A Project Report

On

RFID BASED ADVANCED WASTE COLLECTION SYSTEM

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In

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August, 2020

UNDERTAKING

The work presented in my dissertation titled "*RFID Based Advanced Waste Collection System*", submitted to the Department of Computer Science and Engineering, Hindustan College of Science and Technology, Mathura, for the award of Bachelor of Technology, is my original work. I have neither plagiarized nor submitted the same work for award of any other degree. In case this undertaking is found incorrect, I accept that my degree may be withdrawn.

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CERTIFICATE

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ABSTRACT

One of major problem faced by today's world and our country is the increasing population and with it increases the amount of waste produced. So the next problem that arises in a country with such large population is proper collection and discharge of the generated waste, else it may result in various problems such as diseases and unhealthy society. The current system used by Municipal Corporations has a lot of disadvantages and hence a system is proposed by us to increase the efficiency of the process.

The crux of the system proposed by this paper involves an automated model for proper collection and management of waste, employing Radio Frequency Identification (RFID) as the fundamental tool together with technologies like GPS, GIS. In the proposed system, RFID cards issued to a personnel will be scanned by the waste collector using a reader. The system maintains a web based application for administrators as well as mobile application for both consumer and administrators which provides various functionalities such as maintaining database, on site payment, billing status, locating dump sites and more.

In the last few decades our country has seen an impounding rise in the migration of people from rural to urban areas for their livelihood. This has brought about many positive aspects to our society, better standard of living and more widespread education, to name a few but this change has also presented many problems too. One of the major problems is the Increase in waste production. Apart from destroying the natural beauty of a place, improper disposition of waste invites many diseases too. Therefore proper management of waste seems to be the need of the hour. This paper proposes an automated system through which collection and deposition of waste can be regulated in a better manner by making use of technologies like RFID, GPS, and GIS. For the proper collection of waste, the system comprises of a well-established Database which keeps track of Daily collection of waste which is taken out by waste collectors using RFID scanning at every pickup site to ensure that the waste is collected and addresses any irregularities by providing an option for customers to file complaints, keep track of their bill status and on site payment through a user friendly mobile application. For the proper disposal of waste after collection, the waste collectors also have an app at their helm which can guide them to the nearest recognized dumping site. The system also sends out notification to customers to update them beforehand in case of any disparities.

The proposed work is organised as:

- In chapter 1, we have given a brief introduction of the proposed system. What is the need of the system? The major objectives, its scope and the feasibility study.
- The 2nd chapter consists of the Literature Review, What is the need of the system? Problems with the current system, carried out requirement analysis. Tools and technologies used.
- In chapter 3, the entire working of the system has been explained, all the components of the system along with flow charts and Data Flow Diagrams are explained. This chapter briefs about the working methodology of the system. All the snapshots of the system have been added.
- 4th chapter is the last chapter of the documentation that contains the details about tests being performed, scope, and limitations of the system.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION TO PROJECT

RFID Based Advanced Waste Collection System provides a comprehensive model for facilitating proper collection and disposal of waste. This system is capable of providing a platform for municipals to carry out their waste disposing process in a more eased and sophisticated manner. This system works by employing Radio Frequency Identification for uniquely identifying every user through a RFID card which is then scanned by a reader every time when the waste is collected which is then recorded onto a database. This system maintains a database with information about a user like their daily waste collection & billing status, provides a mobile application for both user and employee for hands on information, tracking waste collection vehicle and also providing them routes to nearest dumping stations.

This system provides a functionality which is easing in nature on both the user as well as employee as it provides a dedicated two way communication channel to the user and gives definite constraint on how to work to the employees.

Fig. 1.1: RFID Based Advanced Waste Collection System

1.2 OBJECTIVES

The whole idea about this system is to provide a way for solving a real life problem of irregular waste disposition which can be formulated by keeping some objectives in mind that have to be implemented in the course of the whole process starting from the collection of waste to its proper disposal. Some of those objectives are listed below:

i. **Regulated Waste Collection:** This system removes the irregularity in waste collection on daily basis as seen in the current functionality because no records are maintained. This system maintains a database for every user and record the waste collection status on a daily basis so if the waste collector skips any day it will be reflected in the database and will be notified.

ii. **Reduce Paper Work:** All records are on paper in the present working. Since this whole waste management system is made on a digital platform, everything is recorded in the database. The user gets the bill receipt in electronic form and the billing status are updated in the mobile application accessible to the user.

iii. **Proper Disposal of Waste:** The waste collected by individual collectors over an area is not properly disposed. One can witness heaps of waste piled up in places which are not meant to be such as empty plots of lands, along the roads or in a pit. This waste is not collected by the municipal vehicles and pollute the environment. This system ensures that the collected waste is disposed into the dedicated Dumping sites by assisting the employee with routes to the nearest dumpsite by making use of technologies such as GPS.

iv. **Ease of Access:** The system employs ways for the user to communicate with the administrators on any arbitrariness. The system also sends updates to the user on their emails.

v. **Large Scale Implementation:** This system is designed so that it can be implemented on a large scale such a city. The Identification technology used in the system can easily be implemented in large population as each user or household can have their own RFID cards and the waste collection team deployed in a region can scan these cards to update the database.

1.3 SCOPE

'RFID Based Waste Collection System' is built on the case study of Hindustan College of Science & Technology, Mathura. The system has divided the college into key buildings such as Library, Auditorium etc. which act as different blocks from where waste has to be collected with every building being characterized by a RFID card and a dedicated database being maintained.

1.4 FEASIBILITY STUDY

The purpose of feasibility study is to find out whether a project which is put forth is worth the investment that it demands for its installation and operation. So in this section the feasibility of this system is discussed in multiple aspects.

1.4.1 Economic Feasibility

The system harbors minimal hardware requirement which consist of RFID cards and a RFID reader both of which are economical. The database is used for keeping all the information thus eliminating the use Paper.

1.4.2 Technical Feasibility

The domain of the database which is used for this system is Microsoft SQL server which provides the systems need of large or medium data size as well as supports more number of users. This together with the RFID identification technology provides for a very technically feasible system with minimum glitches.

1.4.3 Operational Feasibility

This system only needs a single person for maintaining the database because majority of the information is updated in the database automatically when the card is scanned by the reader. Also the employee can easily scan the card by a reader by just placing the reader in front of the card therefore providing optimum operational feasibility.

1.4.4 Social Feasibility

This system has easy to use mobile application for both the user as well as employee which provides hands on information hence the system is socially feasible.

CHAPTER 2

LITERATURE REVIEW

2.1. REQUIREMENT ANALYSIS

Requirement Analysis can be stated as a process in which the needs or expectations of the targeted users are realized which helps the developer to formulate a system which incorporates all those requirements. Under this process all the requirements are analysed for their feasibility and then after deciding on the inculcation of the respective requirement in the system, they are documented, validated and further managed in the software or system.
The process of documentation helps in the future maintenance of the system in case of any faults.

2.1.1. PROBLEM WITH THE CURRENT WASTE COLLECTION & MANAGEMENT SYSTEM

The current state of waste collection and its management is evidently poor. One can see heaps of waste being just dumped onto the sides of road which adversely affect the aesthetic beauty of the place as well as serve as the breeding sites for diseases. There are areas where waste is not even collected which forces the residents to dump their waste in undesignated places such as vacant plots of land or near a waterbody which causes harmful pollution. Therefore a properly organized and regulated waste collection and its management seems to be the need of the hour.

2.1.2 WHY WE NEED THIS SYSTEM?

RFID Based Advanced Waste Management System aims to establish a dedicated framework for executing waste collection and its disposal through structured processes.
This system provides a routine following which we can end the problem of irregular waste disposal which causes harm to both environment and people. It enhances the proper use of the designated dumping site that are built by the municipal for the specific purpose of waste disposal where waste can be segregated properly as recyclable and non-recyclable.
It also provides real time updates to people so that they can know beforehand if the waste would not be collected on a day due to some reason so that people do not dispose off their waste in a wrong manner.

2.1.3. LANGUAGES

Programming languages are used to communicate with machines. These are the set of instructions which could be used for implementing various algorithms and develop various applications to solve real world problems. The languages which are been used in this project as follows:

1. JAVA

Java is one of the most established and widely used programming languages and is used in multiple ways in the field of development. One of the most tremendous feature of Java is its machine independency, which means any program written in java can be executed on any machine having required version of java in it regardless of the specifications of the system. The portability capacity of java programs are better than other languages. Other features include its security, object oriented and many more.
The Platform independency of java is insured by virtual machine called as Java Virtual Machine (JVM) by which a byte code is created for each code instead of an executable file. The created byte code is interpreted by an interpreter.
Java has always been made of secure considering that it used to design distributed applications.

Characteristics of Java

- Simple
- Secure
- Portable
- Object-oriented
- Robust
- Multithreaded
- Architecture-neutral
- Interpreted
- High performance
- Distributed
- Dynamic

2. PHP

It is a type of scripting language that is being written in the server side and is extensively used in development of web applications and websites of both dynamic and static type. Most of the times PHP is used with MySQL because of its in-built features but can also be used with other databases such as ODBC, oracle, MS-SQL etc. Applications that uses PHP can be executed on multiple platforms (Operating Systems) as it is cross platform.

3. MySQL

It is a type of RDBMS (Relational Database Management System) and is relied on Structured Query Language (SQL). Data Warehousing and application logging are few of the major applications of it. MySQL is commonly is used to create a database on web. It can store records of multiple size from one entry to an entire details of anything. Scripting languages are used to make its interaction with applications and websites in real-time.

4. FLUTTER

Flutter is a new way to develop apps for android, iOS and many other platforms.
Flutter builds native apps and they are written in the Dart language. Dart is easy to learn and allows a lot of versatility to the Flutter platform. It allows you to create apps for Android and iOS with the same codebase.

5. DART

It is an object oriented, class based programming language developed by Google and is used to build multiple type of web and mobile applications. JavaScript and Native code are the forms in which it can be compiled to.

2.1.4. TOOLS

RFID Card Reader

Radio Frequency Identification System (RFID) used radio frequency for wireless transmission of data which is helpful in identification, categorization and tracing of assets. It is mostly used because of its high speed, increased accuracy, and cheaper cost.

2.2. PROPOSED SYSTEM

The proposed model aims to develop an overall efficient and improved systems with better features than previous systems. The system aims to provide the following functionalities:

- Regular Waste Collection
- Dedicated Database.
- System control by worthy admins.
- Minimize data manual entry by using scanning devices.
- Approved Dumpsites.
- Increased Efficiency.
- Better Service Quality.
- User Interactive.

CHAPTER 3

DESIGN AND MODULES

3.1. Model Used

The model we have used in our project is Iterative Waterfall Model. This model is used by a developer to lay out a step by step procedure of the processes which have to be undertaken to realize a particular Software Development Cycle (SDC). This model helps the developer to ease through the transition of implementing initial and simple undertakings to working out on more complex and broad multi featured system.

3.1.1 Iterative Waterfall Model

- Iterative Waterfall Model can be better termed as the augmentation of the Classical Waterfall SDC model.
- This model is almost similar to the classical waterfall model except for a few add-ones that are incorporated in order to improve the functional ability of software development.
- The iterative waterfall model allows the customer's to backtrack to a previous developmental stage through feedback paths.
- One point of concern about this model is that it does not provide any feedback paths to feasibility study phase due to which there is no scope for any modification or corrections in this phase.
- Iterative Waterfall Model allows the modification or change in requirements in any prior development phase except the feasibility study as stated above
- Due to the ability provided by the feedback paths it become comparatively easier for the developer to detect and correct any errors which might have been committed.
- In iterative waterfall model, a developer can start working on the subsequent stage only after the previous stage is completed.

Phases of Iterative Waterfall Model:-

1. Requirement Analysis
2. Feasibility Study
3. Software Design
4. Coding/Implementation
5. Software Testing
6. Software Deployment
7. Software Maintenance

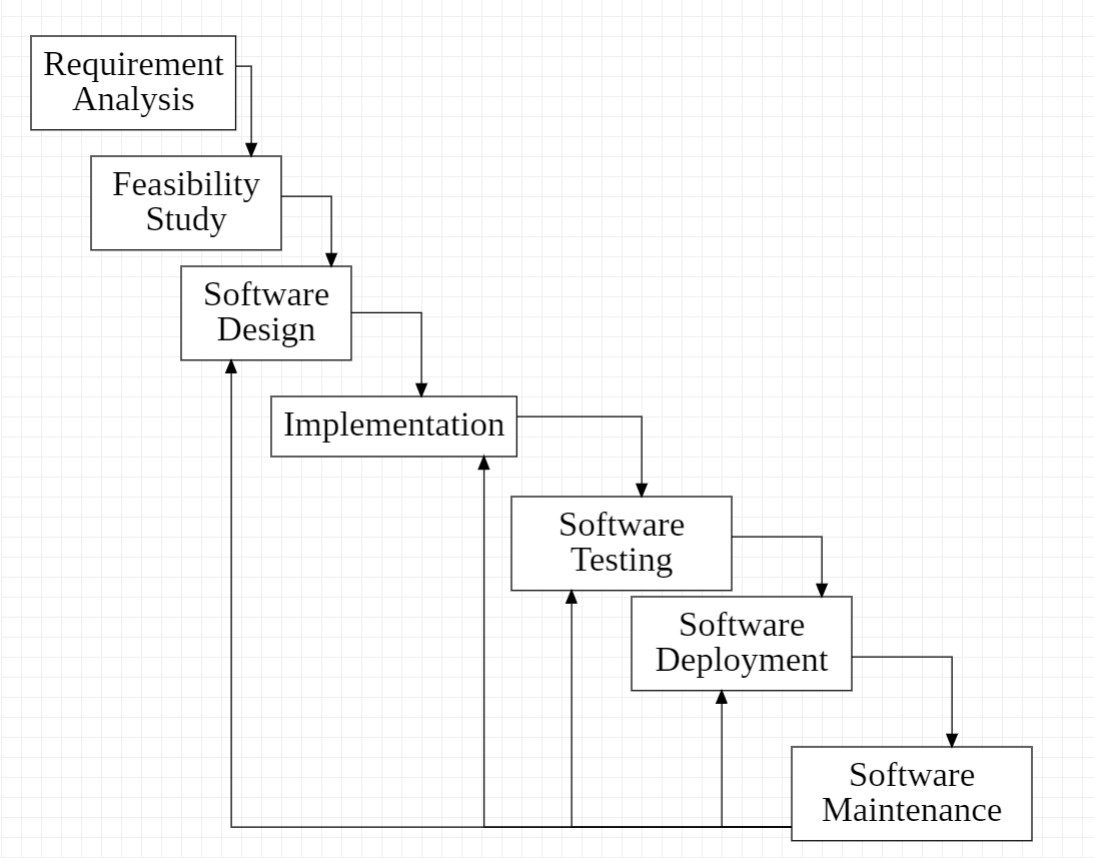

Fig. 3.1: Iterative Waterfall Model

3.1.2. Advantages

- Iterative Waterfall Model can be understood and implemented quite easily.
- Every phase in iterative waterfall model contains a feedback path to its previous stage.
- Any modification or changes in a phase is allowed.
- This model reduces the stress of time constraints for a developer to a certain extent.
- Involvement of customers in the development stage is not required.
- Fit for development of large and complex systems.

3.1.3 Disadvantages

- No feedback path is available for feasibility study phase.
- Requirements should be absolutely clear for smooth implementation.
- Costs more than the traditional systems.
- Risk Handling is not featured in this model.
- No prototypes for customer review as it provides a completed project.
- Not suitable for undertaking of short projects.

3.2. Flow Charts

3.2.1. Employee Portal

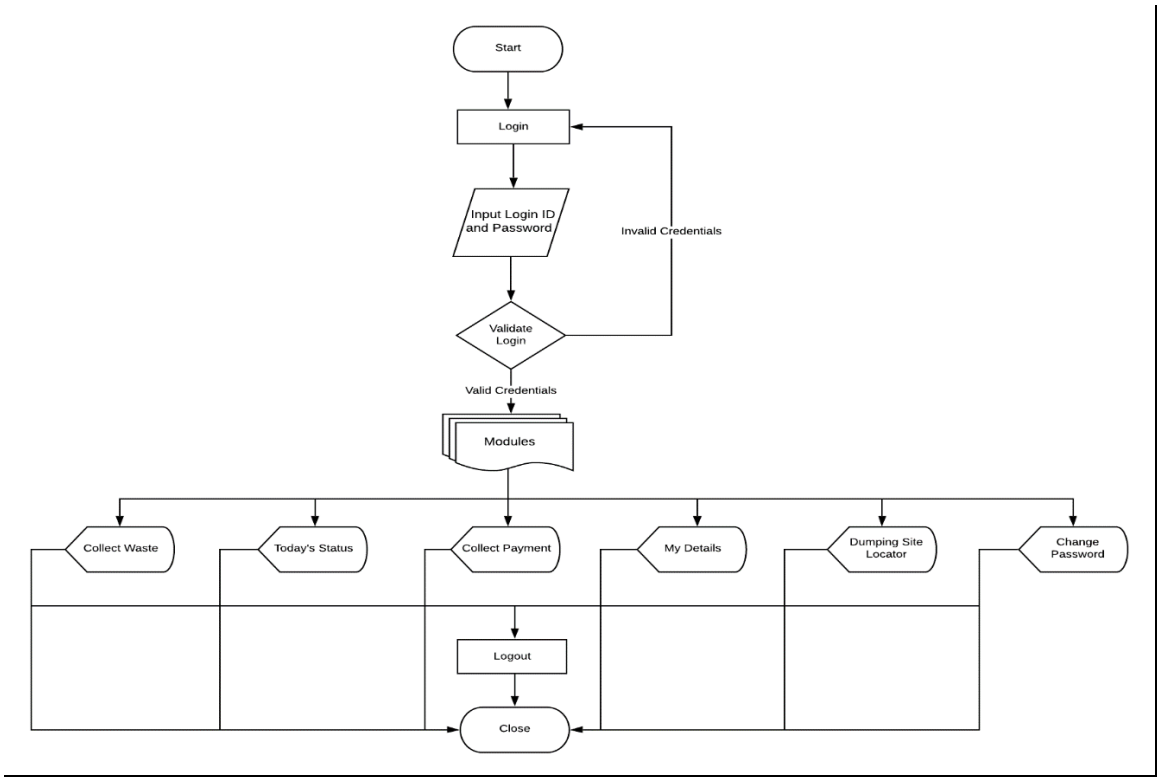

Fig. 3.2: Employee Module Flowchart

3.2.2. Public Portal

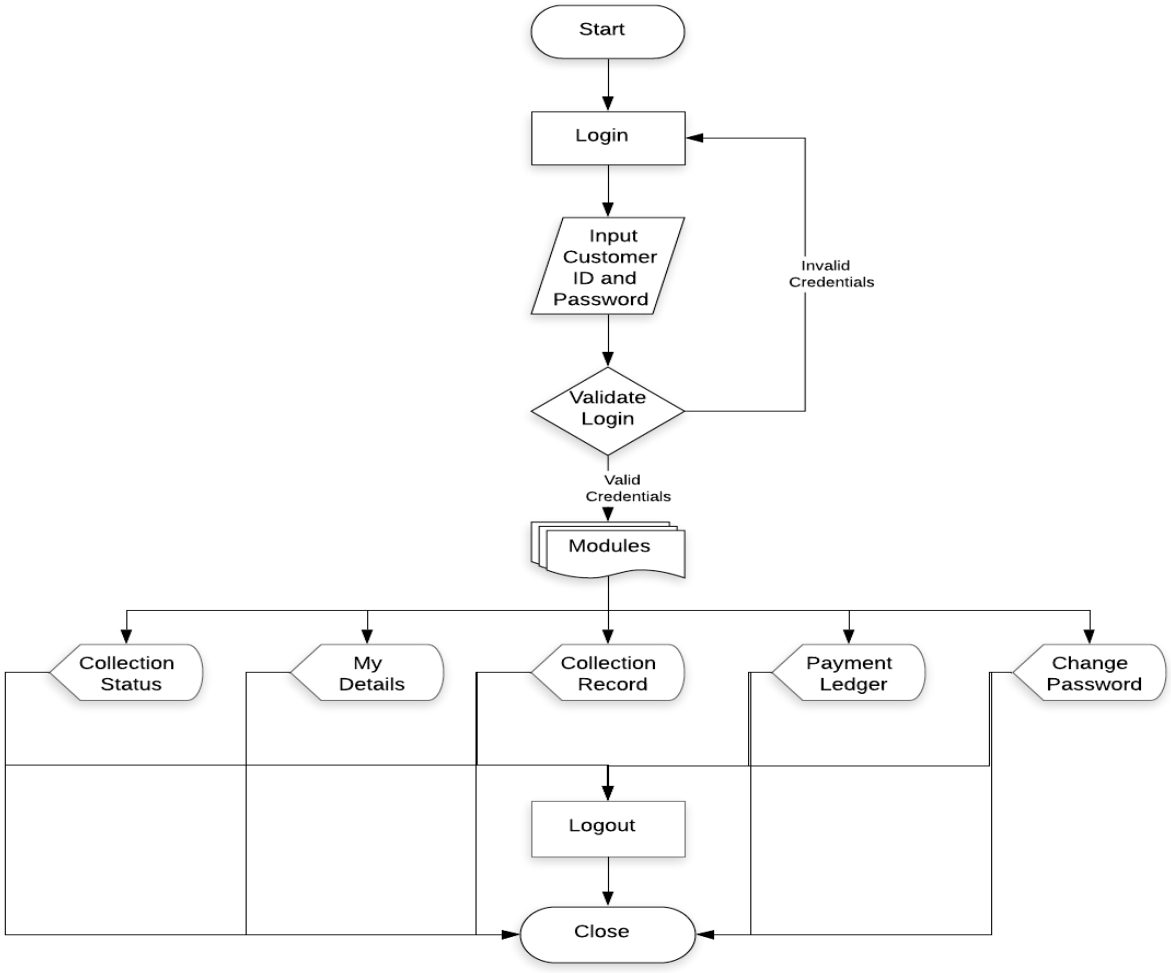

Fig. 3.3: Public Module Flowchart

3.2.3. Software

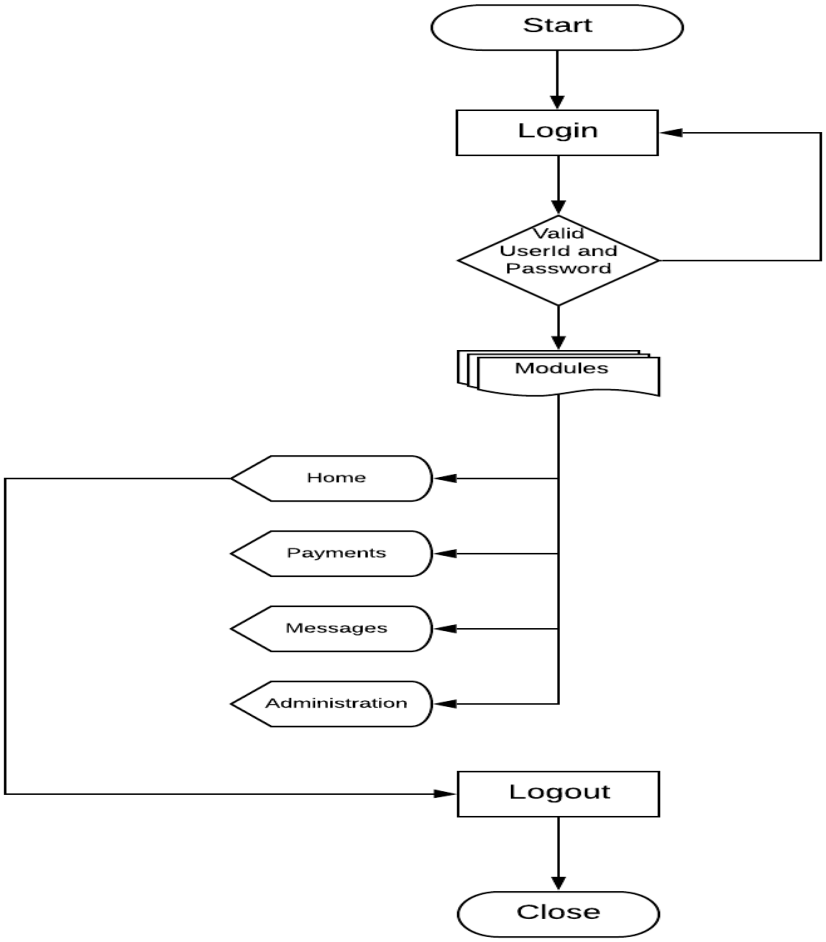

Fig. 3.4: Software Flowchart

3.3. Data Flow Diagrams

3.3.1. Employee Portal

3.3.1.1. DFD Level 0:

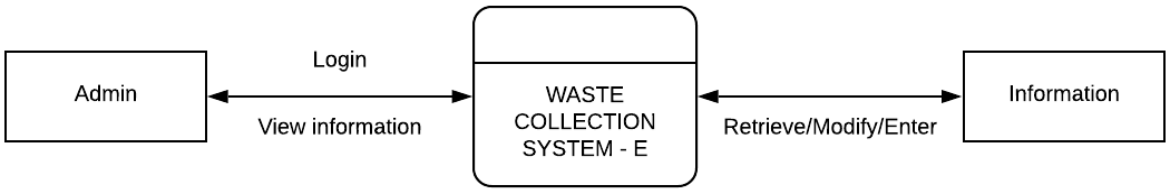

Fig. 3.5: Employee Portal DFD Level 0

3.3.1.2. DFD Level 1:

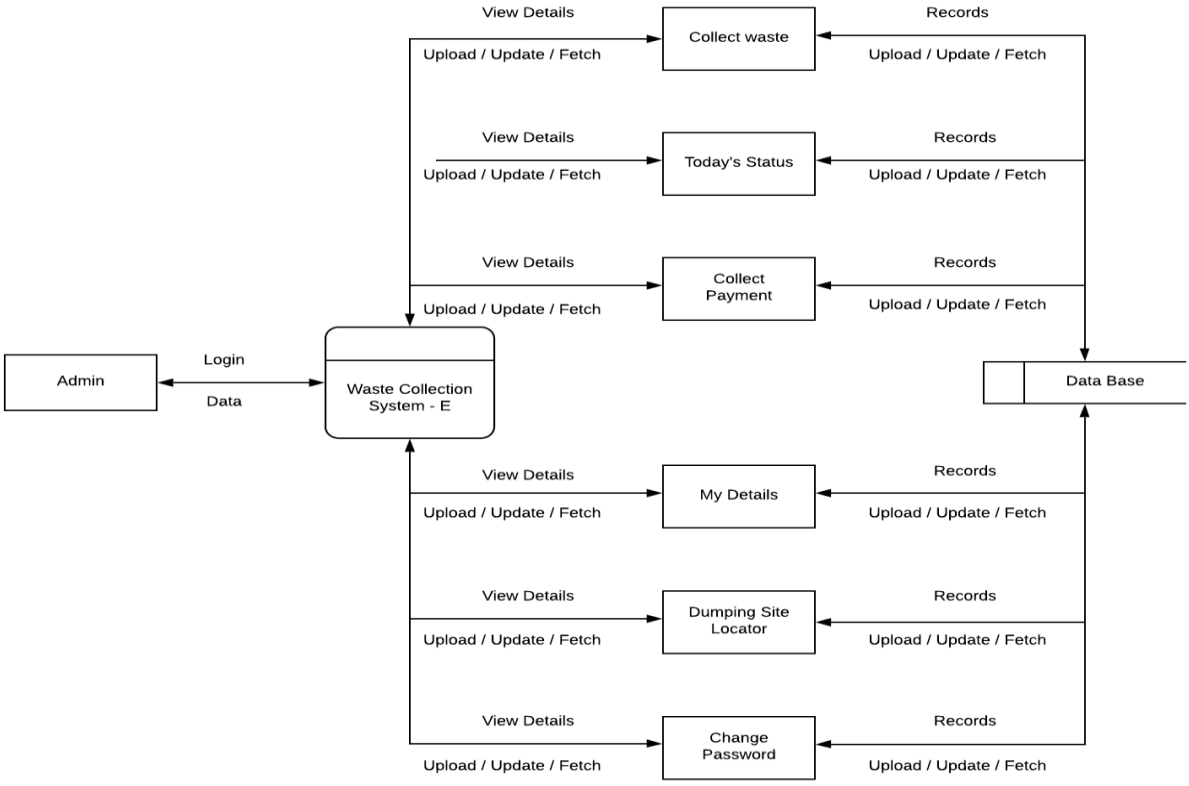

Fig. 3.6: Employee Portal DFD Level 1

3.3.1.3. DFD Level 2:

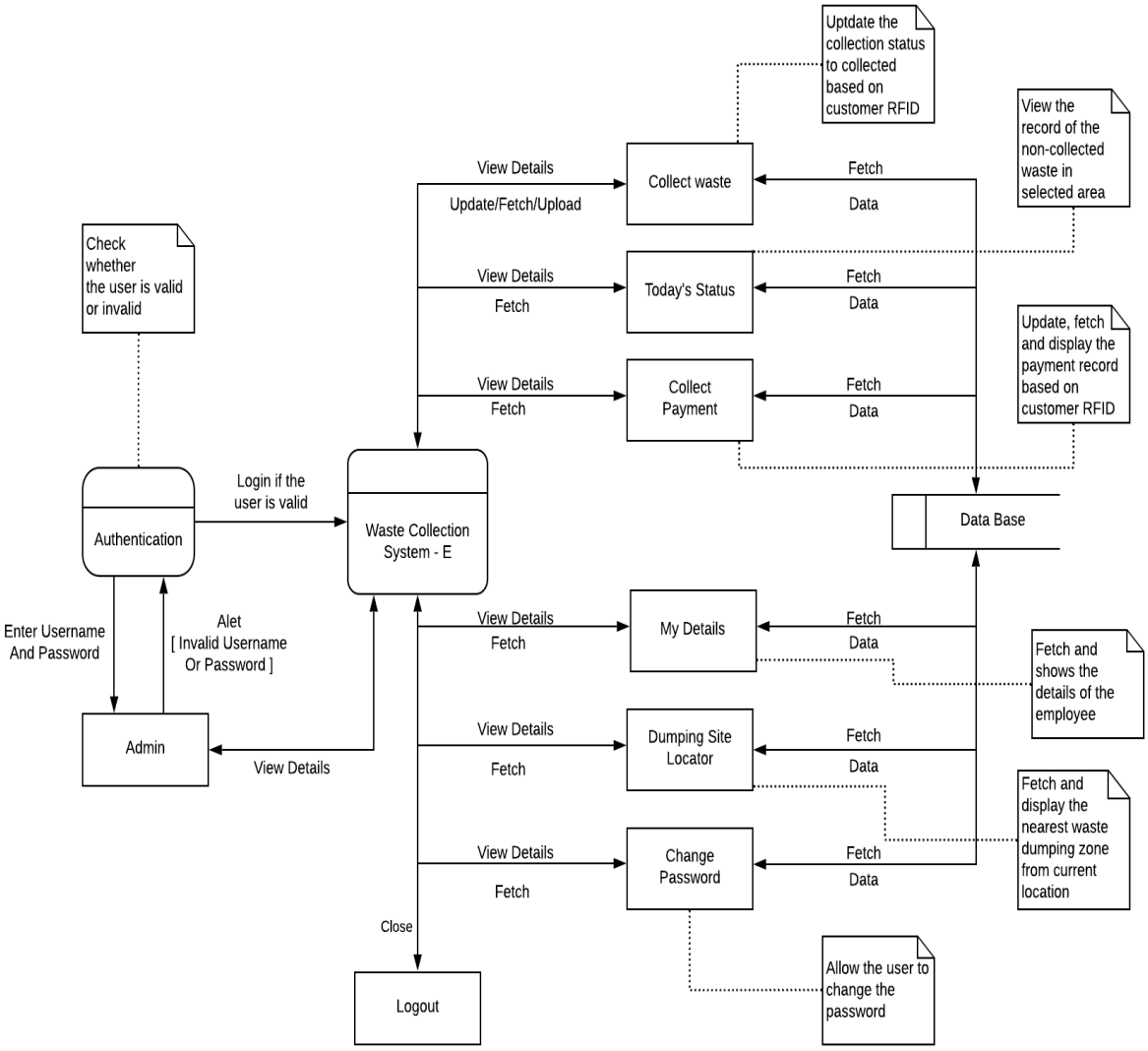

Fig. 3.7: Employee Portal DFD Level 2

3.3.2. Public Portal

3.3.2.1. DFD Level 0:

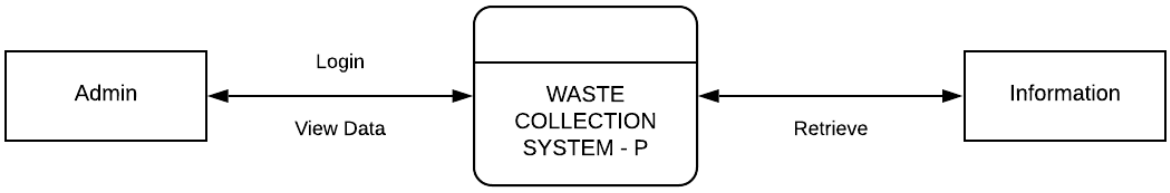

Fig. 3.8: Public Portal DFD Level 0

3.3.2.2. DFD Level 1:

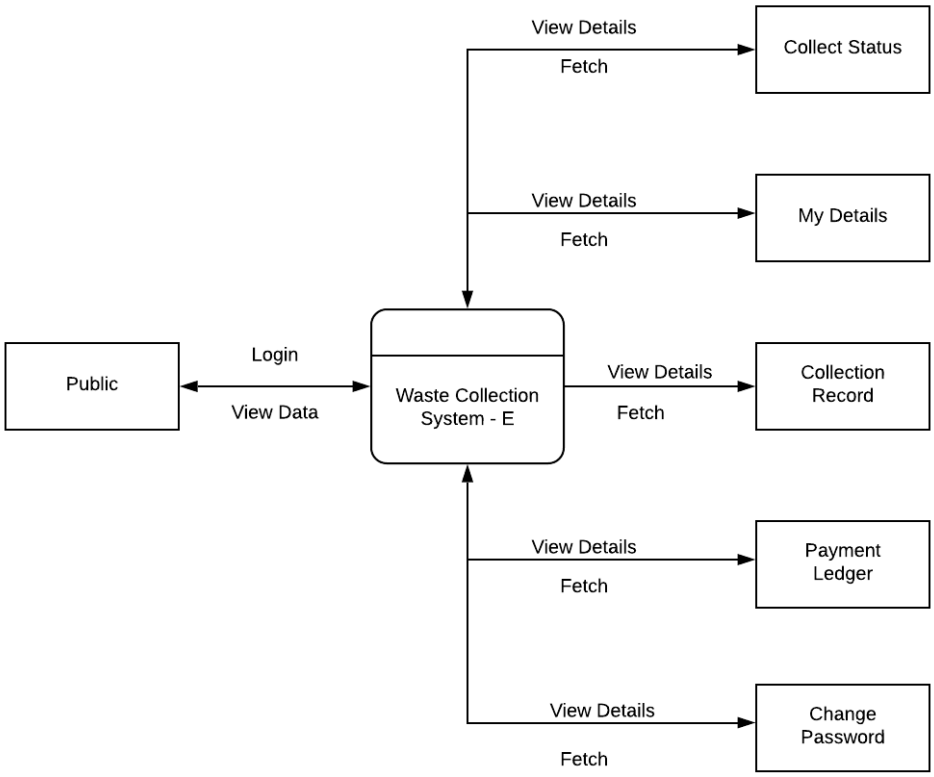

Fig. 3.9: Public Portal DFD Level 1

3.3.2.3. DFD Level 2:

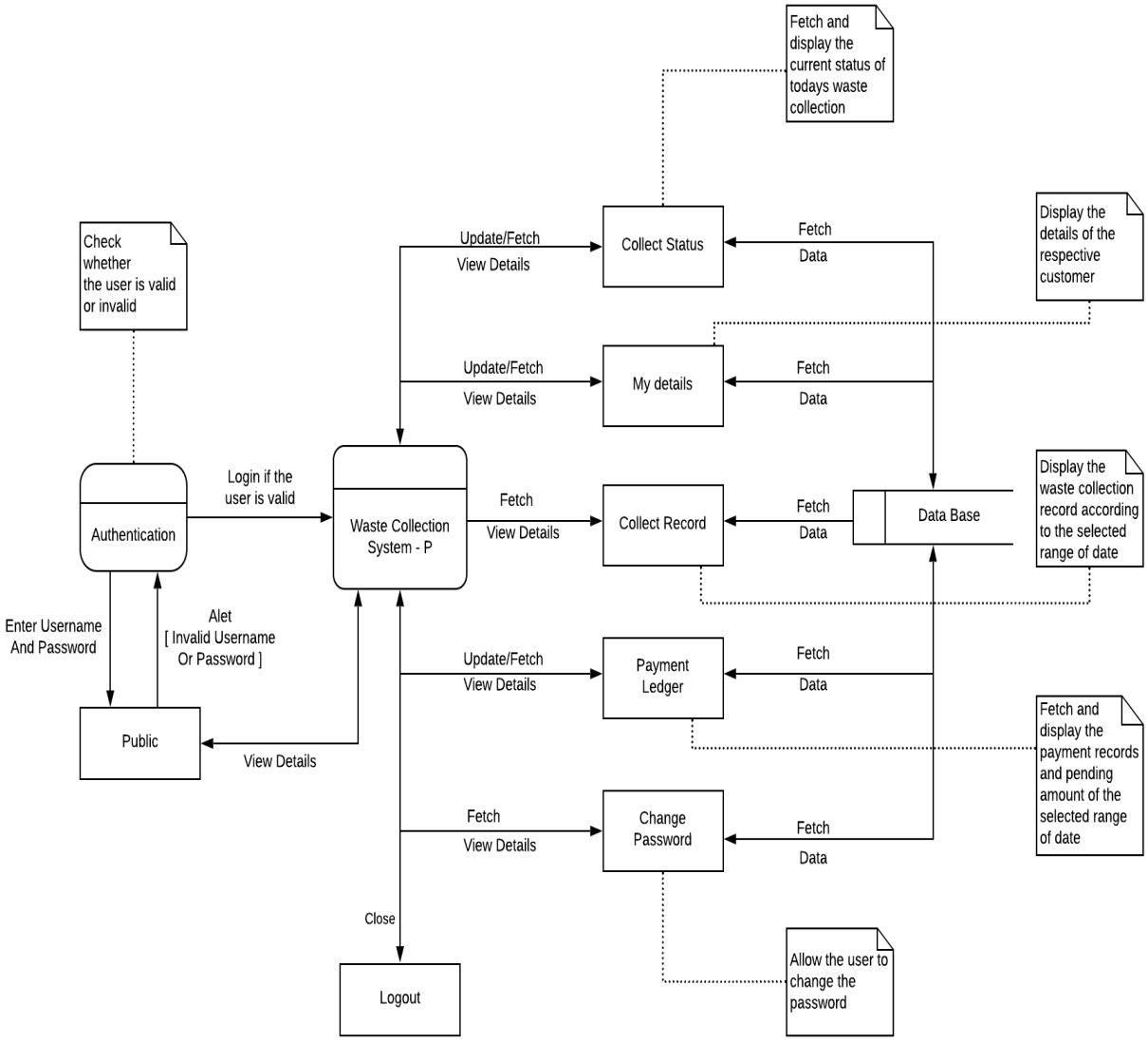

Fig. 3.10: Public Portal DFD Level 2

3.3.3. Software

3.3.3.1. DFD Level 0:

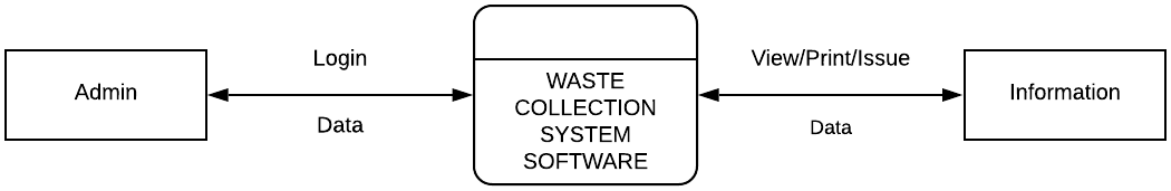

Fig. 3.11: Software DFD Level 0

3.3.3.2. DFD Level 1:

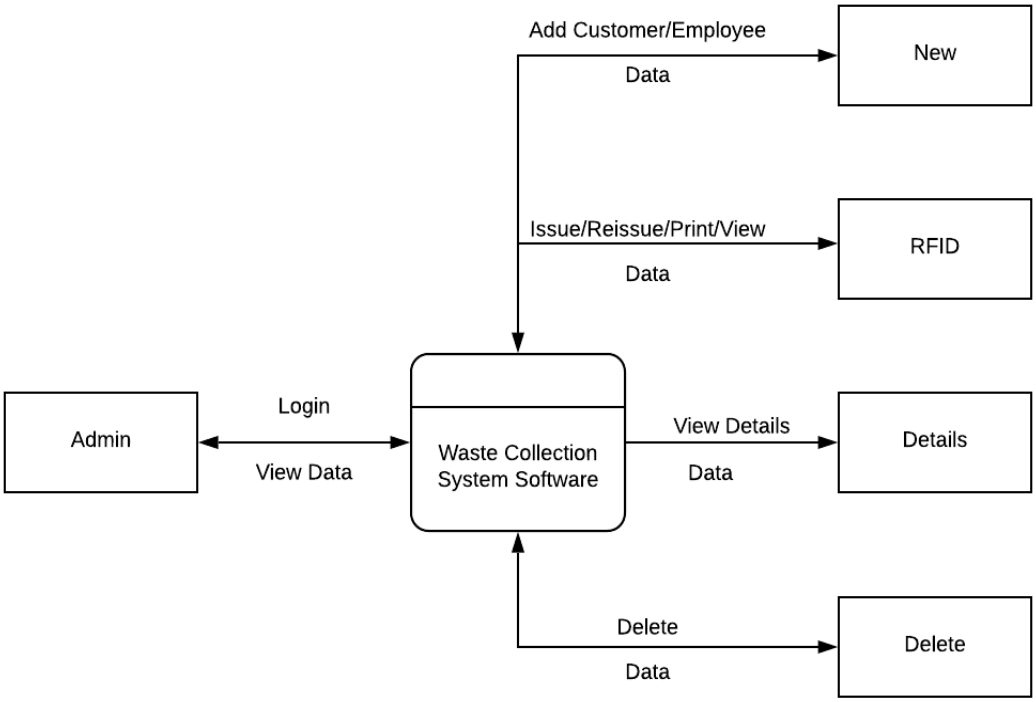

Fig. 3.12: Software DFD Level 1

3.3.3.3. DFD Level 2:

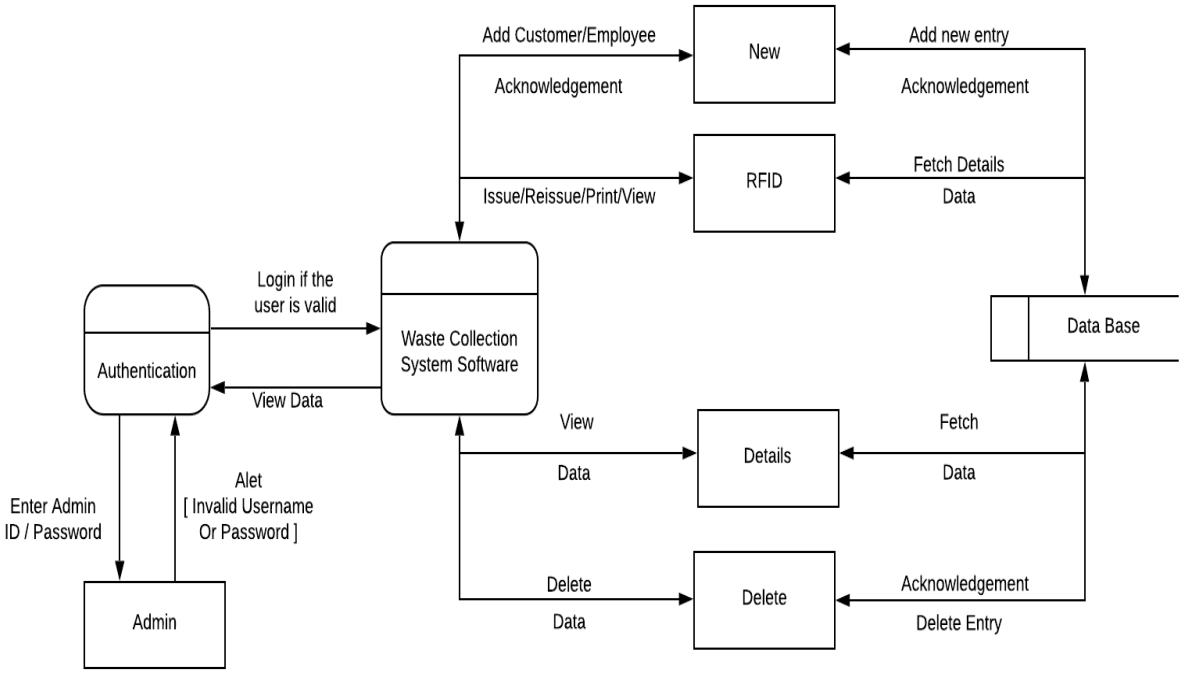

Fig. 3.13: Software DFD Level 2

3.4. Project Modules

3.4.1.Module 1: Mobile Application

3.4.1.1. Employee Portal:

This is a mobile application portal for the employees. Employees will have to login to this application using their unique login ID and password provided by the admin and use this application for various purposes such as recording waste collection, taking payments, viewing details etc. Collection of waste and payment will be done by scanning the RFID card. Employees can also use this app to view their own personal details. Employees can also change their default password (their joining date in ddmmyyyy fromat) by using the specified opition. The mobile application is developed using flutter, it interacts with the database using php written on the server side. All the data sent and received, is done through json so that the data travels in a specific format.

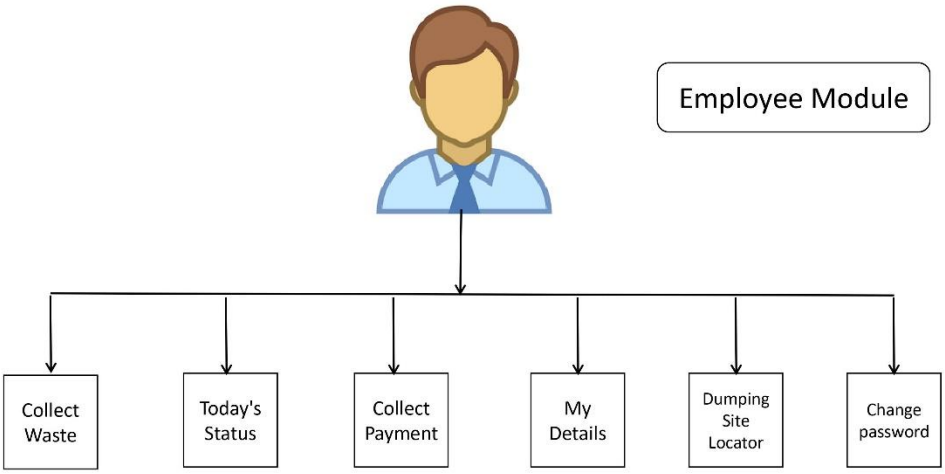

Fig. 3.14: Employee Module

3.4.1.2. Public Portal:

Another mobile application has been made for public use. Every house will be allotted a unique customer ID and password. In the developed model the customer ID will be first 3 letters of area concatenated with room number and the password will be assigned persons mobile number which can be changed through the application. People will be using this application to check their daily waste collection status, payment ledger, time period based waste collection data and personal details. This application is also developed using flutter and interacts with database using php.

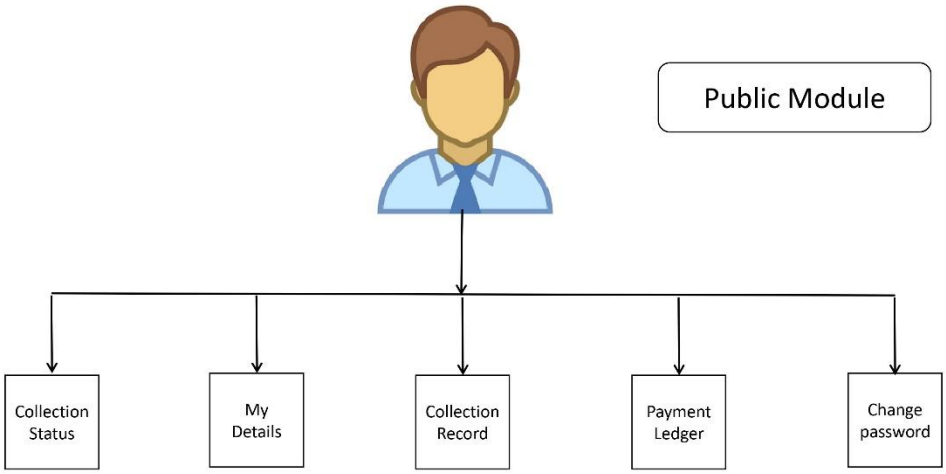

Fig. 3.15: Public Module

3.4.1.3. Libraries Used

1- Font_awesome_flutter:

The Font Awesome Icon pack lay out an augmented pack of 1500 icons that can be used in the app.

2- HTTP:

HTTP (Hypertext Transfer Protocol) can very well be termed as the most popular application protocol that is used in the Web today.

- A HTTP client sends out a request message to an HTTP server, which then works out on the request message and transmit an appropriate answer to the client's request.
- HTTP is widely termed as a stateless protocol which means the current request in line does not know about how the previous request was handled.
- HTTP allows the negotiations in data types & representation, which permits the systems to be developed independent of the fact of data transfer.
- Profound Definition: "Hypertext Transfer Protocol (HTTP) is an application level protocol for distributed, collaborative, hypermedia information systems. It is a generic, stateless, protocol which can be used for many tasks beyond its use for hypertext, such as name servers and distributed object management systems, through extension of its request methods, error codes and headers."

3-Shared_prefrences:

Shared_preferences on Android, provides a resolute store for simple data. Data is added to the disk asynchronously. None of the platform can assure that the writes will be resulted to the disk after coming back therefore this plugin should not be utilized for the storage of vital data.

4-Rich alert:

This package helps you to render an un-traditional alert dialog in your Flutter app.

This package supports usage on both Android and iOS builds.

5-intl:

intl packet dispenses internationalization and localization abilities as well as message translation, plurals and genders, date & number formatting as well as parsing and bidirectional text.

6-Date time picker form field:

A TextFormatField that depicts Date & Time and helps to display material, Cupertino, and other style picker dialogs.

7-Firebase messaging:

Flutter plugin make use of the Firebase Cloud Messaging (FCM) API.
Through this plugin, one's Flutter app can receive and process notifications along with data messages on both Android and iOS.

3.4.1.4. Functions

There are several functions being made in this module completion. For any code to work properly there are proper functions being used and working properly defined. The Functions made are as follows:

1.http.post2-http:
This method posts a blank payload as well as information for the Authorization and User-Agent headings. Using this method the system returns the HTTP status code to the specified variable.

2.sharedPreferences.setString(key, value);: Saves a string value to persistent storage in the background. If value is null, this is equivalent to calling remove() on the key.

3.sharedPreferences.getString("token");: Reads a value from persistent storage, throwing an exception if it's not a String.

4.DateFormat('dd-MM-yyyy').format(initialDate): The function is use to set the date in a particular format.

3.4.2. Module 2: Software

There will be a computer software application in this model that will be installed at the central hub and will be controlled by admins of the system. These admins will be created by master admin. Admins have to login to this software using their credentials and will be using a button to create a new empty dataset for that date so that the process of waste collection can be initiated. Admins will be using this software application to register, delete, modify people or employee details, accept payment, see payment details monitor waste collection, send push notifications to peoples phone, check complaint mails etc. They will be issuing a unique RFID card to each household and can also create a duplicate RFID card in case if it is lost. The software application has been developed using Java Swings and interacts with the database using Java Database Connectivity.

3.4.2.1. Libraries Used:

Libraries are set of methods and functions available with each and every version of the python software. Generally with new versions new libraries are made available which may or may not remove some existing functions and methods. In the module we have used the following libraries:

1. **Java Mail API**

   To send the acknowledgement mail after receiving the mail this API has been used. This has also been used to send the OTP to master admins e-mail.

2. **Date Picker**

   This library has been used to integrate date-picker tool in the software.

3. **Wind api:**

Starting from Microsoft(R) Windows(R) 2000, Windows operating systems provide a built-in cryptographic feature called "Windows Data Protection API" (DPAPI), which allows any application to securely encrypt confidential user data using the user's credentials in a way that it can only be decrypted by the same user.

This Java library exposes Windows Data Protection encryption and decryption features as an easy to use Java API. Behind the scenes, JNA (Java Native Access) library is used to invoke the native Windows CryptoAPI CryptProtectData and CryptUnprotectData functions.

Note:

a. Since this library exposes a Windows feature, it will only work, when called from a Java application running on Windows
b. Only an essential subset of Windows Data Protection API (DPAPI) is supported by this library: advanced cases involving showing prompts to the user etc. are not implemented.

3.4.3. Project Snapshots

3.4.3.1. Software

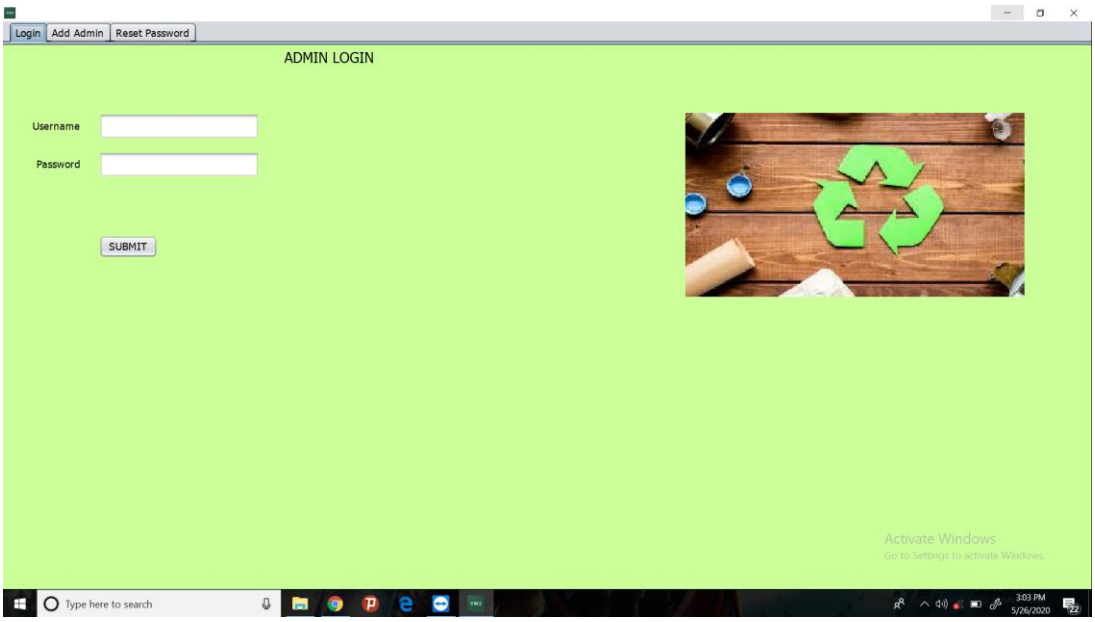

Fig. 3.16: Admin Login Page

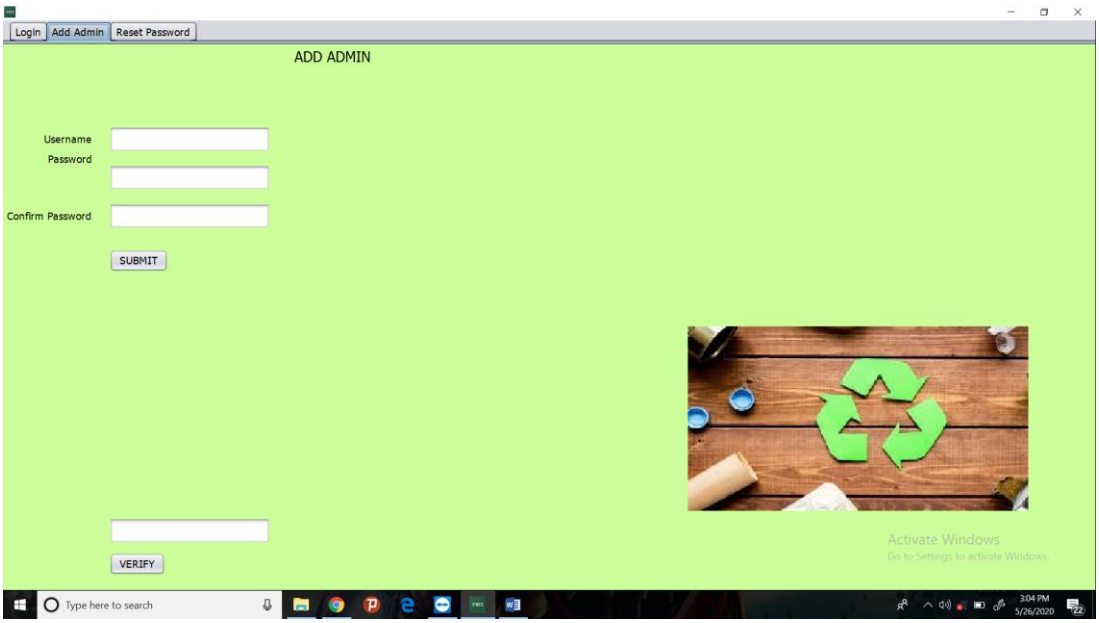

Fig. 3.17: Create Admin Page

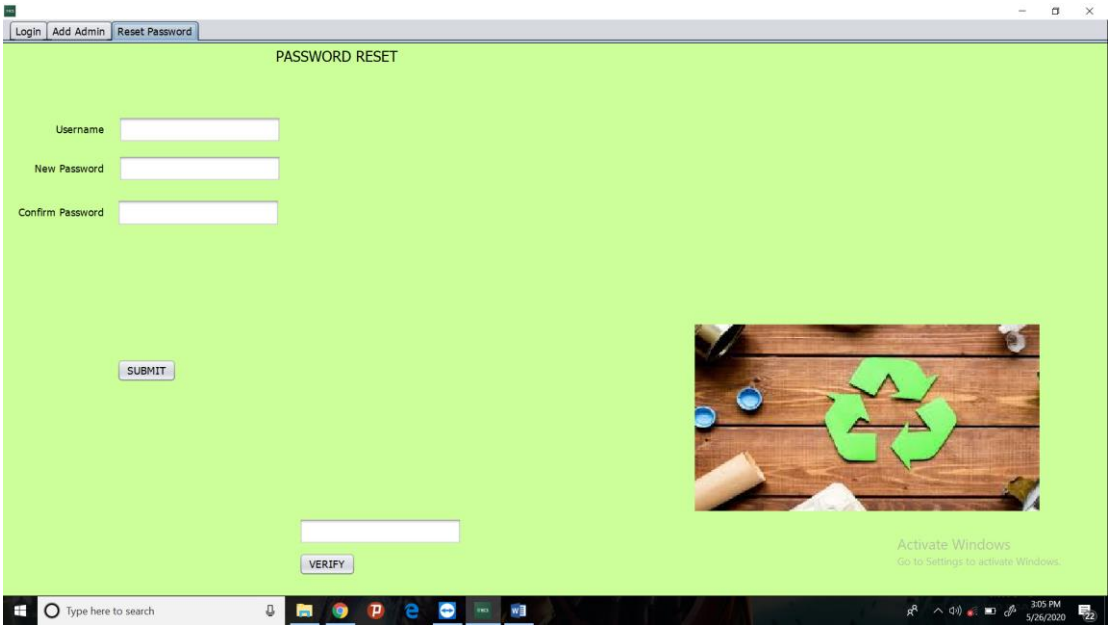

Fig. 3.18: Admin Password Reset Page

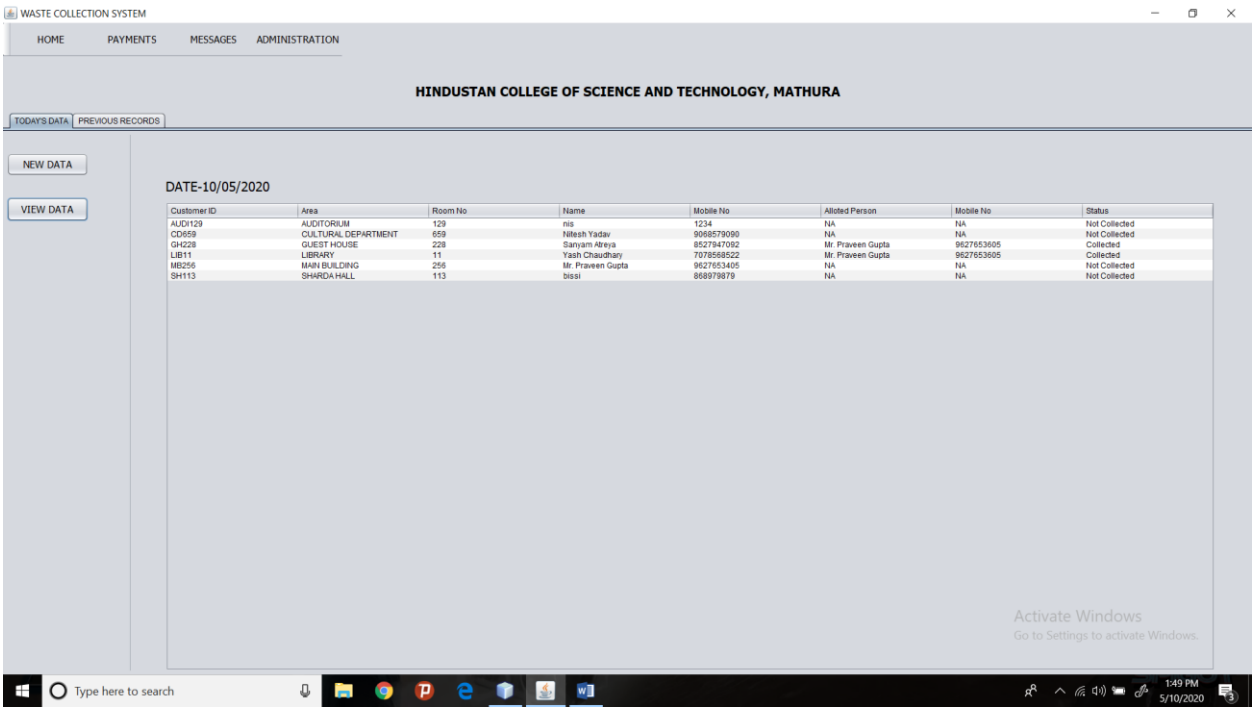

Fig. 3.19: Add New Data Page

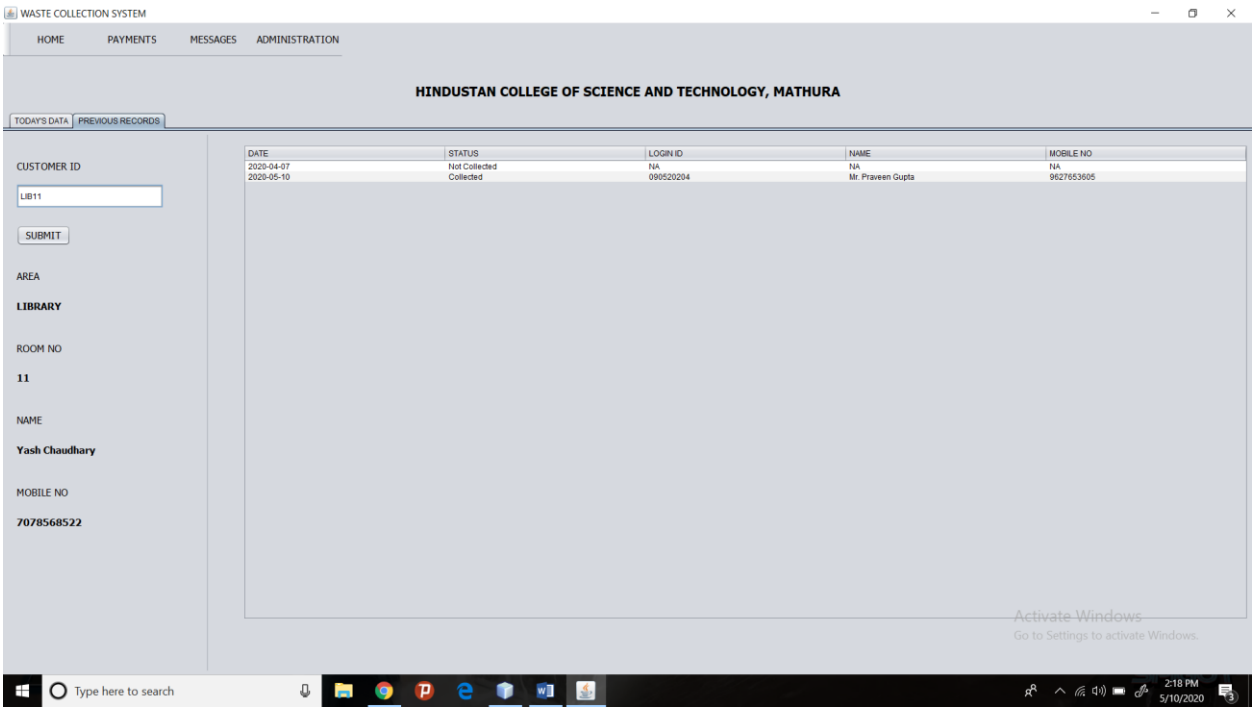

Fig. 3.20: View Waste Collection Data Page

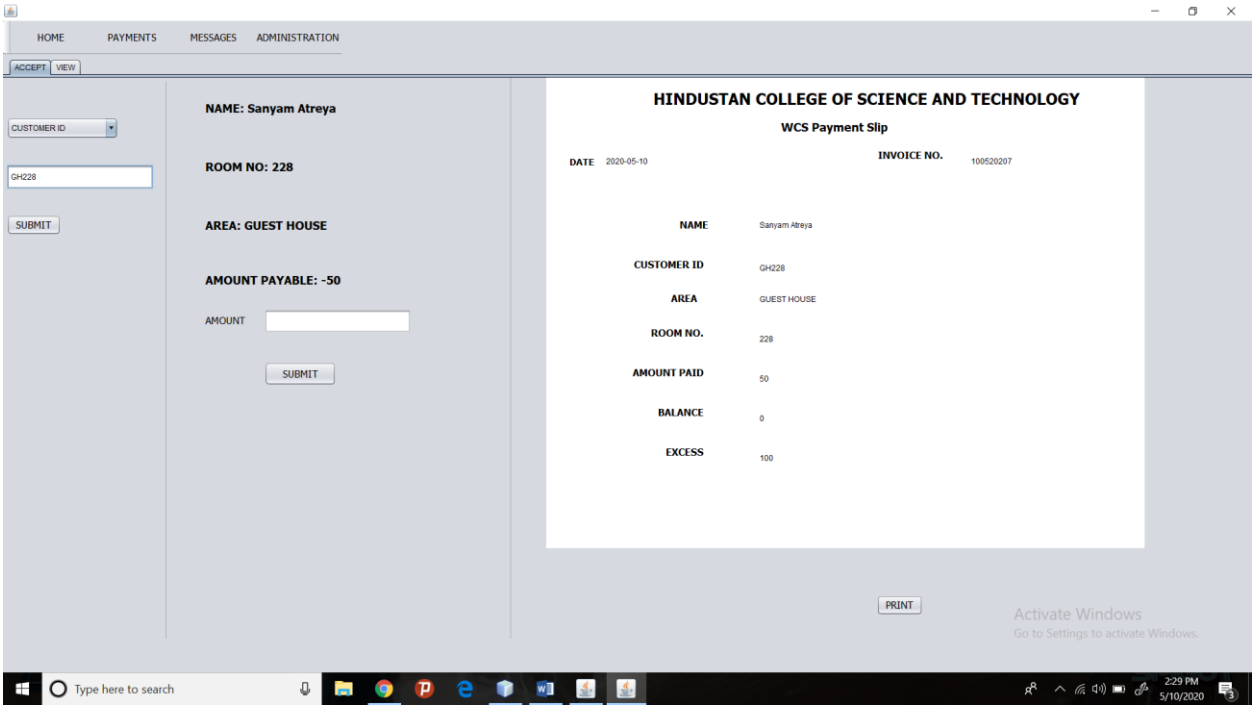

Fig. 3.21: Accept Payment Page

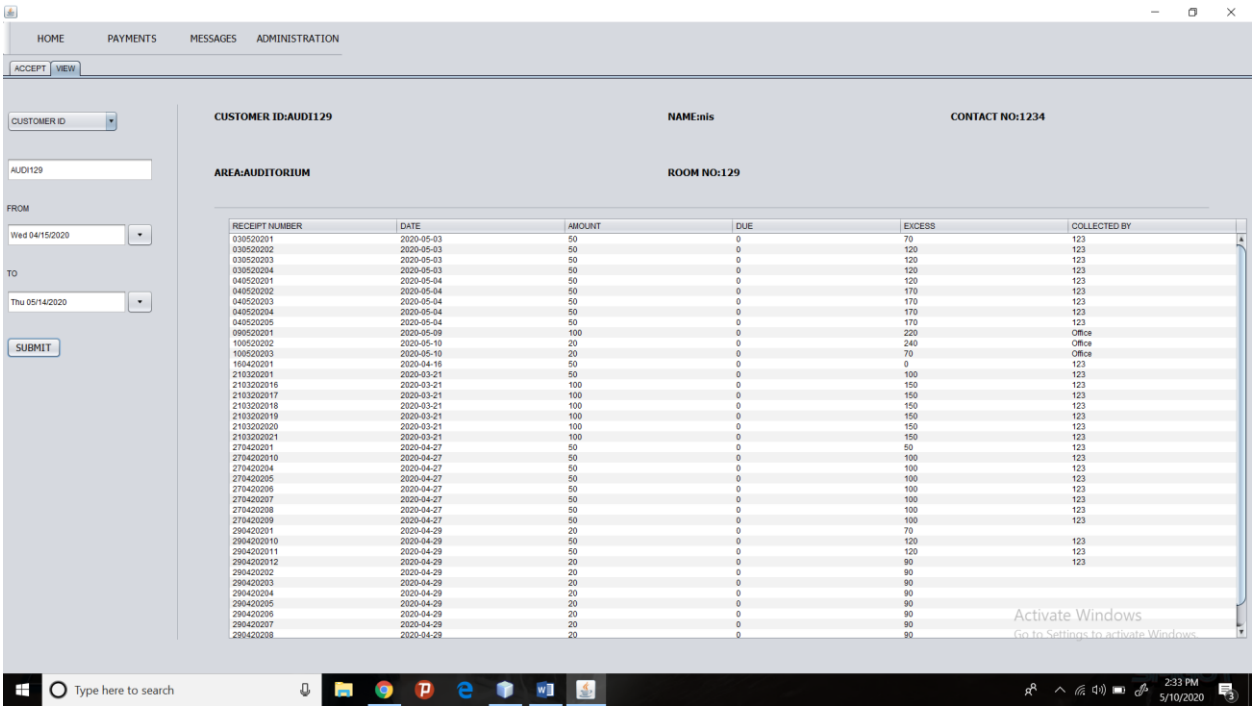

Fig. 3.22: View Payment Details Page

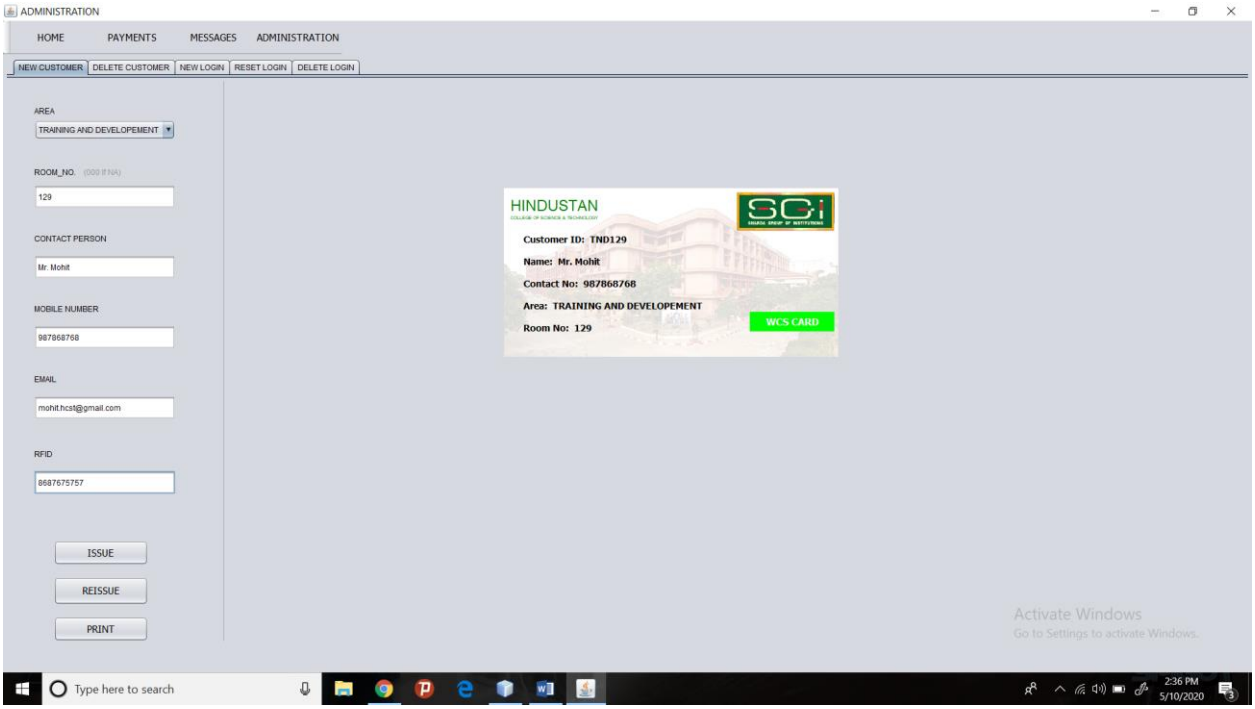

Fig. 3.23: Add new customer page

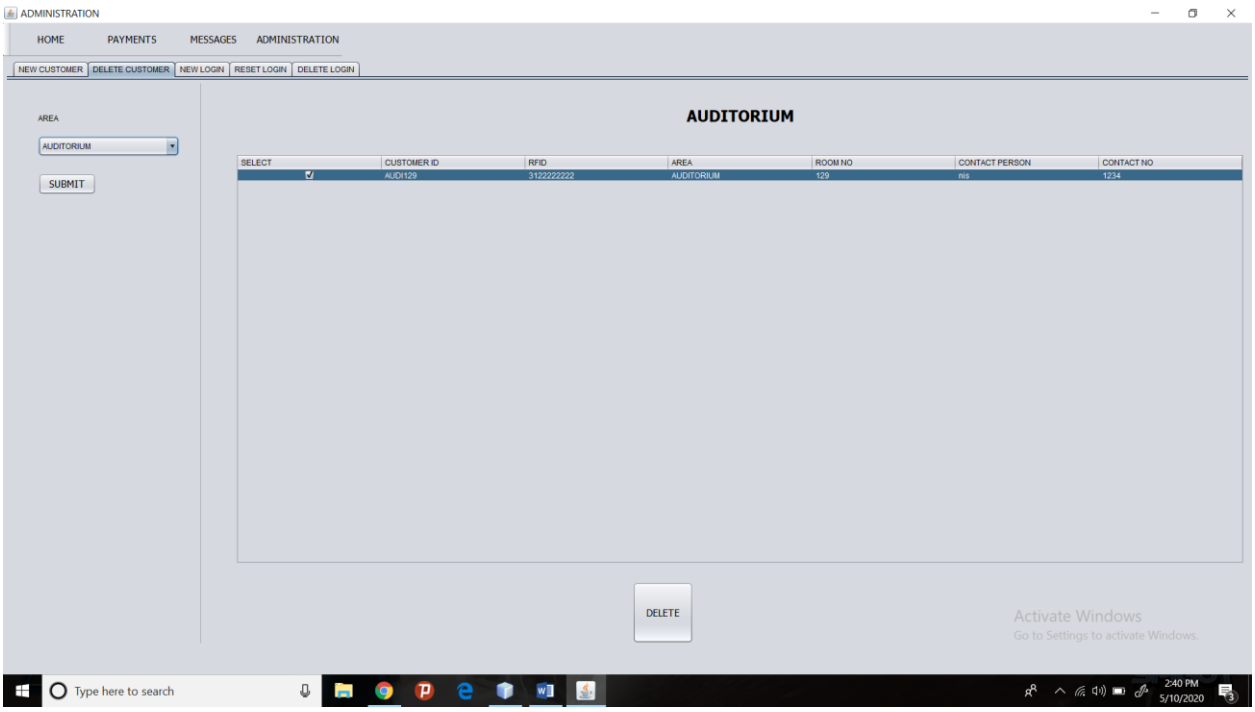

Fig. 3.24: Delete customer page

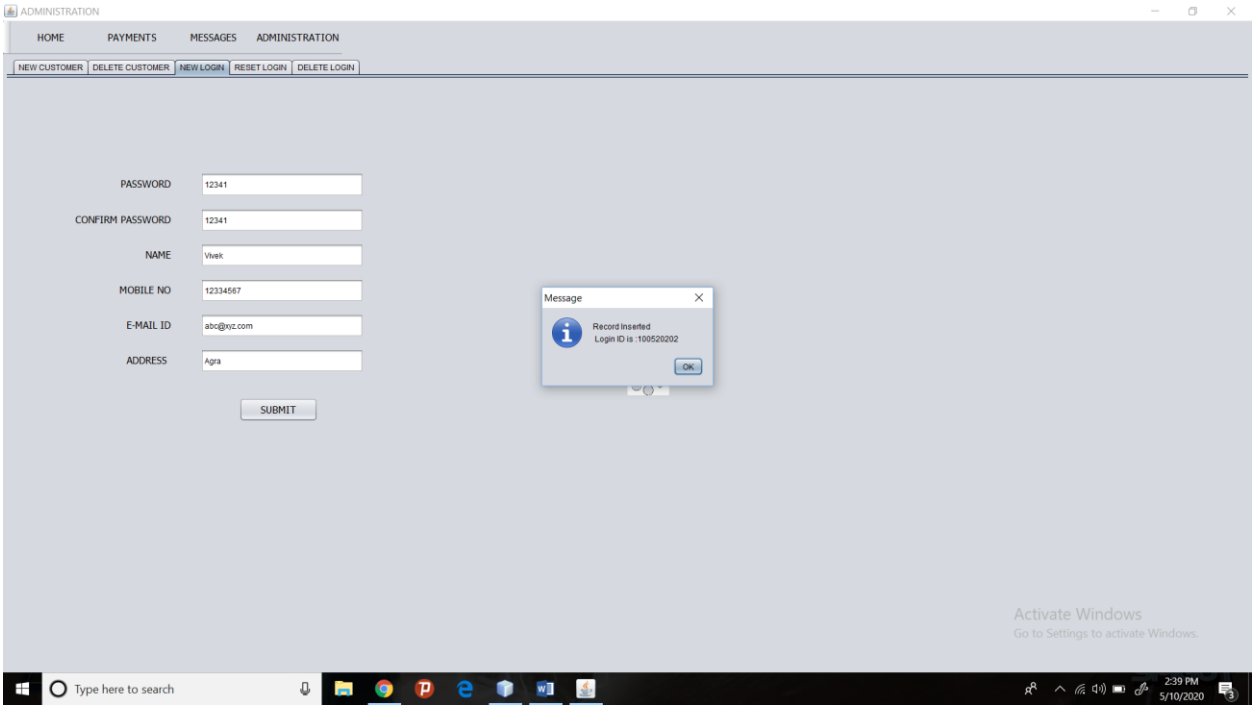

Fig. 3.25: Add New Employee Page

3.4.1.1. Employees Application

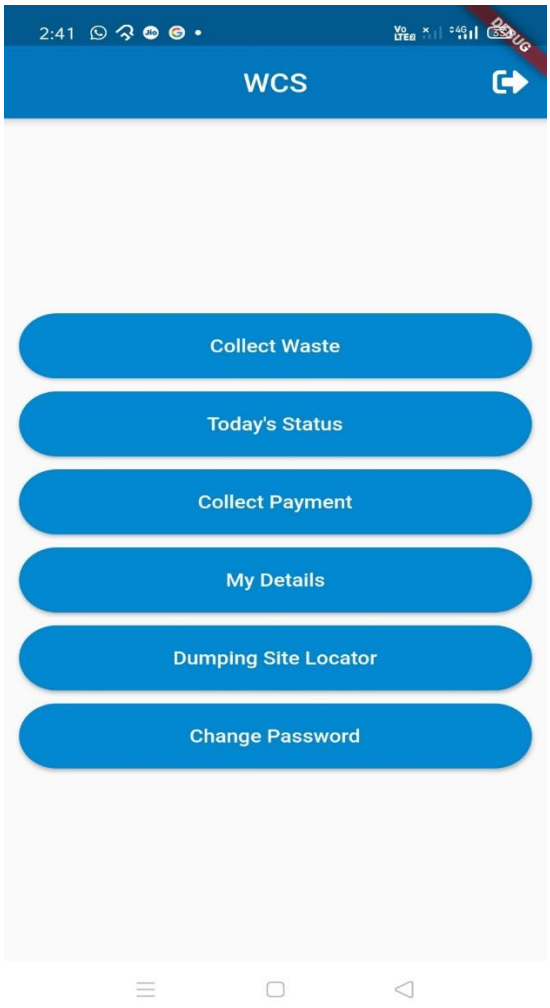

Fig. 3.26: Employees application home page

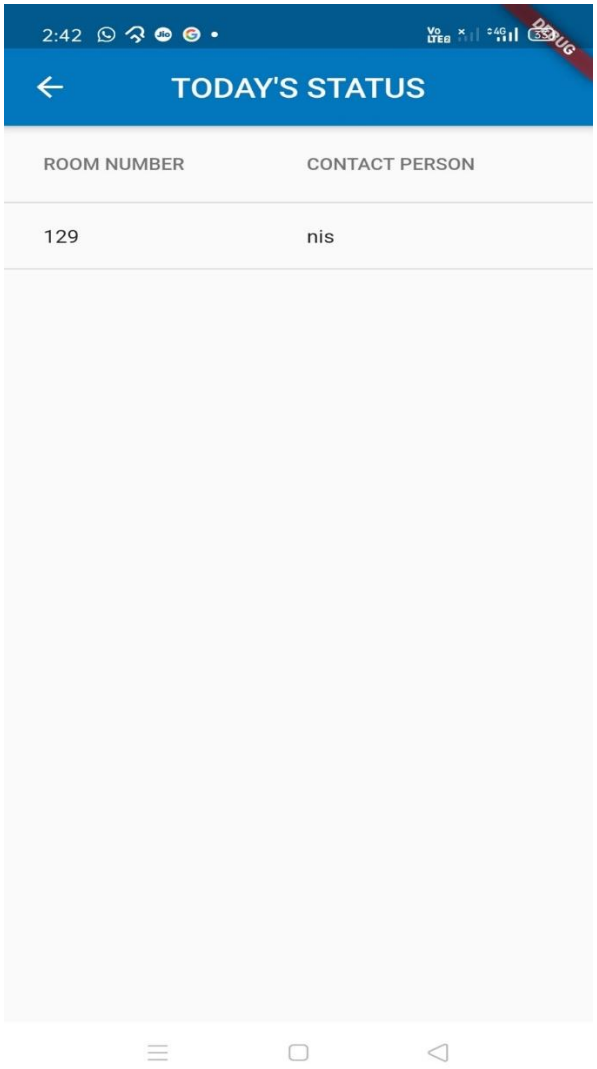

Fig. 3.27: Employees Application Today's status page

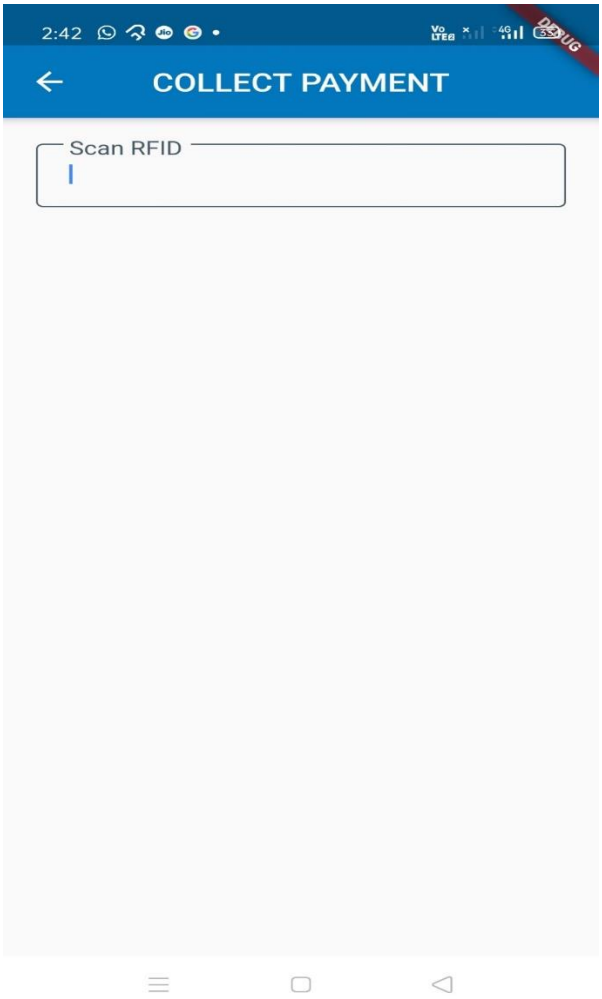

Fig. 3.28: Employees Application Collect Payment Page (Scan RFID)

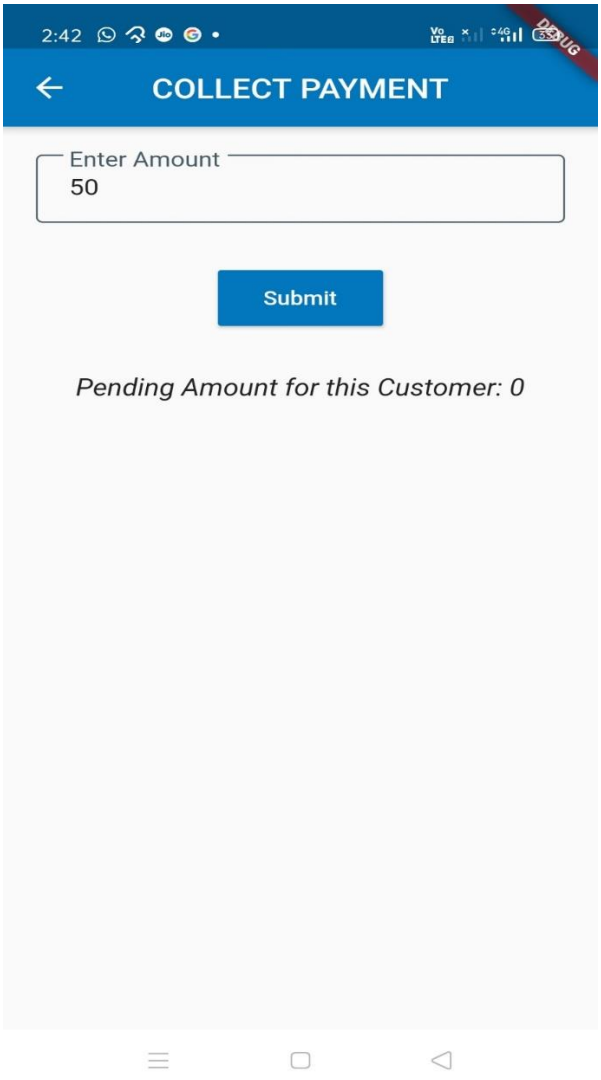

Fig. 3.29: Employees Application Collect Payment Page (Enter Amount)

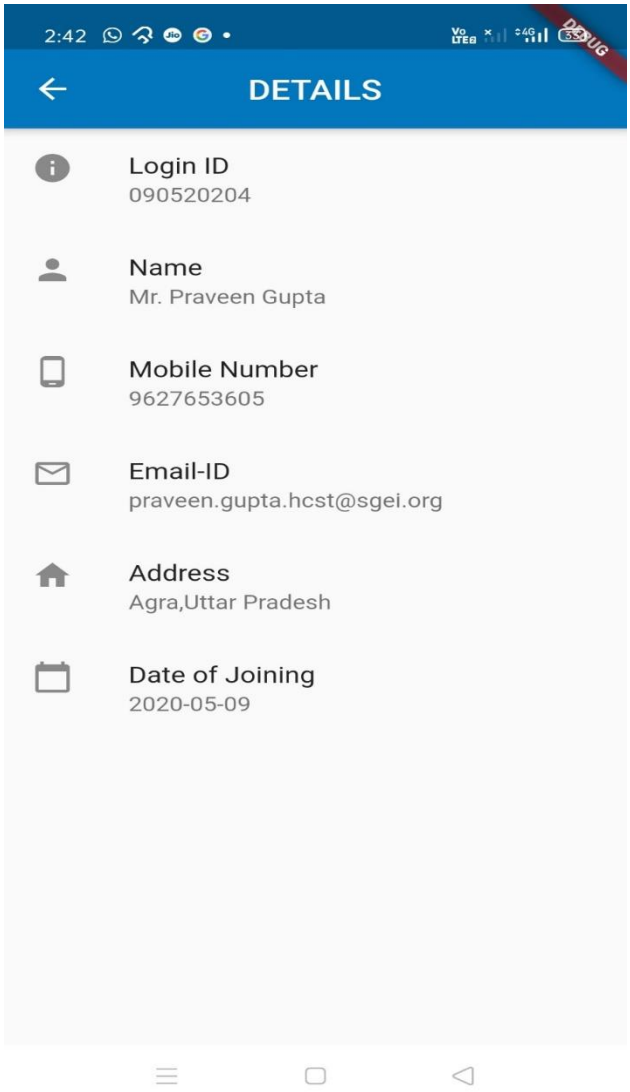

Fig. 3.30: Employees Application My Details Page

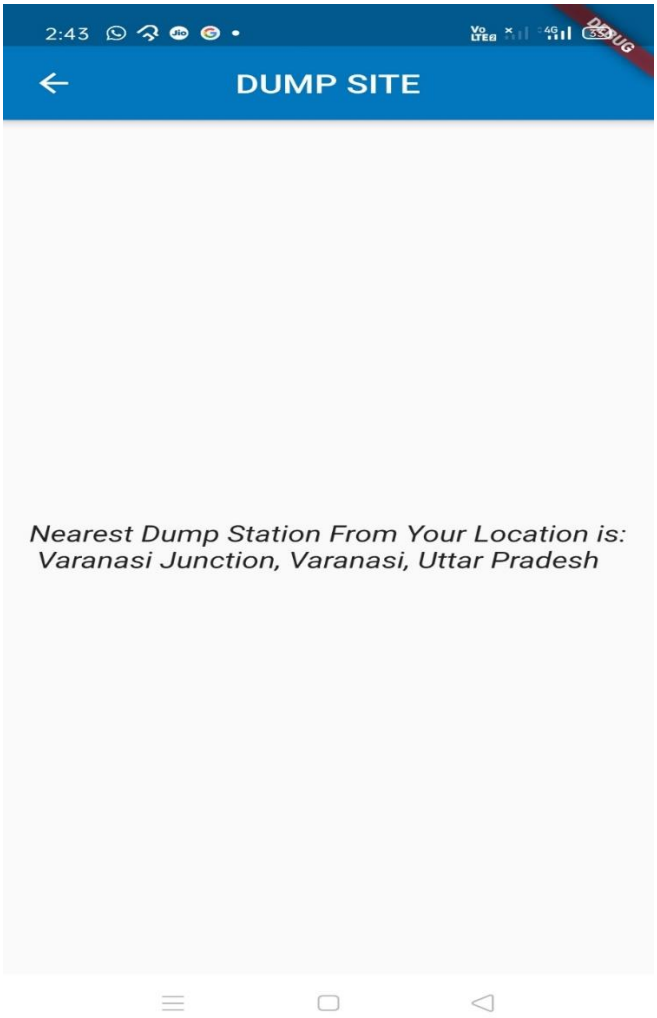

Fig. 3.31: Employees Application Dump Site Locator Page

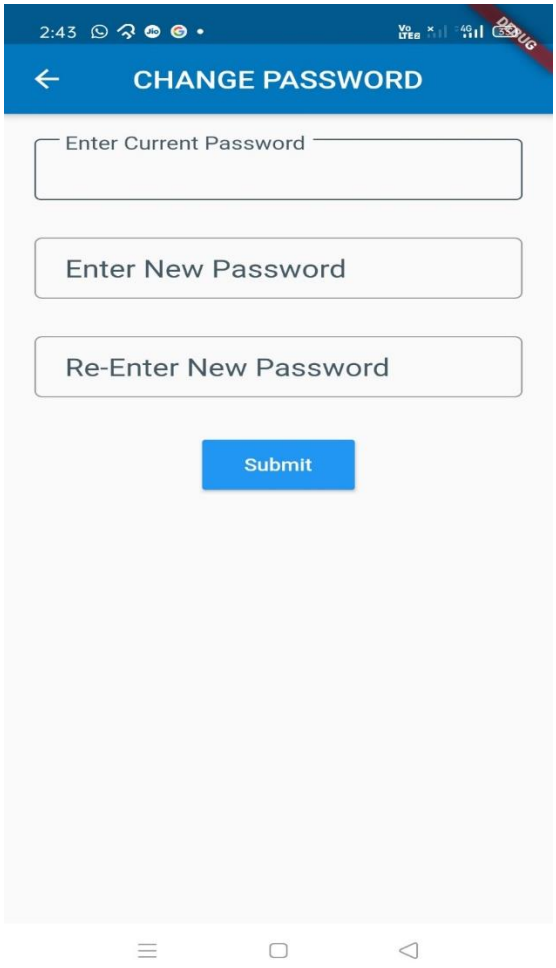

Fig. 3.32: Employees Application Change Password Page

Fig. 3.33: Employees Application Waste Collection Page

3.4.1.2. Public Application

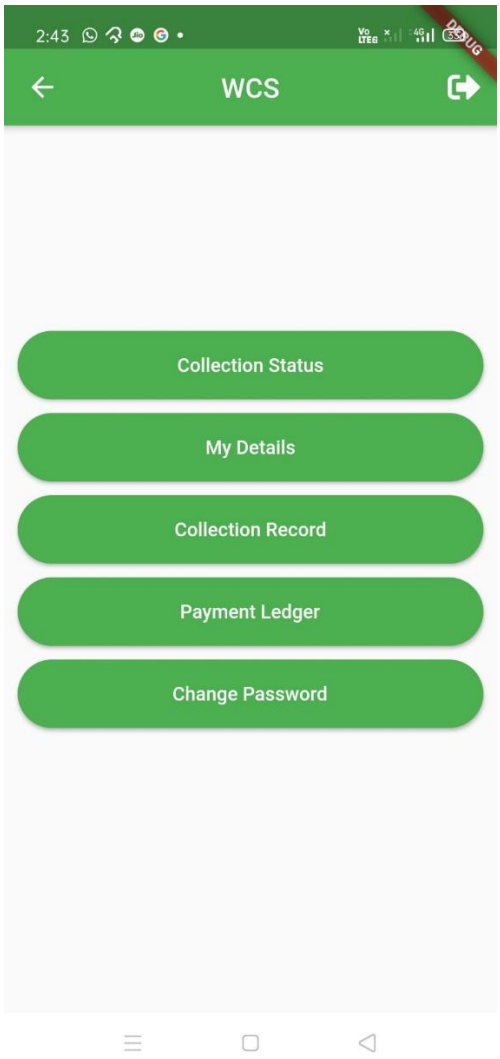

Fig. 3.34: Public Application Home Page

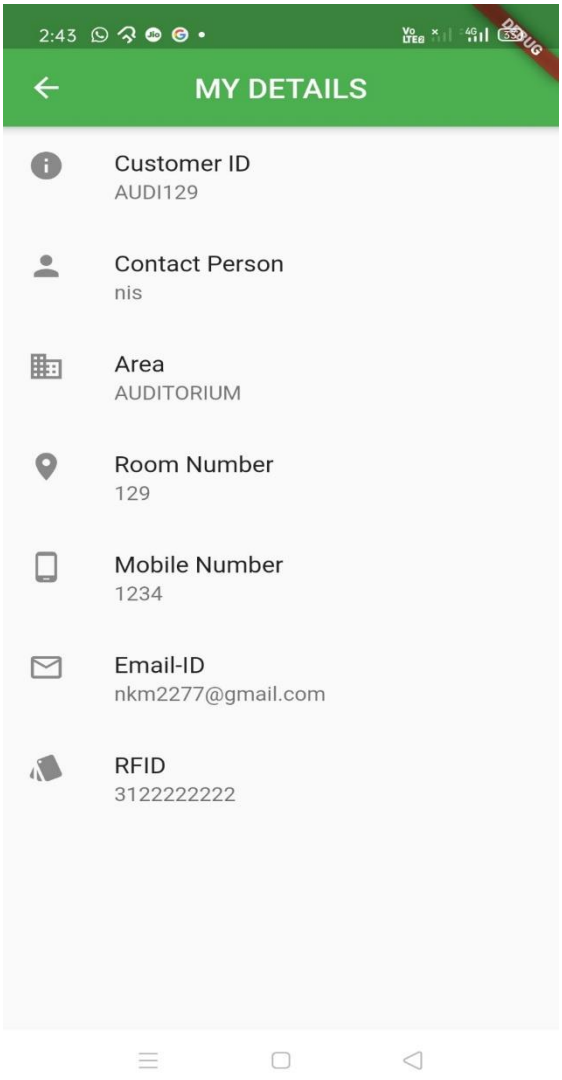

Fig. 3.35: Public Application My Details Page

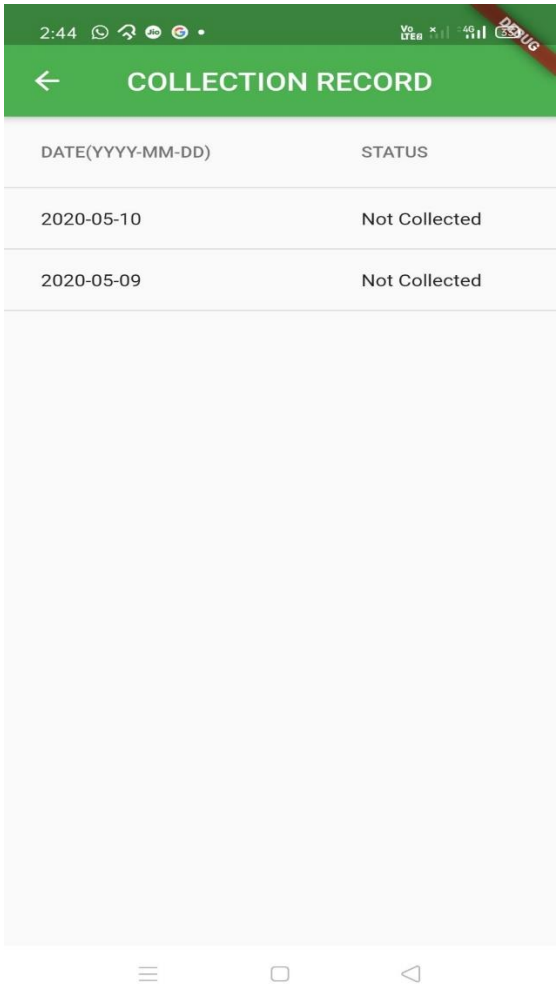

Fig. 3.36: Public Application Waste Collection Record Page

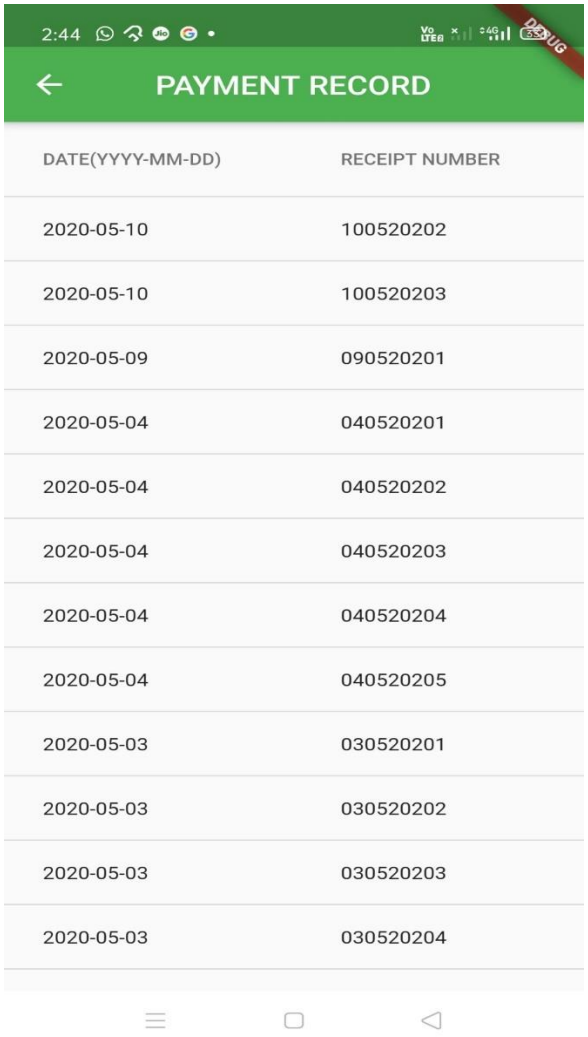

Fig. 3.37: Public Application Payment Record Page

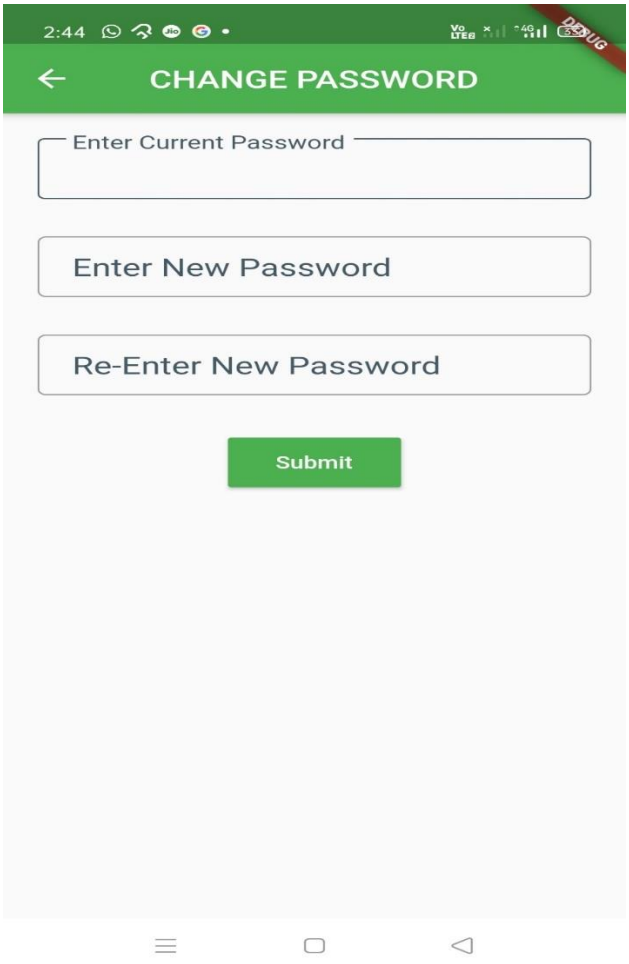

Fig. 3.38: Public Application Change Password Page

CHAPTER 4

TESTING, CONCLUSION, LIMITATIONS AND FUTURE SCOPE

4.1. Manual Testing

Testing plays a decisive role in eliminating all the anomalies which are not desired by developers in their software. Usually testing is conducted on two instances during software production, firstly in the development stage and then the final testing of the finished product which helps to obtain a refined product.

4.1.1. Functional Testing

Functional Testing aims to closely examine the logical parts of the developed application/software by using special cases of conditions or loops. Functional testing ensures that these cases are run on every part of the application that implements logics. It can be useful in removing small typographical error, logical expressions that are being executed multiple times unnecessarily and those having wrong implementation. In the logical part of this testing results are tested upon the output being true or false, non out of bound loops, and correctly used data structures.

4.1.2. Non-functional Testing

Testers use non-functional testing to ensure that for every valid input being provided to the system whether it is able to generate expected output. It is mainly used to verify the validity of input and output along with external data.

4.2. Test Cases

4.2.1. Employee Module

S.no.	Input	Expected output	Output	Result
1.	Valid Username & Password	Employee Detail Page	Employee Detail Page	Successful Login
2.	Invalid Username & password	Alert	Alert	Unsuccessful Login
3.	Collect Waste option	Collect waste page with RFID scan option	Collect waste page with RFID scan option	Employee can scan RFID of customer and collect waste
4.	Today's Status option	Today's Status page with Select Area	Today's Status page with Select Area	Can check the current waste collection status of selected area

5.	Collect Payment option	Collect Payment page with Scan RFID option	Collect Payment page with Scan RFID option	Employee can collect payment of customer by scanning the RFID and entering the due/advance amount
6.	My Details option	Displays the details of the employee with different fields (Login Id, Name, Mobile number, E-mail ID, Address, Date of joining)	Displays the details of the employee with different fields(Login Id, Name, Mobile number, E-mail ID, Address, Date of joining)	Displays the details of the respective employee
7.	Dumping Site Locator option	Displays nearest waste dumping zone	Displays nearest waste dumping zone	Employee is guided to the nearest dumping site.
8.	Change password option	Change Password display appears	Change Password display appears	Employee can change password by entering current and new password
9.	Logout	Login page	Login page	Logout

Table 4.1: Table for Employee Module Test Cases

4.2.2. Public Module

S.no.	Input	Expected Output	Output	Result
1.	Valid username and password	Home Page	Home page	Successful login
2.	Invalid username and password	Alert:	Alert:	Unsuccessful login
3.	Collection Status option	Status of waste collected or not collected	Status of waste Collected or not collected	Displays the status of the waste collected by the employee
4.	Data not available	Alert:	Alert:	Displays an alert box when the data is unavailable
5.	My Details option	Customer Details page with different fields (Customer ID, Contact Person, Area, Room number, Mobile number, E-mail Id, RFID)	Customer Details page with different fields (Customer ID, Contact Person, Area, Room number, Mobile number, E-mail Id, RFID)	Display of the details of the respective customer.
6.	Collection Record option	Select initial date/ final date	Select initial date/ final date	Displays the collection record of the waste for the selected period
7.	Payment Ledger option	Pending bills	Pending bills	User can view pending bills Or bills can be seen between selected period
8.	Change password option	Login page	Login page	Logout

Table 4.2: Table for Public Module Test Cases

S. no.	Input	Expected Output	Output	Result
1.	New Admin	Admin added/deleted	Admin added/deleted	Admin can be added or deleted
2.	Valid username and password	Home page	Home page	Successful login
3.	Invalid username and password	Alert invalid username and password	Alert invalid username and password	Unsuccessful login
4.	Administrator (New)	New employee /customer	New employee /customer	Can add details of new employee/customer
5.	Administrator (Delete)	Delete employee /customer	Delete employee /customer	Can delete details of existing employee/customer
6.	Administrator (Update)	Update page	Update page	Can update and fetch the data
7.	Home(new data)	New data added	New data added	Data will be added to database
8.	Home(view data)	Today's status	Today's status	Displays the data of waste collection system
9.	Payment(accept)	Accept payment page	Accept payment page	Shows the details of payment accepted

10.	Payment(view)	View payment page	View payment page	Fetch and displays the payment collected
11.	Message (send notification)	Firebase page	Firebase page	Can send push notification
12.	Message(E-mail)	E-mail login page	E-mail login page	Can view received E-mails

Table 4.3: Test Cases for Software Test Cases

4.3. Conclusion

Our project is a proposal to fulfil the needs of the society considering that a tremendous amount of uncollected waste results in spread of various kind of diseases, uneasiness in survival and many more problems. This model can be very helpful for the Municipal Corporations to deal with this problematic aspect and manage their work more effectively and a major step towards the initiative of *Digital India.* One of the objectives of the model is to make the process of waste collection regular and more affective with proper monitoring and removing arbitrariness of the authorities. This project can have easy maintenance and can be updated time to time with the needs of the time.

4.4. Limitations of the project

- The limitations and pitfalls of such systems are their online presence.
- Technical person is required to operate this system. No payment gateway is added to this project, all payment collection is via cash.
- Initial implementation cost is high as hardware is required for example:
- RFID Tags, RFID Readers, GPS, Central hub/server

4.5. Future Scope of the project

Today the management of waste is most important raising topic around the globe and especially in India .When the whole process of collection and disposal of waste can be tracked, and has a binary record, the waste can be disposed in a better way.

Some of the improvements that this project can go through are:

Addition of IoT(internet of things) and Machine Learning which will enable the management to get a push notification when a particular bin is full and also this can help in ssegregation of waste properly. A gateway can be added to the application to make the process of payments easier and convenient for customer.

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- http://www.circuitstoday.com/rfid-reader-tag.