary

Data Element	Description	Composition or Data Type	Length	Values
Garbage Details	Details of a garbage disposed by the user	Garbage ID User ID System ID Garbage Category Garbage Type Garbage Weight Garbage Dimensions Garbage Recognition Data Awarded Points Known Garbage		
Garbage ID	Unique ID associated with the disposed garbage	Integer		System generated sequential integer beginning with 1
User ID	ID of the user that disposed the garbage	Integer		
System ID	ID of the system where the garbage was disposed	Integer		
Garbage Category	The category assigned to the garbage based on recognition data. If the system couldn't identify the garbage, category will be assigned as 'unknown'	Alphabetic Characters	20	
Garbage Type	Indicates if the garbage is recyclable or non-recyclable	Boolean	1	0 if non-recyclable, 1 if recyclable
Garbage Weight	Measured weight of the disposed garbage	Positive Integer	5	grams
Garbage Dimensions	Dimensions of the disposed garbage	Alphanumeric Characters	12	Length cm x Width cm x Height cm
Garbage Recognition Data	Image Recognition data of the disposed garbage. These will be used for investigative purposes if	Binary Large Object	65535	Bytes

	the system can't recognise the disposed garbage.			
Awarded Points	Points awarded to the user for disposing this garbage.	Positive Integer	3	
Known Garbage	Indicated if the garbage was recognised by the system	Boolean	1	0 if unknown garbage, 1 if known garbage
User Details	Details of the normal user	User ID Fingerprint Data Image Recognition Data Reward Points		
User ID	Unique ID of a particular user	Integer		System generated sequential integer beginning with 1
Fingerprint Data	Primary data used to identify the user	Binary Large Object	65535	Bytes
Image Recognition Data	Secondary data used for identification if primary identification fails	Binary Large Object	65535	Bytes
Reward Points	Reward points accumulated by the user	Positive Integer	4	
Advertiser Details	Details of the advertiser user class	Advertiser ID Advertiser Name Advertiser Address Advertiser Email Advertiser Phone Advertiser Company Advertiser Password Advertisement ID Advertisement History Account Status Account Balance		
Advertiser ID	Unique ID associated with the advertiser account	Integer		System generated sequential integer beginning with 1

Advertiser Name	Name of the Advertiser	Alphabetic Characters	50	
Advertiser Address	Business address of the Advertiser.	ASCII Characters	100	Valid address
Advertiser Email	Email of the Advertiser	ASCII Characters	50	
Advertiser Phone	Primary phone number of the advertiser	ASCII Characters	20	
Advertiser Company	Company name of the advertiser	ASCII Characters	20	
Advertiser Password	Password for the advertiser account	ASCII Characters	50	Must be atleast 8 characters and include at least 1 capital letter, 1 small letter and 1 number
Advertisement ID	IDs of current advertisements associated with the particular account	Array		Array of advertisement ID
Advertisement History	IDs of past advertisements associated with the particular account	Array		Array of advertisement ID
Account Status	A number that shows and sets the status of the account	Integer	1	
Account Balance	Amount the advertiser has in his account. Price of the advertisement is deducted from here.	Integer	5	BDT
Admin Details	Details of the admin user class	Admin ID Admin Name Admin Address Admin Email Admin Phone Admin Password Access Level		
Admin ID	Unique ID associated with the admin account	Integer		System generated sequential integer beginning

				with 1
Admin Name	Name of the admin	Alphabetic Characters		
Admin Address	Address of the admin	ASCII Characters		
Admin Email	Email of the admin	ASCII Characters		Character restrictions of an email address applies
Admin Phone	Primary phone number of the admin	ASCII Characters		
Admin Password	Password of the admin	ASCII Characters		
Access Level	A number that represents the access level of the particular admin account. A lower access level may not have	Integer	1	1 represents admins with read access to the system features and user accounts. 2 represents admins with write access to system features and user accounts. 3 represents admins with access to everything including the database
Advertisement Details		Advertisement ID System ID Advertiser ID Advertisement Duration Target View Time Start Date End Date Price View Count Accumulated View Time Accumulated Price		
Advertisement ID	Unique ID associated with the advertisement	Integer		System generated sequential integer

				beginning with 1
System ID	IDs of the systems where the advertisement is being run	Array		
Advertiser ID	ID of the advertiser account from which the advertisement was posted	Integer		
Advertisement Duration	Duration of the advertisement video	Time		
Target View Time	Time duration the advertiser pays for. If accumulated view time doesn't reach this, price of the remaining time is calculated and added to the advertiser's balance	Time		
Start Date	Start date of the advertisement	Date		
End Date	End date of the advertisement	Date		
Price	Estimated price according to the target view time, start date, end date	Integer		BDT
View Count	Number of times the ad was shown in the screen	Integer		
Accumulated View Time	Total amount of time the ad was on the screen	Time		
Accumulated Price	Price that's deducted from advertiser's balance after reaching the end date of the advertisement	Integer		BDT
System Details		System ID Location Address Hardware ID Firmware ID Log ID Status Code System Uptime Daily User Count Total User Count User History Cash Reserve Paper Reserve Recyclable Storage		

		Capacity Non-recyclable Storage Capacity		
System ID	Unique ID associated with the particular system.	Integer		System generated sequential integer beginning with 1
Location Address	Address where the system is located	ASCII Characters		Address with map coordinates included
Hardware ID	Unique hardware ID of the system.	Integer		Provided by manufacture r
Firmware ID	Unique firmware ID of the system.	Integer		Provided by software developer
Log ID	ID of the log associated with the system. The log is saved in a separate database.	Integer		Provided by log database
Status Code	Unique status codes that indicate the current condition of the system. Each specific issues and combination of several issues provide their own status codes.	Integer	3	Provided by system controller
System Uptime	The amount of time the system has been online.	Time		Provided by system controller
Daily User Count	Number of users that used the system at that day	Integer		Incremented every time a user uses the system. Resets to zero at 12am.
Total User Count	Total number of users that used the system since it went online	Integer		Incremented every time a user uses the system.
User History	IDs of the users who used the system.	Array		Array of user ID

Cash Reserve	The amount of cash stored inside the system.	Integer	4	BDT
Paper Reserve	The amount of paper stored inside the system. The papers are used to print tickets and coupons.	Integer	4	pieces
Recyclable Storage Capacity	The percentage of space available in the recyclable storage bin	Integer	3	Percentage
Non-recyclable Storage Capacity	The percentage of space available in the non-recyclable storage bin	Integer	3	Percentage

4.3 Reports

4.3.1 User Report

Report Element	**Element Description**
Report ID	R-01
Report Title	User Report
Report Purpose	This report will show the user statistics.
Decisions Made from Report	How much user is using the system, by which how much people are actually getting benefitted from the system.
Priority	Level - 2
Report Users	Administrator
Data Sources	Kiosk
Frequency and Disposition	After every user uses the kiosk.
Latency	5 seconds
Visual Layout	[See UI section]
Header and Footer	Header: none , Footer : None
Report Body	Users and kiosk interaction details.
End-of-report indicator	--End of user Report--
Interactivity	Various user history reporting from different kiosks.

Security Access Restrictions	By Administrator only

4.3.2 Financial Accounts Report

Report Element	Element Description
Report ID	R-02
Report Title	Financial Report
Report Purpose	To see how much profit can be made from this system.
Decisions Made from Report	To see if ad revenue is enough or not.
Priority	Level - 1
Report Users	Administrator
Data Sources	Kiosk and website
Frequency and Disposition	After every new ad entry.
Latency	5 seconds
Visual Layout	[See UI Mockups]
Header and Footer	Header: none , Footer : None
Report Body	Transaction details
End-of-report indicator	--End of financial Report--
Interactivity	Various advertiser from different kiosk.
Security Access Restrictions	By Administrator only

4.3.3 Monthly Garbage Processing Report

Report Element	Element Description
Report ID	R-03
Report Title	Garbage Processing Report
Report Purpose	To see how much of garbage is being processed daily by kiosks.
Decisions Made from Report	How much benefitted the city is ?
Priority	Level - 3
Report Users	Administrator/ Auditors
Data Sources	Kiosks.
Frequency and Disposition	Per month
Latency	5 Seconds
Visual Layout	[See Mockups]
Header and Footer	None
Report Body	Garbage volume of various kiosks.
End-of-report indicator	--End of financial Report--
Interactivity	Garbage amount.
Security Access Restrictions	Administrator/ Auditor

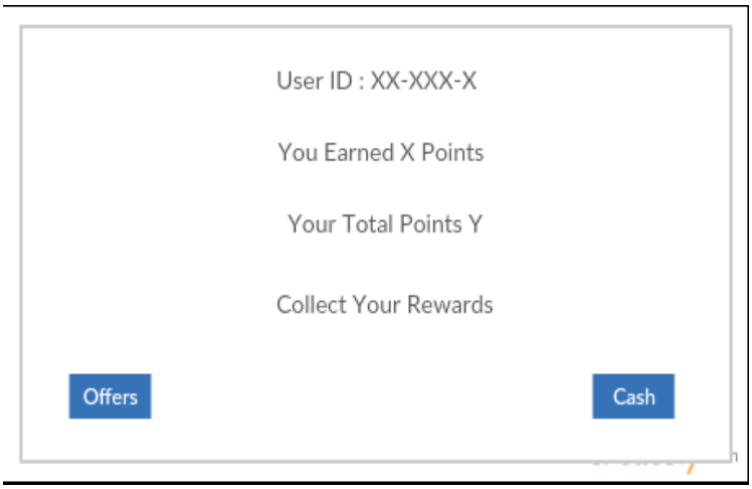
5 External Interface Requirements

5.1 User interfaces

There will be total three types of interfaces in our system.

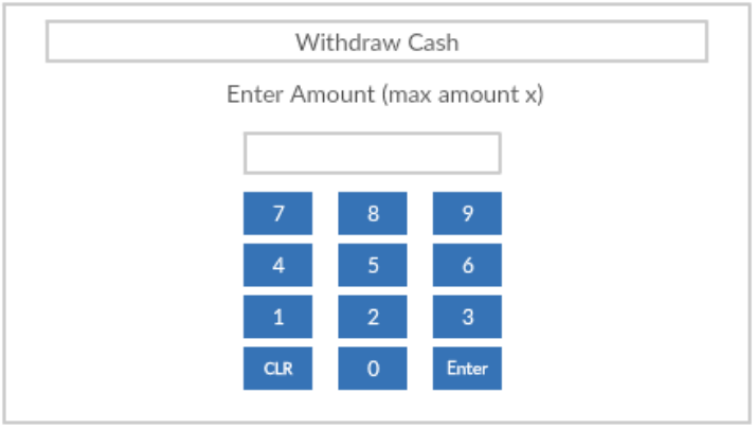
5.1.1 General user interface

This is the kiosk interface. How our kiosk will communicate with general user/ garbage throwers. Generally there will be playing advertisements on the kiosk screen. Whenever any user will come in front of the screen, it will be detected by the sensor.Then instead of playing advertisement, instruction screen will be popped up. After putting user's thumb on the biometric machine a tray will come out. User have to put garbage on it. Then it will take the garbage inside the KIOSK and user detail screen will be popped up.

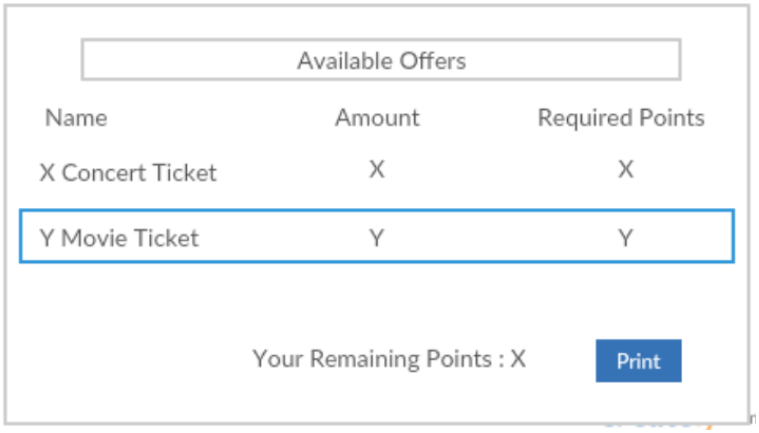


KIOSK Mock-up UI-1: User Details

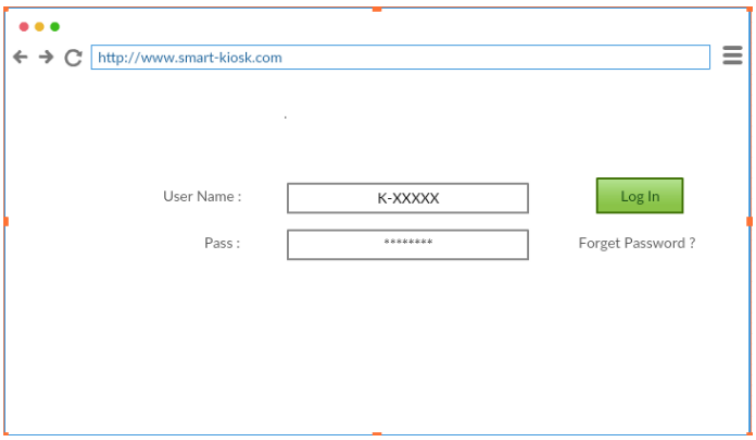
User will be able to get money or avail any offers in return of points. One have to choose offer/cash from the screen.



KIOSK Mock-up UI-2: Cash Withdraw

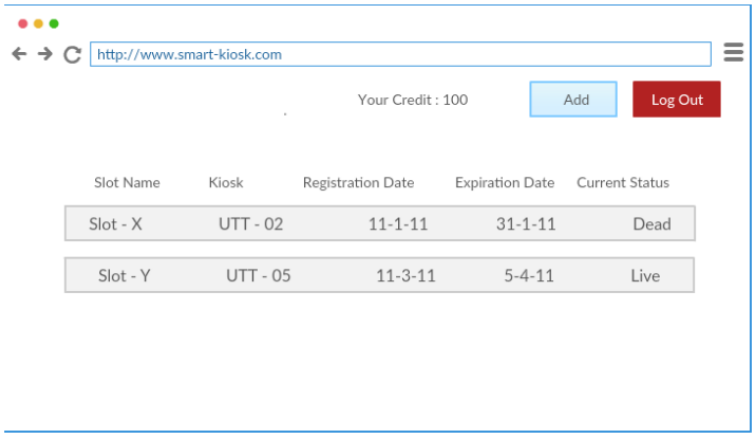


KIOSK Mock-up UI-3: Avail Offers



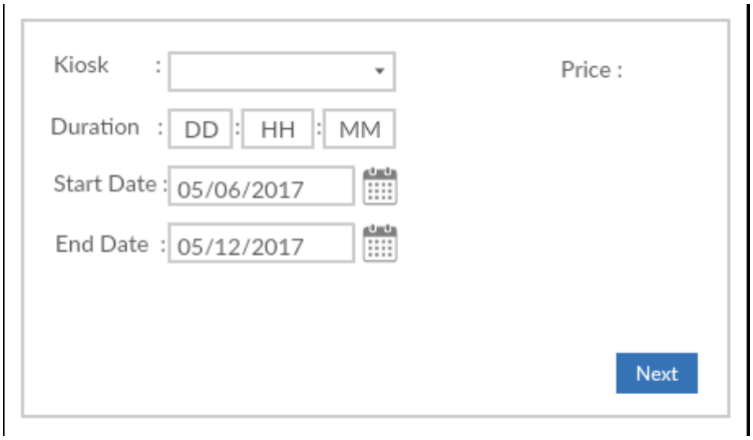
Web interface Mock-up: Login Window

After login advertisers can see their credit amount, issued time slot, button to add new advertisement. A brief status about issued time slot will be available in the home-screen.



Web interface Mock-up: Advertiser's Home

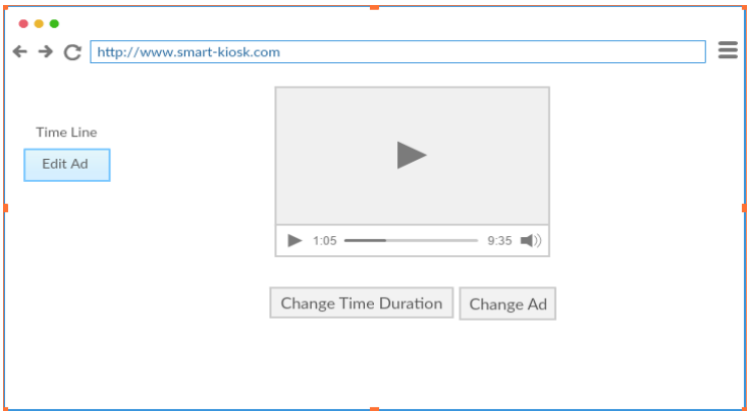
Advertisers will be able to add new time-slot by by clicking "Add" button. After clicking it a new window will open.



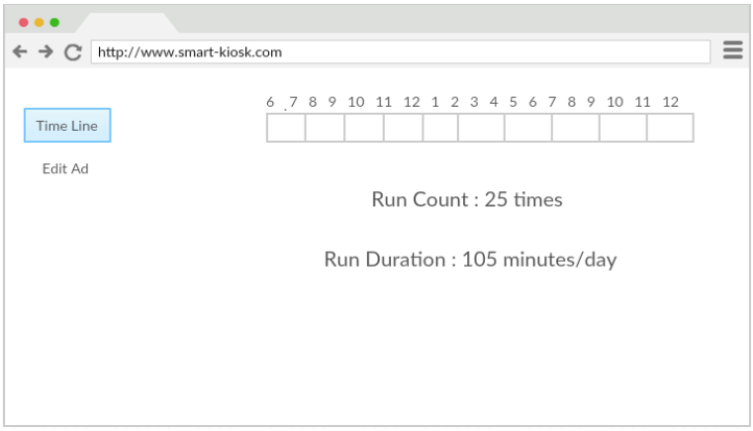
Web interface Mock-up: Add time-slot

After selecting time slot and KIOSK price will be calculated. If advertiser is agree with the pricing criteria, they can proceed next.

To add video or edit time-slot they will have to click on the desired time-slot from the home page. By doing the same they can also see the timeline of a advertisement. When and how long the ad was live will be available in the time-slot's timeline.



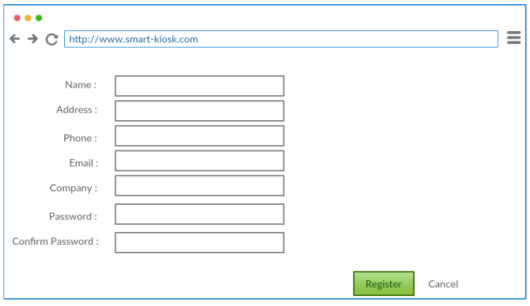
Web interface Mock-up: Edit Advertisement



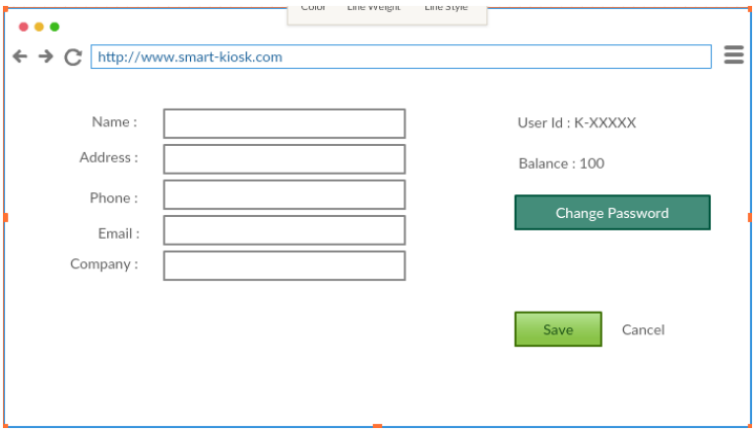
Web interface Mock-up: Ad's Timeline

5.1.2 Administrator user interface

Administrator will be able to create new advertiser id, change Advertiser password, maintain advertisement schedule.

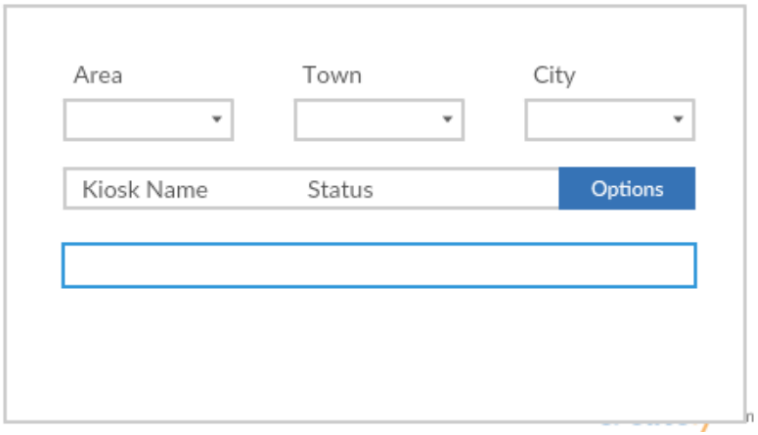


Web interface Mock-up: Create Account



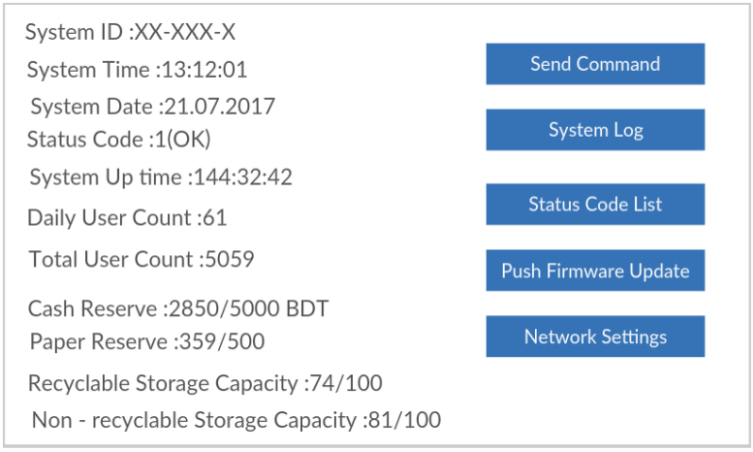
Web interface Mock-up: Update Account

Admin will be able to view and search for KIOSK by area, town or city.



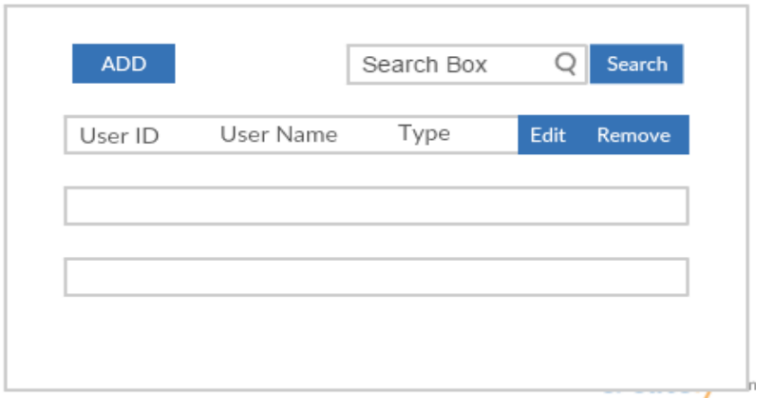
Web interface Mock-up: Kiosk status

After clicking on a kiosk bar, admin will be able to view the kiosk details and current status.



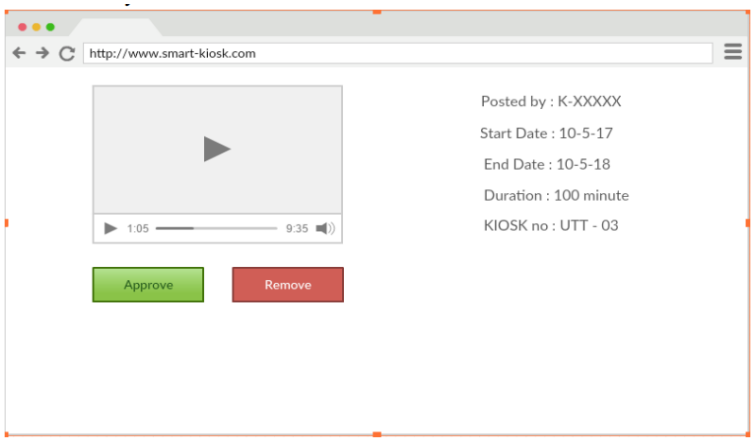
Web interface Mock-up: System Status

Admin will be able to view all user's details and type of users. He will also be able to edit any user's info or delete a user.



Web interface Mock-up: User List

Admin can view all the advertisements posted by an advertiser. Admin will have the authority to approve or remove any advertisement.



Web interface Mock-up: Advertisement Detail

5.2 Software interfaces

5.2.1 SI-01 - System Status Monitoring Interface

1. **Overview:** This interface is responsible for monitoring the status of the whole System
2. **Interface specification:** Process System Status
3. **Timing issue:** Due to usage of Raspberry Pi 3 it is quite fast.
4. **Communication protocol:** Internal application protocol

5.2.2 SI-02 - Internal Trash Management Interface

1. **Overview:**This interface is responsible for identifying and categorization of the trash as well as controlling which storage bin the trash goes to. It also monitors the status of the storage bin.
2. **Interface specification:** Process Trashes.
3. **Timing issue:**Timing depends on the trash amount. but , generally takes 30 second.
4. **Communication protocol:** Internal application protocol

5.2.3 SI-03 - Logic Interface

1. **Overview:**This interface is responsible for performing the logical tasks such as identifying users, calculating the reward points and checking if user is eligible for a reward.
2. **Interface specification:** Takes decisions.
3. **Timing issue:** Depends on the task.
4. **Communication protocol:** Internal application protocol

5.3 Hardware interfaces

5.3.1 HI-01 - External Ultrasonic Sensor Hardware Interface

1. **Overview:**This interface will notify the system if a user is approaching or leaving the kiosk.
2. **Connection:** USB 2.0.
3. **Data and control flow:** Hardware to Raspberry pi.

5.3.2 HI-02 - Display and Digitizer Hardware Interface

1. **Overview:**This interface will provide graphics data to the display and provide touch inputs to the system.
2. **Connection:** HDMI, USB 2.0
3. **Data and control flow:** Raspberry pi to Display and Touch Panel to Raspberry Pi

5.3.3 HI-03 - Fingerprint Hardware Interface

1. **Overview:**This interface will send fingerprint data to the system.
2. **Connection:** USB 2.0
3. **Data and control flow:** Hardware to Raspberry pi

5.3.4 HI-04 - Tray Control Hardware Interface

1. **Overview:**This interface will open and close the garbage collection tray and send its present status to the system.
2. **Connection:** GPIO
3. **Data and control flow:** Raspberry Pi to Tray

5.3.5 HI-05 - Weight Measurement Hardware Interface

1. **Overview:** This interface will provide the weight of the garbage placed in the tray to the system.
2. **Connection:** USB 2.0
3. **Data and control flow:** Hardware to Raspberry pi

5.3.6 HI-06 - Light Curtain Sensor Hardware Interface

1. **Overview:** This interface will provide the dimensions of the garbage placed in the tray to the system.
2. **Connection:** USB 2.0
3. **Data and control flow:** Hardware to Raspberry pi

5.3.7 HI-07 - Image Sensor Hardware Interface

1. **Overview:** This interface will provide the dimensions of the garbage placed in the tray to the system.
2. **Connection:** USB 2.0
3. **Data and control flow:** Hardware to Raspberry pi

5.3.8 HI-08 - Trash Separation Arm Controller Hardware Interface

1. **Overview:** This interface will control the separator that sends organic and inorganic trash to the designated storage bins.
2. **Connection:** USB 2.0
3. **Data and control flow:** Hardware to Raspberry pi

5.3.9 HI-09 - Crusher Controller Hardware Interface

1. **Overview:** This interface will control the crusher to crush the recyclable waste product.
2. **Connection:** GPIO
3. **Data and control flow:** Raspberry pi to hardware

5.3.10 HI-10 - Coupon Printer Hardware Interface

1. **Overview:** This interface will provide printing capability for printing coupons/vouchers/tickets.
2. **Connection:** USB 2.0
3. **Data and control flow:** Raspberry pi to Printer

5.3.11 HI-11 - Cash Request Button Hardware Interface

1. **Overview:** This interface will provide hardware button to the user for requesting quick cash withdrawal.
2. **Connection:** GPIO
3. **Data and control flow:** RPi to Hardware

5.3.12 HI-12 - Cash Dispenser Hardware Interface

1. **Overview:** This interface will provide cash to the user.
2. **Connection:** GPIO
3. **Data and control flow:** RPi to Hardware

5.3.13 HI-13 - Internal Ultrasonic Sensor Hardware Interface

1. **Overview:** This interface will provide capacity status of the storage bins to the system.
2. **Connection:** USB 2.0
3. **Data and control flow:** Hardware to Raspberry pi

5.3.14 HI-14 - LAN Hardware Interface

1. **Overview:** This interface will provide networking to the system.
2. **Connection:** Ethernet
3. **Data and control flow:** Hardware to Raspberry pi

5.3.15 HI-15 - USB Hub Hardware Interface

1. **Overview:** This interface will provide connectivity for all USB 2.0 devices in the system.
2. **Connection:** USB 2.0
3. **Data and control flow:** Hardware to Raspberry pi and vice versa.

5.4 Communications interfaces

1. **Overview:** This interface is responsible for networking with database
2. **Connection:** A web browser
3. **Timing issues:** Fast. (less than 20 second) Raspberry pi and vice versa.
4. **Communication protocol:** TCP/IP

6 Quality Attributes

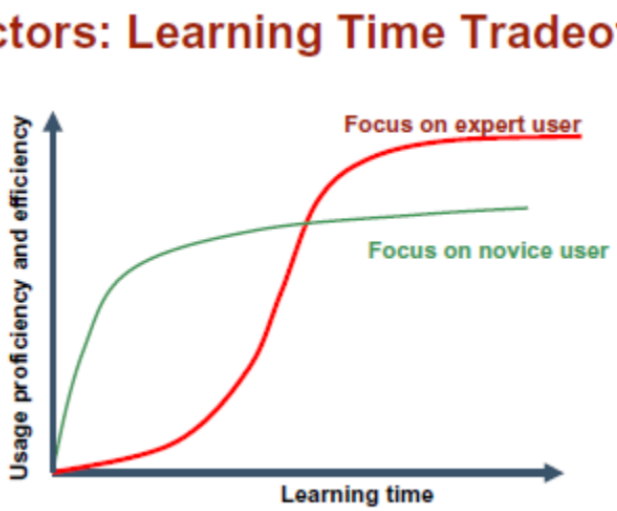
6.1 Usability

6.1.1 Concerns

- Learnability - easy to learn; novices can readily start getting some work done in the Smart Garbage Kiosk.
- Efficiency - efficient to use;
- Memorability - easy to remember; casual users do not have to learn everything every time to use Smart Garbage Kiosk.
- Errors - low error rate; users make few errors and can easily recover from them.
- Satisfaction - pleasant to use; discretionary/optional users are satisfied when and like it F

6.1.2 Factors

- Tradeoffs - depending on the situation, usability might be increased or decreased on purpose
- Categories of users - depending on user experience, usability might have to be tailored to the user.



Learning curves for systems that focus on novice or expert users.

- It is not the case that a system is either easy to learn but inefficient or hard to learn and efficient. A user interface can provide multiple interaction styles.
- Users start by using a style that is easy to learn.
- Later move to a style that is efficient.
- Learnable systems have a steep rise at the beginning and allow users to reach a reasonable level of proficiency within a short time and this is where our system does best.
- Walk-up-and-use

6.2 Performance

Performance. The degree to which a system or component accomplishes its designated functions within given constraints, such as speed, accuracy, or memory usage. A misnomer is that performance equates to speed; that is, to think that poor performance can be salvaged simply by using more powerful processors or communication links with higher bandwidth.
Faster might be better, but for our system faster is not sufficient to achieve timeliness. This is particularly true of real-time systems
As noted in , the objective of "fast computing" is to minimize the average response time for some group of services, whereas the objective of real-time computing is to meet individual timing requirements of each service.

- Hardware mechanisms such as caching, pipelining and multithreading, which can reduce average response time, can make worst-case response times unpredictable is used in our Kiosk System.
- In general, performance engineering is concerned with predictable performance whether its worst-case or average-case performance. We used both in our Smart Garbage System.Execution speed is only one factor.
- Predictability, not speed, is the foremost goal in our real-time-system design

6.3 Security

Secure systems are those that can be trusted to keep secrets and safeguard. Our System istotally safe from unauthorized access.
Large-scale, distributed systems cannot be totally isolated from intruders - no amount of "hardening"can guarantee that systems will be invulnerable to attack.We design buildings to deal with environmental stress such earthquakes as well an intentional attacks such as a break-in.We need to apply a similar approach to software where the faults are malicious attacks. Extended security to include the ability to maintain some level of service in the presence of attacks. Success is measured in terms of the success of mission rather than in the survival of any specific system or component.

6.4 Safety

Software safety is a systems issue, not a software-specific issue. The hazards caused by software must be analyzed and solved within the context of good systems engineering principles.

An isolated safety engineer may not be able to produce effective solutions to potential software-caused hazardous conditions without the assistance of supplemental expertise.The software safety "team" should consist of the safety engineer, software engineer, system engineer, software quality engineer, appropriate "ility" engineers (configuration Finally,software safety engineering cannot be performed effectively outside the umbrella of the total system safety engineering effort. There must be an identified link between software faults, conditions, contributing factors, specific hazards and/or hazardous conditions of the system.

The safety engineer must also never lose sight of the basic, fundamental concepts of system safety engineering. The product of the system safety effort is not to produce a hazard analysis report, but to influence the design of the system to ensure that it is safe when it enters the production phase of the acquisition life cycle. This can be accomplished effectively if the following process tasks are performed:

- Identifying the safety critical functions of the system.
- Identify the system and subsystem hazards/risks.
- Determine the effects of the risk occurrence.
- Analyze the risk to determine all contributing factors (i.e.. hardware, software, human error, and combinations of each.)
- Categorize the risk in terms of severity and likelihood of occurrence.
- Determine requirements for each contributing factor to eliminate, mitigate, and/or control the risk to acceptable levels. Employ the safety order of design precedence
- Determine testing requirements to prove the successful implementation of design requirements where the hazard risk index warrants.
- Determine and communicate residual safety risk after all other safety efforts are complete to the design team and program management.

6.5 Modifiability

6.5.1 Concerns

- **Extensibility -** adding/enhancing/repairing functionality
- **Simplification -** streamlining/simplifying functionality

- **Restructuring -** rationalizing services, modularizing/optimizing/creating reusable components
- **Time to deploy -** time taken from specifying a requirement for new capability to the availability of that capability
- **Functional scalability -** ability to scale both up/down in terms of users, system throughput, availability, etc.
- **Functional flexibility -** turning an existing capability to new uses, new locations, or unforeseen situations

6.5.2 Factors

- **Component complexity -** in general the more complex the components, the more difficult they are to change
- **Component size -** smaller components are generally easier to modify than large ones
- **Scope of modification -** architecture level modifications are more difficult; may involve a complete redesign with different components and interactions

6.5.3 Methods

- **Modularity -** partition a system into distinct modules representing separate areas of functionality; a classical modifiability technique

7 Internationalization and localization requirements

The process of designing a software application so that it can be adapted to various languages and regions without engineering changes.
It is important that application software that is meant for deployment in many different countries with different cultures and languages be designed with internationalization in mind, to be able to accommodate possibly different ways of expressing an item of information or peculiarities of a different language. Some of the issues that internationalization needs to grapple with include:

1. Date and time formats
2. Currency format
3. Language peculiarities (e.g., alphabets, numerals and left-to-right script vs. right-to-left)
4. Language character encoding sets for textual display
5. Names and titles
6. Sorting of names and text
7. Identification numbers, e.g. social security and passport numbers
8. Telephone numbers, addresses and international postal codes
9. Weights and measures

All of these issues should be kept in mind during development of Smart Garbage Kiosk

While the cultural and linguistic demands may change from country to country, the core code of Smart Garbage System program dealing with the functionalities of system do not change and so it is common practice to separate text and other environment-dependent data from the program code itself. Which should be strictly maintained in our system. This makes it easier to support internationalization as changes only need to be made to the environment-dependent resources. Minimal code changes are required.
The better internationalized an application is, the easier it is to localize. This is because a well internationalized application will have built-in support to cater to items that are needed for localization. These may include:

1. Hardware support for certain languages, e.g. input devices and methods
2. Local customs
3. Local content
4. Aesthetics
5. Cultural values and social context.
6. Language translation

The major work of localization is in translating the user interface and documentation but it involves more than just translating the language used. It also needs to cater to other relevant changes such as the usage of appropriate cultural and social values, symbols peculiar to the language, display of numbers, 32 dates, currency, appropriate input methods, etc.

8 Other Requirements

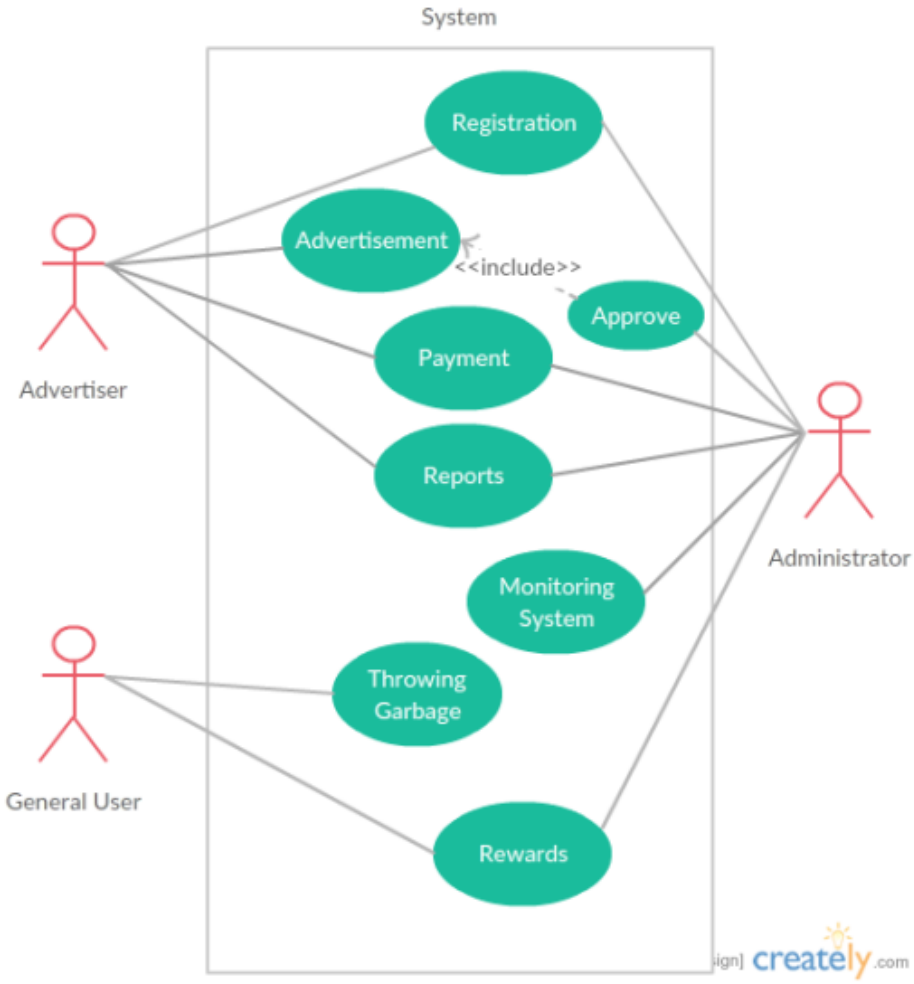
The system needs constant internet connection and also needs constant electricity connection . Also, The kiosks need to be waterproof .

A Appendix: Glossary

Kiosk: A small structure in a public area used for providing information or displaying advertisements, often incorporating an interactive display screen or screens.
User: A person who uses or operates something, especially a computer or other machine.
Interface: A common boundary or interconnection between systems, equipment,concepts, or human beings.
Database: A structured set of data held in a computer, especially one that is accessible in various ways.
Image recognition: Image recognition is the process of identifying and detecting an object or a feature in a digital image or video.
Artificial Intelligence: the theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.
Machine learning: Machine learning is a type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed. Machine learning focuses on the development of computer programs that can change when exposed to new data.
Raspberry pi: The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries.

Light Curtain: Safety Light curtains are opto-electronic devices that are used to safeguard personnel in the vicinity of moving machinery with the potential to cause harm such as presses, winders and palletisers.
Scanner: A device for examining, reading, or monitoring something, in particular.
Sensor: A sensor is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena.
Modem: An electronic device that makes possible the transmission of data to or from a computer via telephone or other communication lines Ultrasonic sensor: It is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.
Biometric Sensor: It is a security identification and authentication device. Such devices use automated methods of verifying or recognising the identity of a living person based on a physiological or behavioral characteristic. These characteristics include fingerprints, facial images, Iris prints and voice recognition.
Robotic Arm: A robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm; the arm may be the sum total of the mechanism or may be part of a more complex robot.
Crusher: A machine is designed to press or squeeze with a force that destroys or deforms.
USB: A Universal Serial Bus (USB) is a common interface that enables communication between devices and a host controller such as a personal computer (PC).
LAN: A local area network (LAN) is a network that connects computers and other devices in a relatively small area, typically a single building or a group of buildings.
Modularity: Modularity is the degree to which a system's components may be separated and recombined.

B Appendix: Analysis models



Model : Use Case Diagram