EMEDCOM - MEDICINE WASTAGE MANAGEMENT AND REQUIREMENT PREDICTION SYSTEM

A PROJECT REPORT

submitted by

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to

the APJ Abdul Kalam Technological University
in partial fulfillment of the requirements for the award of the Degree

of

Master of Computer Applications

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Trivandrum - 695016

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DECLARATION

I undersigned hereby declare that the project report (EMedCom : Medicine Wastage Management and Requirement Prediction System), submitted for partial fulfillment of the requirements for the award of degree of Master of Computer Applications of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Prof. Bhagya Vijayan. This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title

Place

Date PHEBE JOHN

DEPARTMENT OF COMPUTER APPLICATIONS

COLLEGE OF ENGINEERING TRIVANDRUM

CERTIFICATE

This is to certify that the report entitled **EMedCom - Medicine Wastage Management and Requirement Prediction System** submitted by **Phebe John** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Master of Computer Applications is a bonafide record of the project work carried out by him under my guidance and supervision. This report in any form has not been submitted to any University or Institute for any purpose.

Internal Supervisor External Supervisor

Head of the Dept

ACKNOWLEDGEMENT

If words are considered as symbols of approval and tokens of acknowledgment, then let words play the heralding role of expressing my gratitude.

First of all, I would like to thank God the almighty for bestowing me with wisdom, courage and perseverance which had helped me to completion of this project ***EMedCom - Medicine Wastage Management and Requirement Prediction System***. This project has been a reality as a result of the help given by a large number of personalities.

I would like to remember with gratitude **Prof. Jose T Joseph**, Head Of Department, Department of Computer Applications, College of Engineering Trivandrum for the encouragement and guidance rendered.

I express my sincere thanks to **Prof. Bhagya Vijayan,** Assistant Professor, Department of Computer Applications, College of Engineering Trivandrum for her valuable guidance, support and advice that aided in the successful completion of my project.

Finally, I wish to express my sincere gratitude to all my friends, who directly or indirectly contributed in this venture.

PHEBE JOHN

ABSTRACT

Wasted or unused medicine is a serious and growing problem you can help tackle. Often people may have an excess amount of medicines with them. Based on the current situation, there is no way that a person can give medicines if it is not needed or excess, to customers who need it. Here, I am proposing a system where the people who have excess medicines can be re-used effectively. I would like to introduce a Collection Centre, where people can return unused medicines before expiry. People can sell and buy these unused medicines within the expiry date. Further, the collection centre will re-distribute efficiently to other charity organisations.

The system also predicts districts where a particular medicine is more used. In this project, I am predicting district using transfer data. I am using multiple models from the training data in order to predict the district. The various algorithms used for predicting district based on transferred data are K-Nearest Neighbour, Naive Bayes and Decision trees algorithm. Pharmacists currently identify the district manually. This is a completed automated system.

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Chapter 1

Introduction

Reducing medicines waste will improve quality and save resources. There are a need and an opportunity for strong leadership from pharmacists to help reduce medicines waste. Reducing unnecessary dispensing and supply of medicines is an important way of reducing waste. Wasted medicine is everyone's responsibility and there are small changes you can make to help reduce the amount of medicine being wasted. When possible, try to make these medicines reusable. It is everyone's responsibility.

Medical wastes are highly hazardous and put people under risk of fatal diseases. The generation of medical waste has been increasing in quantity and variety, due to the wide acceptance of single-use disposable items. In this project, waste minimization and reusing are practised, thus significant amounts of medical wastes are to be used. This is a useful project for everyone who would like to donate or even sell their unused medicines to poor people. The collection centre collects medicine and distributes it to the charity organisations. Often charity organisations can request their needed medicines. Collection centre also exchanges their medicines between districts.

It includes a huge amount of data being transferred each day, therefore district prediction is included. The main aim is to predict the district where a particular medicine is most used. It shows which district needs a particular medicine more from the exchange of medicines in between collection centres. The transferred data is taken as dataset and is cleaned. Now, the feature data is extracted. A set of data is taken for training and testing. Then a suitable model along with cross-validation is applied to get more accurate results. It uses kNN and decision tree classifier to find the nearest neighbouring clusters. The accuracy is measured and output is predicted.

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Chapter 2

Requirement Analysis

2.1 Purpose

The purpose of this system is to build a simple to use android application and to predict district. In the current scenario, there is no way to reuse the available or rejected medicines in hand. People usually throw away unused medicines which can cause pollution. Also, no one knows how medicine-making company reuse the medicines before expiry. Reducing medicine waste will improve quality, save resources and helps to add value to patient care.

Reducing medicines waste will improve quality and save resources. There are a need and an opportunity for strong leadership from pharmacists to help reduce medicines waste. Reducing unnecessary dispensing and supply of medicines is an important way of reducing waste. Wasted medicine is everyone's responsibility and there are small changes you can make to help reduce the amount of medicine being wasted. These savings could be reinvested into more front line care and services for the benefit of all. When possible, try to make these medicines reusable. It is everyone's responsibility.

There requires a proper medicine wastage management system to reuse the medicines to the needy instead of throwing them into the earth. Also, people can donate their unused medicines to the people who can't afford such valuable medicines which can save human life, thus making the application a service-oriented platform. Medical wastes are highly hazardous and put people under risk of fatal diseases. The understanding of medical waste management and control techniques are important. The generation of medical waste has been increasing in quantity and variety, due to the wide acceptance of single-use disposable items. In this project, waste minimization and reusing are practised, thus significant amounts of medical wastes are to be used.

2.2 Overall Description

Medication waste can occur in all stages of the pharmaceutical supply chain. For instance, physicians may prescribe unnecessarily large quantities in the prescribing stage. During the dispensing stage, pharmacists dispense larger quantities as manufacturers package sizes may exceed the amount required for treatment. Once the medication has been supplied to the patient, early treatment changes, for example, due to some side effects or unsatisfactorily efficacy, can lead to an excessive amount of additional medication at home. Moreover, low adherence of patients to treatment regimens can contribute to medication waste as well. Finally, medications that are left unused and of good quality, are generally destroyed if returned to the pharmacy.

One can presume that each person has already initiated various strategies to reduce this waste. However, information that is realised in practice to reduce waste is limited. The availability of such information could facilitate an exchange of knowledge between pharmacists on how to reduce medication waste and could improve the implementation of such activities in daily practice. In this project, I am going to reuse every single count medicines instead as a whole strip.

EMedCom is an android application. After installing, three types of users include collection centres, people and charity organisations. Each one has to register along with their provided identity numbers. People who register in the application can donate and sell medicines before a limited expiry. Those who sell medicine will be awarded points alternatively of cash in order to avoid fraud bills. Using these points, they can buy medicine.

Collection Centre adds medicine onward with their amount where people can view these and donate their medicines. They also can view users of their respective districts. Often, they can request medicine to other districts and also can view requests from other districts. Collection centres will redistribute medicines at free of cost to charity organisations from the donated medicines. They can also validate the bill and other medicine details from people donating their medicines. They can also block the people if any fraud is found for the second time from the same person. Charity Organisations can request their needed medicines to the collection centres. They have to update their medicinal need within a limit of days. They can view the request as well. Often, they can send push notifications to urgent medicinal needs. They can also view the medicine stock as well.

It includes a huge amount of data being transferred each day, district prediction is included. The main aim is to predict the district where a particular medicine is most practised. It shows which district needs a particular medicine more from the exchange of medicines in between collection centres. The input comprises source district from where the medicine is given, the generic name of medicine, count of medicine, disease condition and the month of transfer. About three thousand data are there in the dataset for training and testing the data. Then a suitable model is applied to get more accurate results. It uses kNN and decision tree classifier to find the nearest neighbouring clusters. The accuracy is measured and output is predicted.

For the storage of all these transactions and data, Firebase is used. With a variety of server-side technologies that are on the market today, developers have a tough job of deciding what kind of back-end is most suitable for their app. Firebase is a mobile and web app development platform that provides developers with a plethora of tools and services to help them develop high-quality apps, grow their user base and earn more profit. Here, authentication, real-time database and storage are used. The Firebase Realtime Database is a cloud-hosted NoSQL database that lets you store and sync between your users in real-time. The Realtime Database is really just one big JSON object that the developers can manage in realtime. The system uses a server for different methods, to display output from the application. The users edit their profile as well. They can also delete their accounts if no longer they need that. They can also reset the password if they forget their passwords. After all, the users can logout from their current accounts.

There is increased awareness of the financial impact of medication waste. Health care budgets are limited and unused medications can be considered a waste of resources. Pharmacists are key players in the pharmaceutical supply chain and are in a position to contribute to the reduction of medication waste. Here, one can presume that individual people have already initiated various strategies to reduce this waste.

Medication disposal is an alarming issue today and gaining more and more awareness from healthcare professionals as well as consumers. Proper patient counselling on safe medication disposal can make a significant difference to public health and the environment. The knowledge on the method of reusing of unused medicines is equally important as that of the misuse of medicines. This project aims to provide a background, the importance and significance of proper medication reuse, describe the exact methods to return to the concerned officials before expiry.

2.2.1 Product Functions

- Unused medicines can be reused efficiently
- Easy platform to donate medicines before the expiry
- Can request medicine based on user needs
- Will get bonus to people which will encourage them to buy other medications
- Reduces fraud activities by blocking illegitimate users
- Log in for three types of users
- Developed as an Android application
- Prediction for the flow of medicine

2.2.2 Hardware Requirements

- Intel core i3 or equivalent CPU
- 4 GB or more RAM
- 2 Gb Hard Disk space
- Server Computer
- Network Connectivity
- Android device with SDK >22
- USB cable

2.2.3 Software Requirements

- Android 3.3
- Firebase
- jupyter notebook
- Linux
- Python 3
- XAMPP / Apache + PHP
- pip

2.3 Functional Requirements

The system is designed to reuse unwanted and unused medicines before expiry. It helps to reduce pollution, thus increasing the quality of medicine. People can return their unused medicines before the expiry which is reused. It also helps to the proper disposal of medicine by using it efficiently rather than throwing it into the soil, which is good for the environment. There is increased awareness of the financial impact of medication waste. Pharmacists are key players in the pharmaceutical supply chain and are in a position to contribute to the reduction of medication waste. Here, one can presume that individual people have already initiated various strategies to reduce this waste.

Functional requirements represent the intended behaviour of the system. This behaviour may be expressed as services, tasks or functions that the specified system is required to perform. The following functional requirements have been identified for this project. The proposed system consists of 3 modules. They are given below:

2.3.1 Collection Centre

Collection centres can add medicine details and medical store details. They can request medicines to other collection centres. They can accept medicine requests from people and charity organisations. They can view details of people registered in the application and can block them if found illegitimate. The collection centre can also view the flow of a particular medicine in a district. In this module, I am using various classification algorithms to create different models, these models are then used to predict district. The various models generated using the training dataset are K-Nearest Neighbour classifier and decision tree classifier.

2.3.2 Charity Organisation

Charity organisation can request medicine to the collection centre. They can delete the request if no longer needed.

2.3.3 People

People can donate or sell medicines. Those who sell medicines will be awarded bonus points as a reward in order to avoid fraud bills. Using these bonus, he can buy other medicines and the bonus will be reduced. He can also view user history.

2.4 Performance Requirements

The system would need a minimum of 4GB RAM along with an android device SDK greater than 22 to run the application. It also predicts the flow of medicines in districts. The system requires an additional computer to act as a server. The system is accurate, maintainable, scalable, powerful and reliable. It keeps backups to atone for system failures and log its activities periodically.

It includes the non-functional requirements, which define the general qualities of the software product. Performance Requirements is in effect a constraint placed on the system or the development process. They are usually associated with product descriptions such as maintainability, usability, portability, etc. it mainly limits the solutions for the problem. The solution should be immeasurable to satisfy non-functional requirements.

- Accuracy: Accuracy in functioning and the nature of user-friendliness has maintained in the application.
- Speed: The application is capable of offering speed.
- Scalability: The software will meet all of the functional requirements.
- Maintainability: The application maintainable. It keeps backups to atone for application failures.
- Reliability: The acceptable threshold for down-time is long as possible. And if the application is broken, time required to get the system back up again should be minimum.

Chapter 3

Design And Implementation

3.1 Overall Design

EMedCom is an android application. After installing, three types of users include collection centres, people and charity organisations. Each one has to register along with their provided identity numbers. Different users can request medicines based on their needs and uses. People can return their unused medicines before the expiry which is reused. It also blocks the illegitimate users. The user account can also be deleted.

It includes a huge amount of data being transferred each day, district prediction is included. It shows which district needs a particular medicine more from the exchange of medicines in between collection centres. The input includes source district from where the medicine is given, the generic name of medicine, count of medicine, disease condition and the current month. It uses kNN to find the nearest neighbouring clusters. The accuracy is measured and output is predicted.

Medication disposal is an alarming issue today and gaining more and more awareness from healthcare professionals as well as consumers. Proper patient counselling on safe medication reuse can make a significant difference to public health and environment. A practical approach should be there to incorporate this important issue in the curriculum as the need of the hour. Also, the establishment of cost-effective and acceptable government-run collection and reuse systems is necessary. There should be some norms and stringent guidelines for the same. Careful and proper use of medications can help to decrease an environmental load of drugs. All multidisciplinary stakeholders, government, physician, pharmacist, patient, and the public should work together hand in hand to reduce the burden of unused medicine on the ecosystem. Proper medicine reuse strategy is needed to ensure the health and environmental safety.

3.2 User Interfaces

EMedCom is very easy to use application. One of the main aim while designing the application was to abstract as much lower-level details of the system as possible from the user. There is a simple to use user interface for all users. The application starts with a splash screen, provided by a set of functions in the dashboard of the application. Different users register here and are redirected to their particular pages. Collection Centre can add medicine and pharmacy details. It also helps to request medicines to other collection centres. People can return their unused medicines with a valid bill. Charity organisations can request medicines to the collection centre.

The application also uses a simple interface for prediction. It uses an API call for the GET and POST requests for input and output. The phone and the server system is connected to the same network. The user enters the input through the android device. Now when the button is clicked, the protocol for API is called and the output is shown on the android device.

3.3 Hardware Interfaces

The system requires a minimum of 4GB to install and run the android application. An Android device, such as a phone is very important here, along with a USB cable, unless emulator in Android Studio is to be used. It also requires frequent internet connectivity to build the application and also to use Firebase, which is the database used here. It also requires a server computer for API call as well. Here, the GET and POST requests are given for input and output.

3.4 Communications Interfaces

The android application can be installed either by building a apk file from the project itself or by running the project connected with the android device. Each data entered from the phone is stored to the database Firebase and is fetched when the data has to be retrieved. Due to a large amount of data that is transferred each day, the system needs to be updated. During prediction, the system uses GET and POST requests to provide input and to produce output in the android device. It is done using API calls by setting a server computer.

3.5 System Design

In this project, different users can request medicines based on their needs and uses. People can return their unused medicines before the expiry which is reused. It also blocks the illegitimate users. The user account can also be deleted. It includes a huge amount of data being transferred each day, district prediction is included. It shows which district needs a particular medicine more from the exchange of medicines in between collection centres. The input includes source district from where the medicine is given, the generic name of medicine, count of medicine, disease condition and the current month. It uses kNN to find the nearest neighbouring clusters. The accuracy is measured and output is predicted.

3.5.1 EMedCom Application

EMedCom is an android application. Each one has to register along with their identity numbers. People who register in the application can donate and sell medicines before a limited expiry. Those who sell medicine will be awarded points instead of cash in order to avoid fraud bills. Using these points, they can buy medicine. Collection Centre adds medicine along with their amount where people can view these and donate their medicines. They also can view users of their respective districts. Often, they can request medicine to other districts and also can view requests from other districts. They can also validate the bill and other medicine details from people donating their medicines. They can also block the people if any fraud is found for the second time from the same person.

Charity Organisations can request their needed medicines to the collection centres. They have to update their medicinal need within a limit of days. They can view the request as well. Often, they can send push notifications to urgent medicinal needs. They can also view the medicine stock as well. It includes a huge amount of data being transferred each day, district prediction is included. The main aim is to predict the district where a particular medicine is most used. It shows which district needs a particular medicine more from the exchange of medicines in between collection centres. The input includes source district from where the medicine is given, the generic name of medicine, count of medicine, disease condition and the current month. About three thousand data are there in the dataset for training and testing the data. Then a suitable model is applied to get more accurate results. It uses kNN to find the nearest neighbouring clusters. The accuracy is measured and output is predicted.

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3.5.2 Workflow

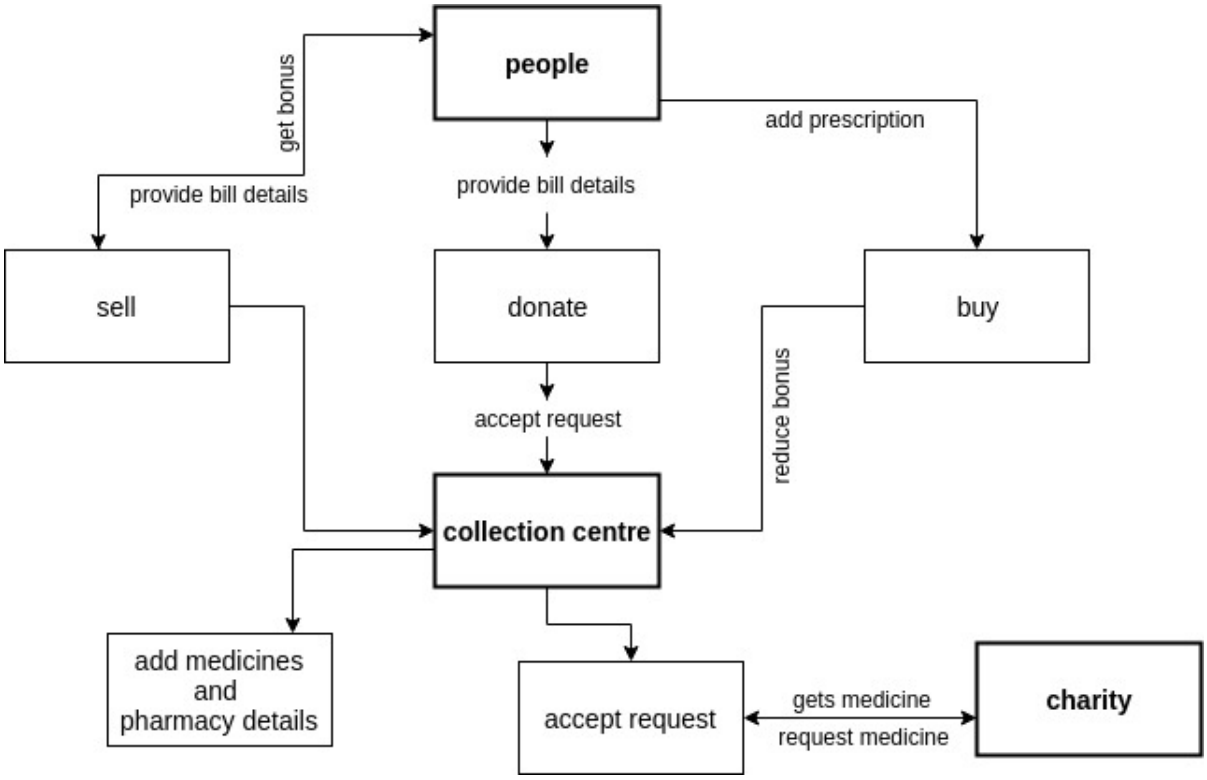

Figure 3.1: Workflow of EMedCom

3.5.3 Collection Centre

Collection centre can add medical store details. Thy can add medication details. They can view all users and block them if found illegitimate. They can request medicines to other collection centres. They can also view medicine request from people, other collection centres and charity organisations. They are responsible for distributing medicines to charity organisations. Collection centres can also view the district where a particular medicine is more used. It uses machine learning prediction methods to predict the district along with training and testing.

3.5.4 People

People have a very good role in the application. They are the assets of the application. Those who registered can donate their medicines in free of cost or sell them. They will be awarded with bonus when they sell medicines. The bonus instead of cash has been introduced to avoid fraudulent bills. Using these points, they can buy other medicines. The user can also view the user history regarding their transactions of medicines.

3.5.5 Charity Organisation

Charity organisations are able to send medicine requests to the collection centre. They can also delete their requests if the medicine is not needed. They can view the requests too.

3.5.6 EMedCom Prediction using transferred data

It includes a huge amount of data being transferred each day, therefore district prediction is included. The main aim is to predict the district where a particular medicine is most used. It shows which district needs a particular medicine more from the exchange of medicines in between collection centres. The transferred data is taken as dataset and is cleaned. Now, the feature data is extracted. A set of data is taken for training and testing. Then a suitable model along with cross-validation is applied to get more accurate results. It uses kNN and decision tree classifier to find the nearest neighbouring clusters. The accuracy is measured and output is predicted.

3.5.6.1 Analysis of the dataset

Basic details of the dataset was found in National Health Service in kaggle.Other attributes were done manually. The dataset, which will be referred came with a .csv file that contains 3078 instances that are described by 6 attributes, a mix of numerical and categorical variables.

3.5.6.2 Data Pre-processing

Unfortunately, this data set does have a lot of invalid or missing entries that are represented with question marks. Thus, I have to pre-process the data so it is ready to be used as input for machine learning algorithms. Here, I began, by replacing entries with the symbol ? and convert them into NAN (not a number). Next, I split the data into features and target label and convert the non-numerical variables using the MinMax Scaler/Label encoder feature in Python. Additionally,

I need to convert the non-numeric target variable Class/destination district to numerical values for the learning algorithm to work. Thus, I split the given data into two parts. 80% of the data will be used to train the model and this data will be referred to as the training data set and 20% of the data will be reserved for testing the accuracy and effectiveness of the model on data that the model has never seen before and will be referred as the testing data set. Thus, my training set has 2414 samples, and the testing set has 604 samples.

The random partitioning of data into testing and training data also helped me to determine whether my model is under-fitting (too simple, high bias, low variance) or over-fitting (too complicated, high variance, low bias). A model that has high training and testing error is a model that under-fits. This means my model is too simplistic. A model that has low training error, but a high testing error is one that over-fits. In other words, its important to test my model and see how it generalizes to unseen data by applying the model with testing data which was not a part of the model creation.

3.5.6.3 Features Exploration

This data contains 704 instances and contains the following attributes:

1. generic name of the medicine
2. condition
3. source district form where medicine id transferred
4. count on number of medicines transferred
5. month when the medicine is transferred
6. destination district to where medicine is transferred

This work aims to explore several competing machine learning classification techniques namely:

- k-Nearest Neighbors
- Decision Tree Classifier
- Naive Bayes Classifier

3.5.6.4 Algorithms and Techniques

1. **k-Nearest Neighbors (kNN):**
   The k Nearest Neighbor (kNN) algorithm is based on mainly two ideas: the notion of a distance metric and that points that are close to one another are similar. Let x be the new data point that I wish to predict a label for. The k Nearest Neighbor algorithm works by finding the k training data points x 1, x 2, x k closest to x using a Euclidean distance metric. kNN algorithm then performs majority voting to determine the label for the new data point x. In the case of binary classification, it is customary to choose k as odd. In the situation where I encountered a tie as a result of majority voting there are couple things I can do. First of the all, I could randomly choose the winner among the labels that are tied. Secondly, I could weigh the votes by distance and choose the weighted winner and last but not least, I could lower the value of k until I find a unique winner.

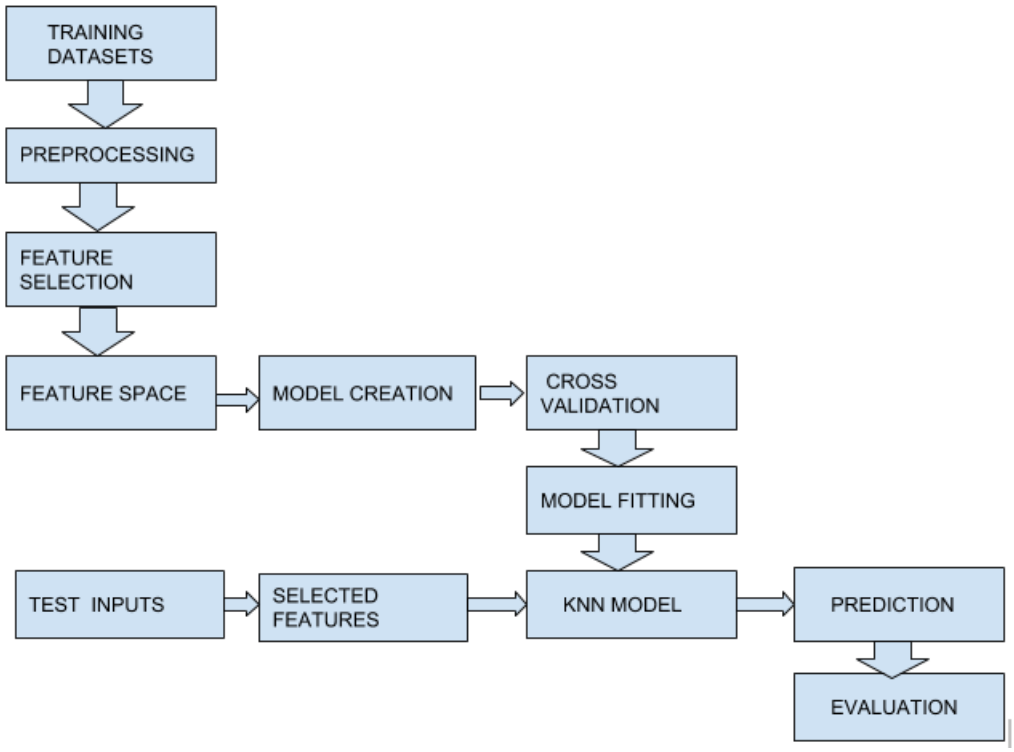

Figure 3.2: Flow in kNN model training using transferred dataset

2. **Decision Tree Classifier :**
   Decision tree algorithm falls under the category of the supervised learning. They can be used to solve both regression and classification problems. Decision tree uses the tree representation to solve the problem in which each leaf node corresponds to a class label and attributes are represented on the

internal node of the tree. Anyone can represent any Boolean function on discrete attributes using the decision tree. At the beginning, I consider the whole training set as the root. Feature values are preferred to be categorical. If the values are continuous then they are discredited prior to building the model.

On the basis of attribute values records are distributed recursively. I used statistical methods for ordering attributes as root or the internal node. When I use a node in a decision tree to partition the training instances into smaller subsets the entropy changes. Information gain is a measure of this change in entropy.

3.5.6.5 Cross Validation

Cross-validation is a model validation technique for assessing how the results of a machine learning algorithm will generalize to an unseen data set. The goal of cross-validation is to define a dataset to test the model in the training phase (i.e., the cross-validation dataset), in order to limit problems like under-fitting or over-fitting, and give an insight on how the model will generalize to an independent unknown dataset.

3.5.6.6 k-Fold Cross Validation

One of the disadvantages in performing cross-validation is that I lose quite a bit of data that could have been used to train the model and thus possibly arrive at more correct predictions. In a traditional train-test split, the error metric can have high variance, i.e., the error may depend heavily on which data points end up in the training set and which end up in the test set, and thus the evaluation may be significantly different depending on how the division is made. To overcome these difficulties, another popular technique for model assessment with the same flavour as cross-validation but the slight variation is called k-Fold Cross Validation is used. The k-fold cross-validation technique is designed to serve two purposes, namely model selection and to obtain a conservative error estimation for the model.

The first step in the technique is to split the available data into two sets: the training set and the testing set. Next, k-fold cross validation splits the training data into k equal sub-buckets (also known as groups or folds). The learning function is then trained using (k - 1) sub-buckets of training data, and the remaining bucket (fold) is used to validate the model, i.e., to compute an error metric. I repeat this process k times, using all possible combinations of (k-1) sub-buckets and one bucket for validation. Next, I average out the error metric of all the k different trial runs

on the model. The model with the lowest average error score is then selected as the final model. Then, I evaluate the final model against the pre-withheld test data to obtain a conservative error estimation.

The advantage of k-fold cross validation is that it matters less how the data gets divided. Every data point gets to be in a test set exactly once and gets to be in a training set (k-1) times. The variance of the resulting error estimate is reduced as k is increased. Since I pre-processed the prediction dataset, I did not run into any problems or difficulties. To implement each of the mentioned methods, I used Scikit library.

3.5.6.7 Metrics

Given a set of labelled data and a predictive model, every data point will lie in one of the four categories:
True positive: District is predicted correctly and correctly predicted as the result
True negative: The district is incorrect and correctly predicted the district is incorrect
False positive (Type 1 Error): The district is incorrect, but I incorrectly predicted that the district is correct.
False negative (Type 2 Error): The district is correct, but I incorrectly predicted that the district is incorrect.
These counts can also be represented in a confusion matrix that allows to visualize the performance of a supervised machine learning algorithm.

3.5.6.8 Accuracy

Accuracy measures how often the classifier makes the correct prediction. In other words, it is the ratio of the number of correct predictions to the total number of predictions (the number of test data points). Accuracy is defined as the fraction of correct predictions.
accuracy = (true positive + true negative)/(true positive + false positive + false negative + true negative)

3.5.6.9 Precision

Precision measures how accurate the positive predictions were i.e., out of all the points predicted to be positive how many of them were actually positive.
precision = true positive/(true positive + false positive)

3.5.6.10 Recall

Recall measures what fraction of the positives the model identified, i.e., out of the points that are labelled positive, how many of them were correctly predicted as positive.
recall = true positive/(true positive + false negative)

3.5.7 Data Flow Diagram

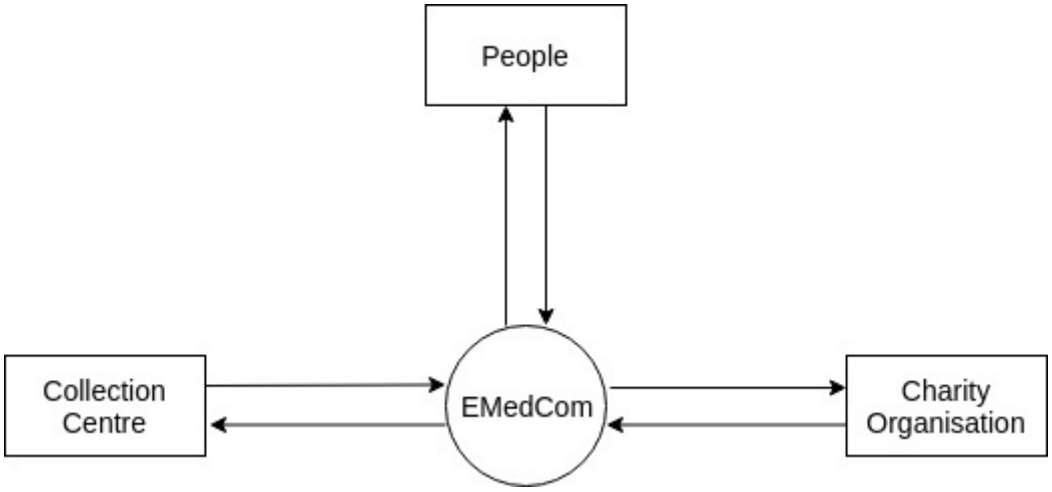

Figure 3.3: Level 0 Data Flow

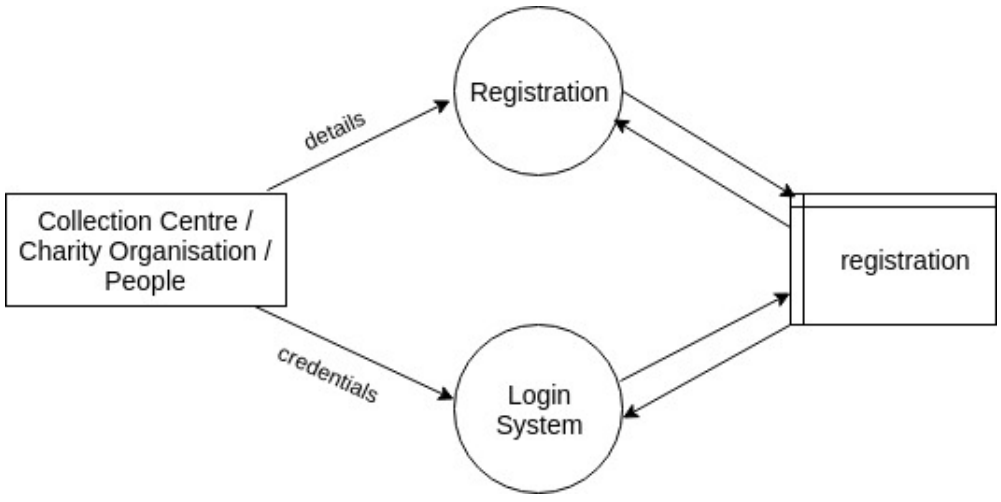

Figure 3.4: Level 1 Data Flow

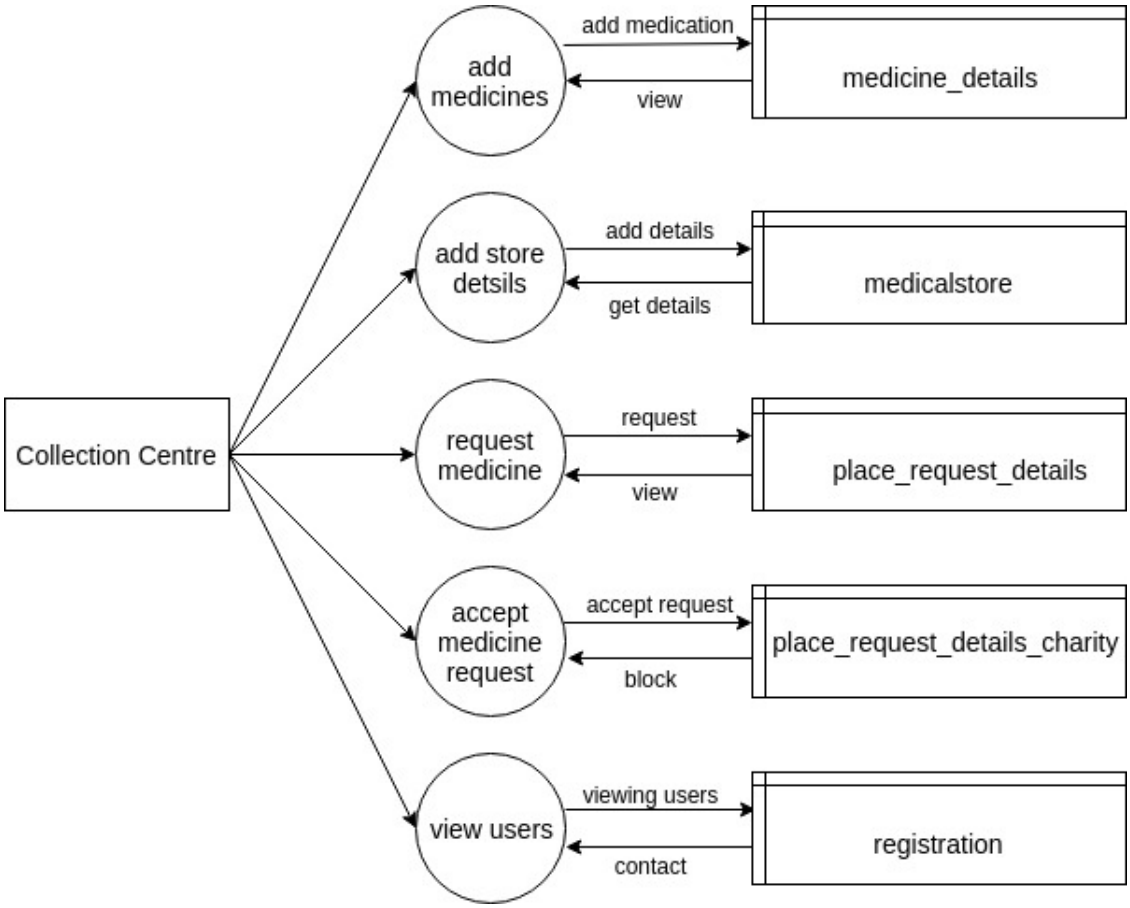

Figure 3.5: Level 2.1 Data Flow

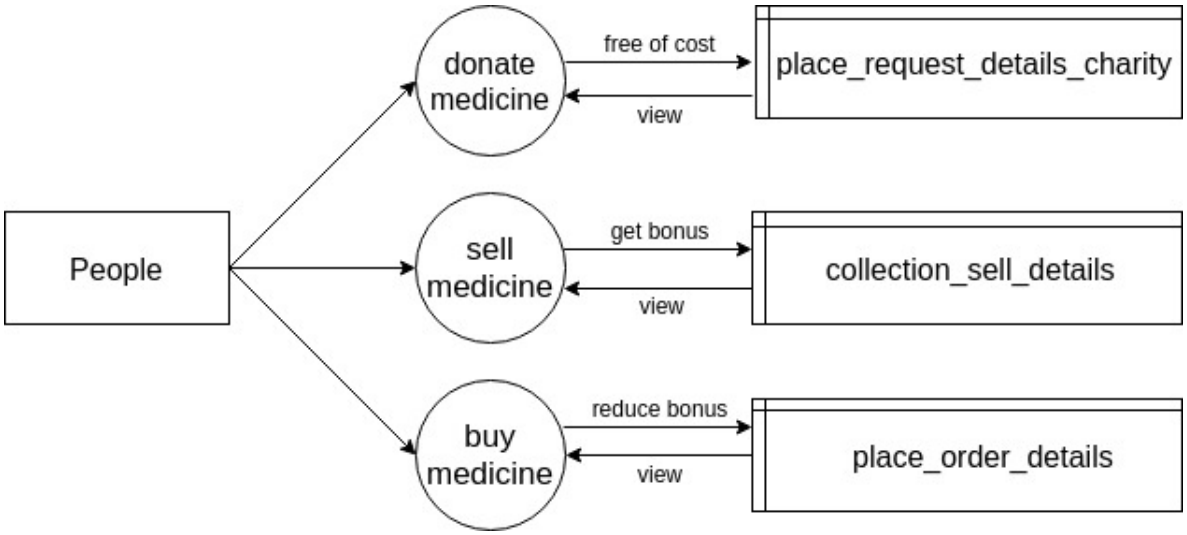

Figure 3.6: Level 2.2 Data Flow

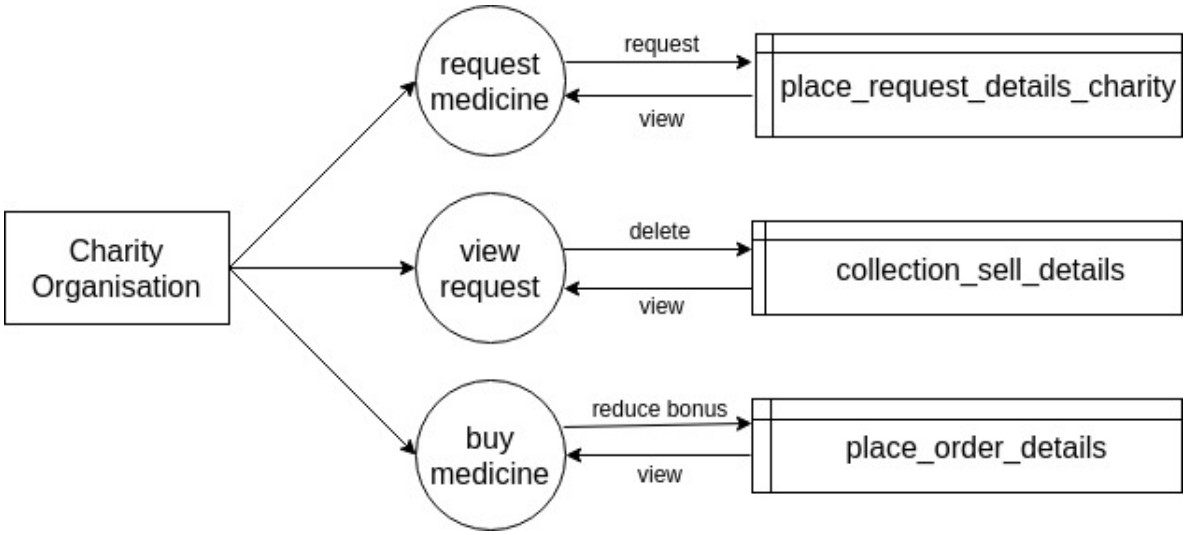

Figure 3.7: Level 2.3 Data Flow

3.5.8 Database Design

Firebase provides a real-time database and back-end as a service. The service provides application developers an API that allows application data to be synchronized across clients and stored on Firebase's cloud. The company provides client libraries that enable integration with Android, iOS, JavaScript, Java, Objective-C, Swift and Node.js applications. The database is also accessible through a REST API and bindings for several JavaScript frameworks such as AngularJS, React, Ember.js and Backbone.js. The REST API uses the Server-Sent Events protocol, which is an API for creating HTTP connections for receiving push notifications from a server. Developers using the real-time database can secure their data by using the company's server-side-enforced security rules. Cloud Firestore which is Firebase's next generation of the Realtime Database was released for beta use.

It stores data as key-value pairs. It's a NoSQL database and hence is accessed using the child reference with the help of listeners. Firebase is a mobile and web app development platform that provides developers with a plethora of tools and services to help them develop high-quality apps, grow their user base, and earn more profit. The Firebase Realtime Database is a cloud-hosted NoSQL database that lets you store and sync between your users in real-time.

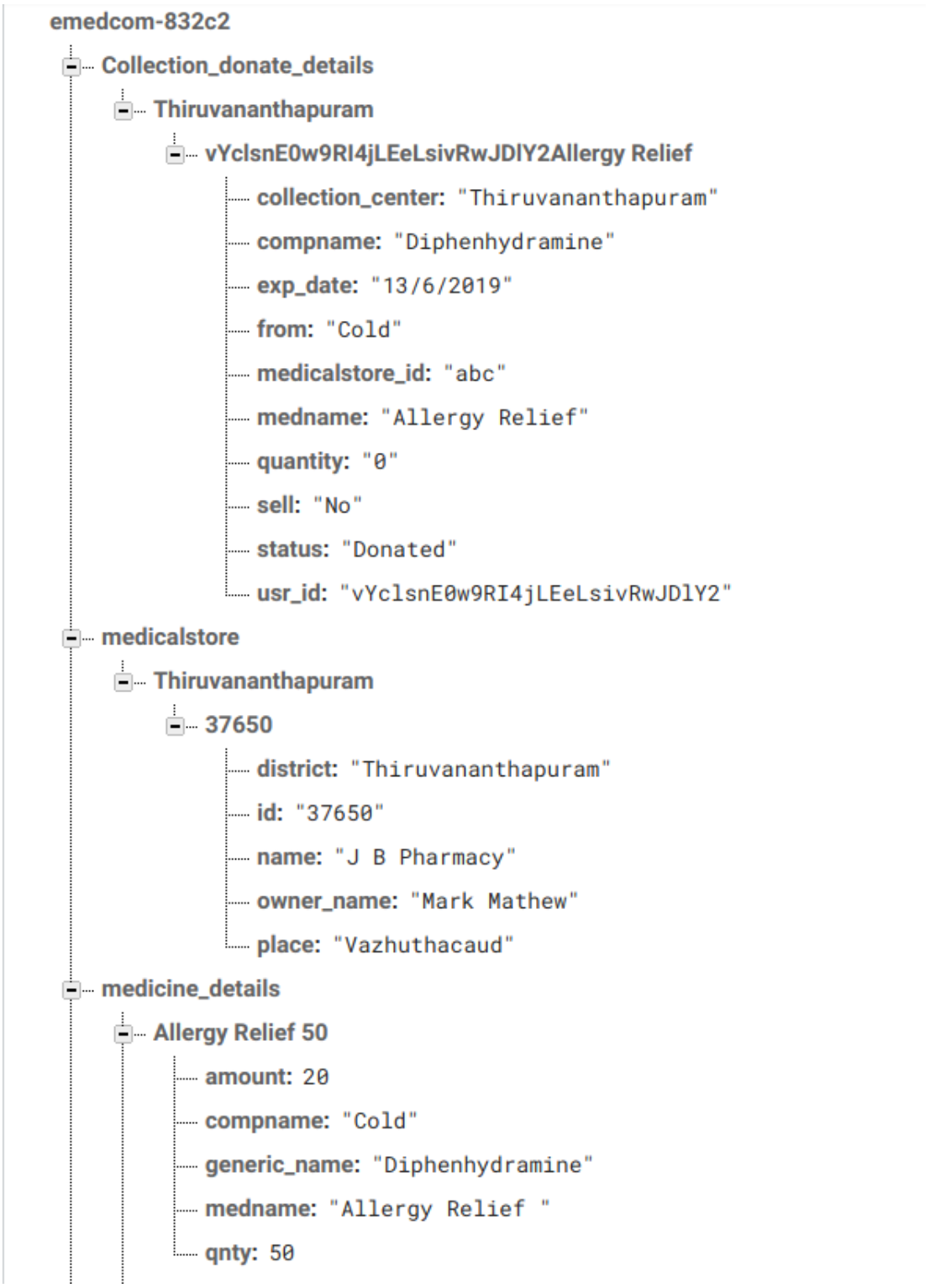

Figure 3.8: Firebase Database Design 1

Figure 3.9: Firebase Database Design 2

Figure 3.10: Firebase Database Design 3

3.5.9 Screenshots

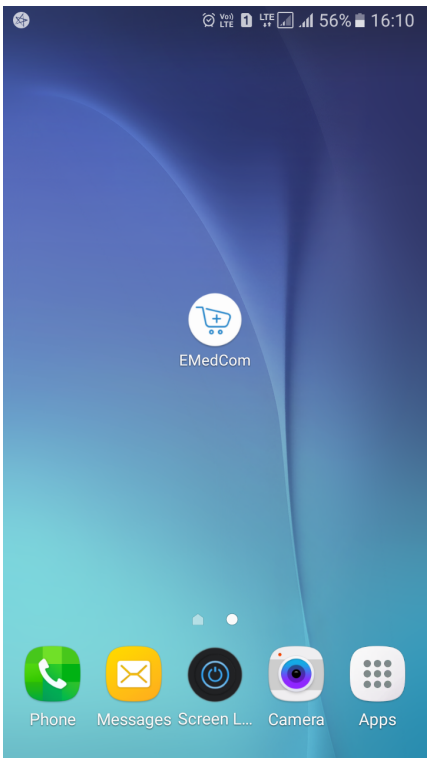

Figure 3.11: EMedCom icon

Figure 3.12: Splash Screen

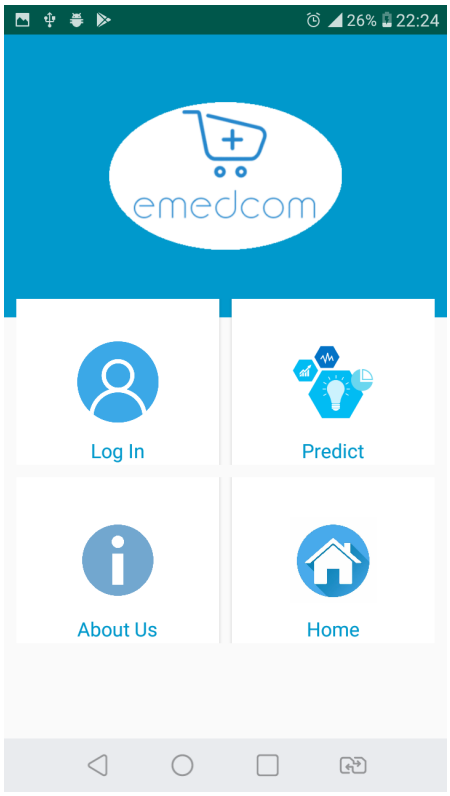

Figure 3.13: Dashboard

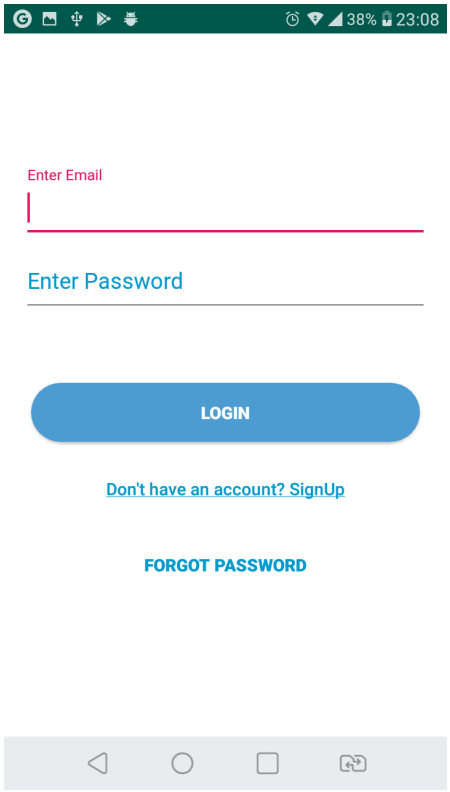

Figure 3.14: Login Page

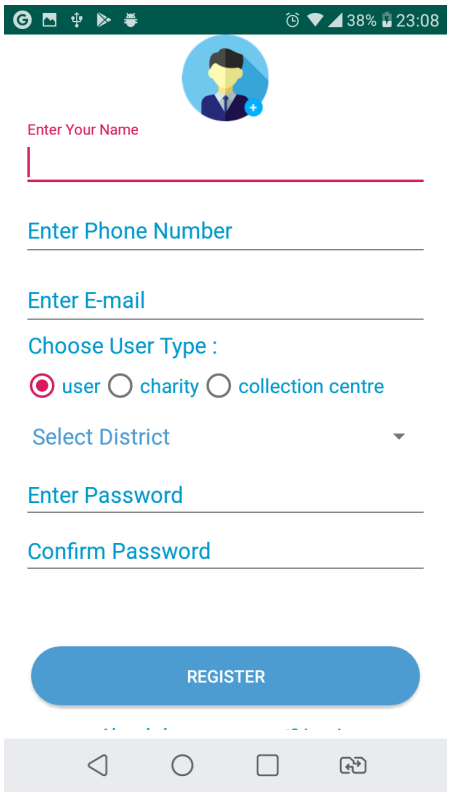

Figure 3.15: User Registration

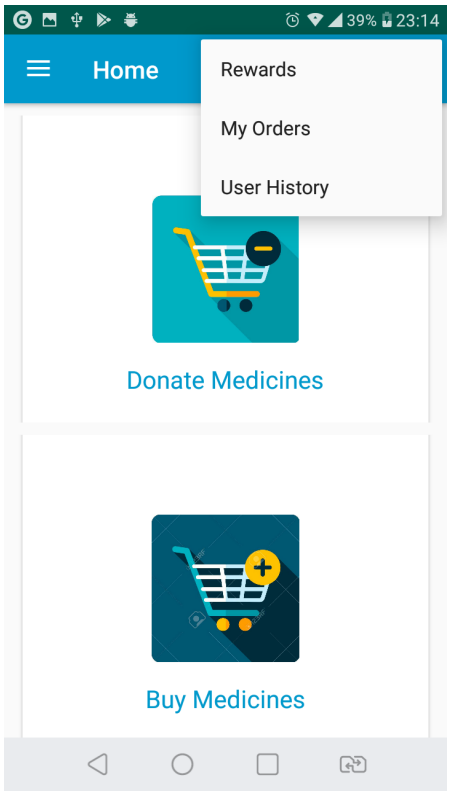

Figure 3.16: Home page for people

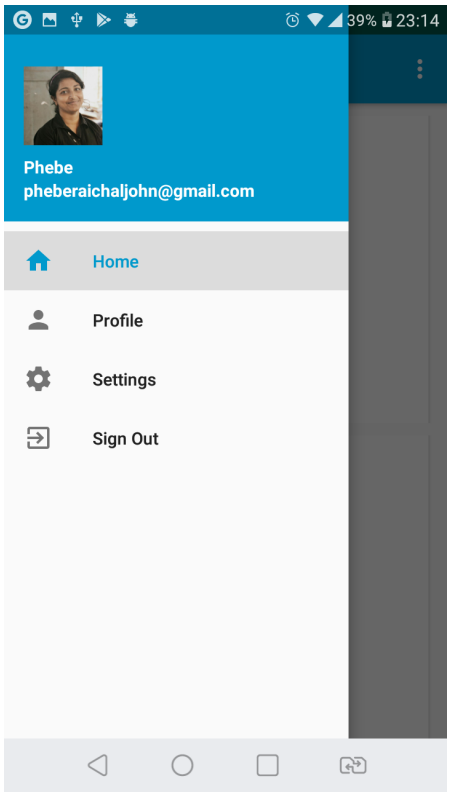

Figure 3.17: Details of user

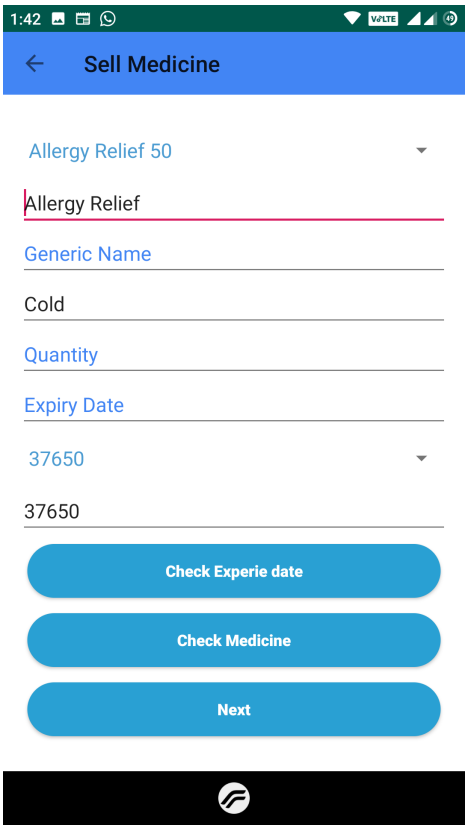

Figure 3.18: Sell medicines to collection centre

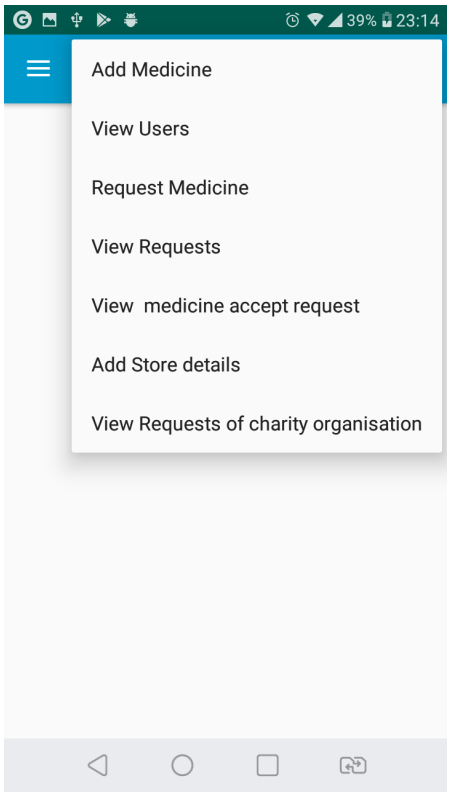

Figure 3.19: Collection Centre Home Page

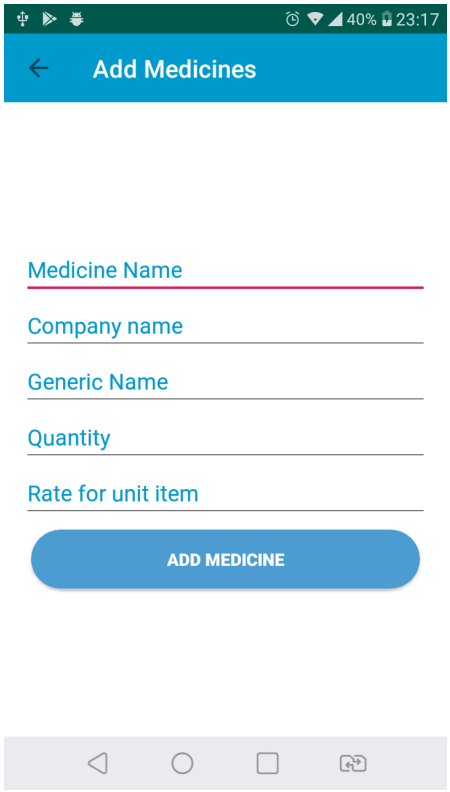

Figure 3.20: Adding Medicine Details

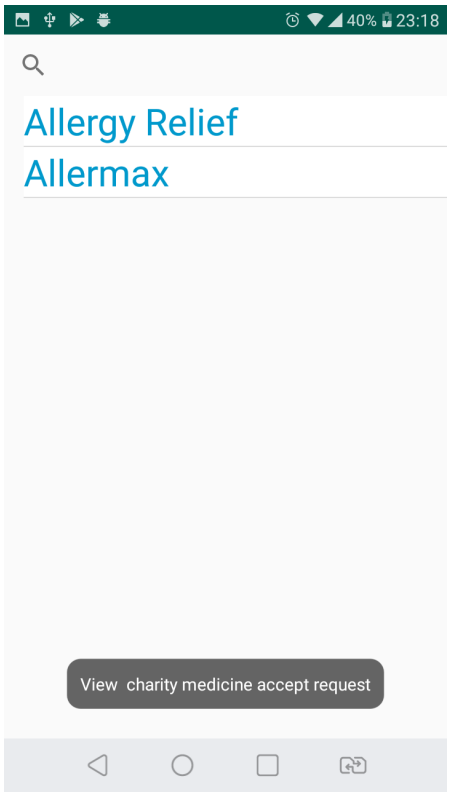

Figure 3.21: Searching and Viewing Request

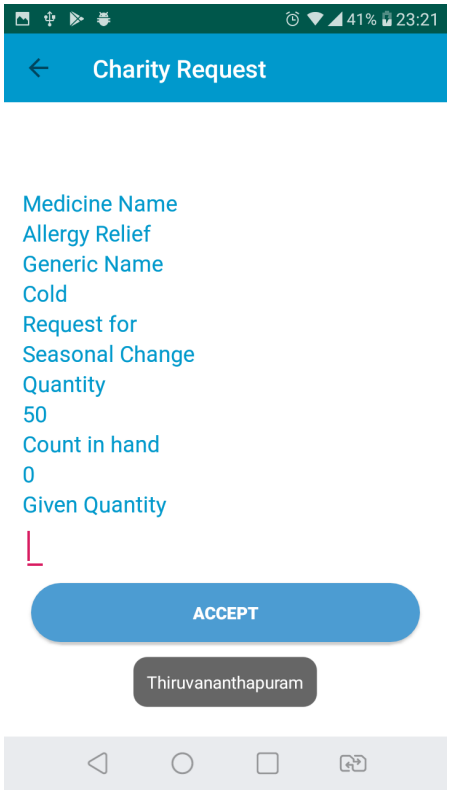

Figure 3.22: Accepting Request for Medicine

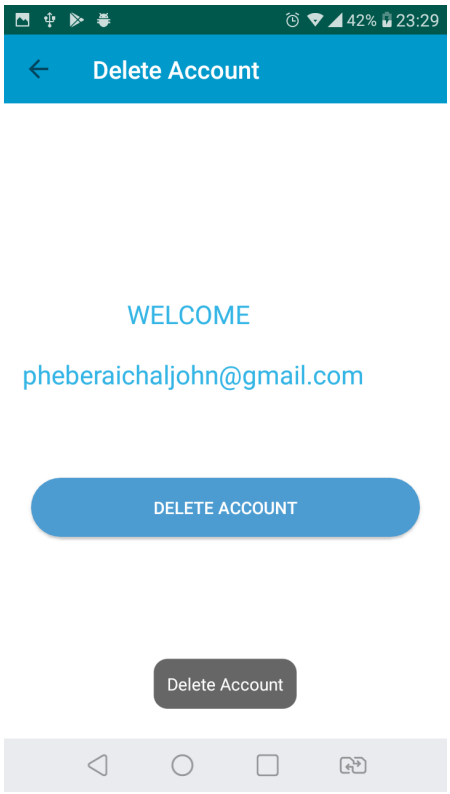

Figure 3.23: Deleting User Account

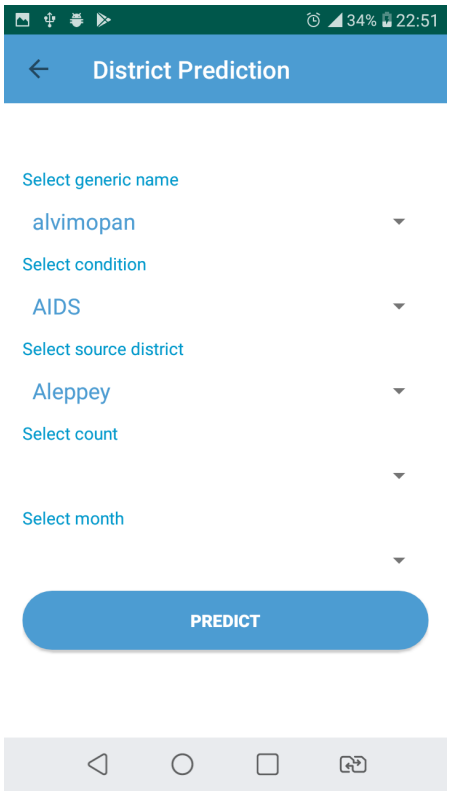

Figure 3.24: Machine Learning Prediction

Chapter 4

Coding

Algorithm 1 Android Application

1: Create splash screen activity to display welcome screen for 3 second by using Handler class
2: A dashboard is displayed done using the cardview which displays common functions of the application
3: Create activity for login and register. In register button onClickListener launch a new activity and fetch user data and store it into the database.
4: In login button onClickListener fetch and compare the data in firebase real-time database and in authentication. On success, navigate to the homepage of the corresponding user.
5: For collection centre login : Create a navigation drawer Activity CollectionHome with navigation icons as Home, Profile and Signout. Create layouts and menus for each function which includes add medicine, store details, request medicine, block users and view medicine request.
6: For people login : Create a navigation drawer Activity Home with navigation icons as Home, Profile and Signout. Create layouts and menus for each function which includes donate medicines and buy medicines.
7: For student login : Create a navigation drawer Activity CharityHome with navigation icons as Home, Profile and Signout. Create layouts and menus for each function which includes request medicine and delete request.

Algorithm 2 District Prediction using kNN

1: Start
2: Read the csv file new.csv into a data frame data.
3: Drop the records with missing values
4: Convert the categorical variables and object types to numbers using the label encoder module
5: Select the relevant features to be considered and store it in features raw
6: Split the data-set into training and test set using train test split() method
7: Create an KNeighbors classifier kNN with n neighbors as 3
8: Perform ten fold cross validation and print the mean of cv score
9: Perform ten fold cross validation and print the cv score for different values of n neighbors
10: Fit a model using kNN
11: Make predictions for the test data-set
12: Print the classification report
13: Connect the server with phone API
14: Make prediction for a new input and display the result
15: End

Algorithm 3 District Prediction using Decision Tree Classifier

1: Start
2: Read the csv file new.csv into a data frame data.
3: Drop the records with missing values
4: Convert the categorical variables and object types to numbers using the label encoder module
5: Select the relevant features to be considered and store it in features raw
6: Split the data-set into training and test set using train test split() method
7: Fit a model using decision tree
8: Make predictions for the test data-set
9: Print the classification report
10: Connect the server with phone API
11: Make prediction for a new input and display the result
12: End

Chapter 5

Testing and Implementation

System testing is the stage of implementation which is aimed at ensuring that the system works accurately and efficiently before live operation commences. Testing is the process of executing the program with the intent of finding errors and missing operations and also complete verification to determine whether the objective is met and the user requirements are satisfied.

The ultimate aim is quality assurance. Tests are carried and the results are compared with the expected document. In that case of erroneous results, debugging is done. Using detailed testing strategies a test plan is carried out on each module. The test plan defines the unit, integration and system testing approach. The test scope includes the following: A primary objective of testing application systems are to assure that the system meets the full functional requirements, including quality requirements(Non-functional requirements).

At the end of the project development cycle, the user should find that the project has met or exceeded all of their expectations as detailed in requirements. Any changes, additions or deletions to the requirements document, functional specification or design specification will be documented and tested at the highest level of quality allowed within the remaining time of the project and within the ability of the test team.

The secondary objective of testing application systems will be doing: identify and expose all issues and associated risks, communicate all known issues are addressed in an appropriate matter before release. This test approach document describes the appropriate strategies, process, workflows and methodologies used to plan, organize, execute and manage the testing of software project "EMedCom : Medicine Wastage Management and Requirement Prediction System".

5.1 Unit Testing

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	Login into the system	Invalid login is Blocked	Same as expected	Pass
2	Register the user	Student can register as an inmate	Registration successful	Pass
3	Contact people	Direct call to the needed authorities	Same as expected	Pass
4	Add medicines	Collection centre add medicine details and view them	Same as expected	Pass
5	Add pharmacy details	Collection centre add pharmacy details and view them	Same as expected	Pass
6	View users	View all users of that district	Get the basic details of all the users	Pass
7	View user history	users can view history	Same as expected	Pass
8	Delete Account	Deletes user account	Same as expected	Pass
9	Data preprocessing	To get the data processed for classification and evaluation	Same as expected	Pass

Table 5.1: Unit test cases and results

5.2 Integration Testing

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	Donate medicines	People can donate medicines along with valid bill	People get bonus points as rewards	Pass
2	Request Medicine	Sent request to collection centre	Same as expected	Pass
3	Model fitting and prediction	Most accurate prediction	Accurate on most cases	Pass

Table 5.2: Integration test cases and results

5.3 System Testing

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	Transfer Medicine	Accept medicine request if found valid	Same as expected	Pass
2	Block users	block people if found any fraudulent attempts	Same as expected	Pass
3	Server startup	Server starts	Same as expected	Pass
4	Prediction based on transferred data	predicts the district	Same as expected	Pass

Table 5.3: System test cases and results

5.4 Advantages and Limitations

The proposed system consists of several advantages compared with previous systems. It automates the daily hectic procedures and other functionalities. The app manages the hectic task of registering different users and reuse of unexpired medicines effectively. Collection centre can add details of pharmacy and other medicine details. The people place requests for donating medicines to the collection centre along with the copy of the bill and they can also sell medicine. If found valid, the medicines are accepted by the collection centre and are awarded a bonus for those who sell medicine. The people who try to make any fraud attempts are blocked by the collection centre. Charity organisation can also request medicines according to their need. All medicine requests are accepted by the collection centre. The application also predicts the districts where a particular medicine is most used. Currently, the district prediction is done manually based on some inferences. The manual steps have got a lot of disadvantages as it needs an expert. But in this system, everything is automated and more accurate.

Advantages

- Adding pharmacy and medication details
- Placing Request
- Contact users directly
- Blocking users if found illegal
- Predicts district
- Use different aspects of a transfer for evaluation which increases accuracy
- Proper evaluation methods
- Database is synced with the app in real-time

There are also some limitations to the proposed system. Large amounts of data in the database may affect the speed of the app.

5.5 Future Extensions

The proposed system can be extended. This application can be made more effective by using image processing for validating the bill details. Push notifications can also be added in order to request very urgent medicines. Complete details of all medicines can be added. All bill details from every pharmacy to collection centre can be added to improve bill validity.

Chapter 6

Results and Inferences

The results for district prediction using transferred data are as follows:

Sl No	Algorithm used	Input data	Cross validation	Accuracy
1	kNN	transferred data	93.86%	91.5%
2	Naive Bayes	transferred data	92.73%	91.3%
3	Decision trees	transferred data	32.57%	28.8%

Table 6.1: Cross-validation and accuracy measures of each algorithm

The inference from the above finding is that kNN gives the best score for accuracy.

Accuracy measures how often the classifier makes the correct prediction. In other words, it is the ratio of the number of correct predictions to the total number of predictions (the number of test data points). Accuracy is defined as the fraction of correct predictions.

accuracy = (true positive + true negative)/(true positive + false positive + false negative + true negative)

Chapter 7

Conclusion

Reducing medicines waste will improve quality and save resources. There are a need and an opportunity for strong leadership from pharmacists to help reduce medicines waste. Reducing unnecessary dispensing and supply of medicines is an important way of reducing waste. Wasted medicine is everyone's responsibility and there are small changes you can make to help reduce the amount of medicine being wasted. These savings could be reinvested into more front line care and services for the benefit of all. When possible, try to make these medicines reusable. It is everyone's responsibility.

The purpose of this system is to build a simple to use android application and to predict district according to the flow of medicines. In the current scenario, there is no way to reuse the unused or unwanted medicines in hand. People usually throw away the available medicines which can cause pollution. Also, no one know how the medication making company reuse the medicines before expiry. In this project, it provides an automated way to reuse unwanted medicines before expiry.

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