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Design and Implementation of an Android Nigerian Recipe Generating System

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***Abstract*—Food is any edible substance that is expected to give nutritional value to the living body. It is required for vitality, development and counteractive action of disease and repair of body cells. Daily, individuals are confronted with lack of knowledge on what to cook, how to cook or what ingredients are available or unavailable for cooking. This could be as a result of various reasons and can result to other problems like overthinking, food repetition, ignorance of availability of ingredient and food wastage, thus, this system was developed to help eliminate or reduce these problems. The system generates possible Nigerian meals that can be prepared with available ingredients in stock. It was developed for Android devices and implemented using Android Studio, with Java as the programming language, XML for the interface and SQLite for the database. The system was deployed on forty user's mobile devices for testing and got positive feedbacks. The system proved to be useful and satisfied its potential users.**

Keywords-recipe generator; smart systems; Android applications; mobile applications

I. INTRODUCTION

Food is any edible substance that is expected to give nutritional advantages to the living bodies. It is the second requirement for life after air. Food is required by the body for vitality, development, counteractive action of disease and repair of body cells [1]. Traditionally, cooking is a one of the functionalities of every household; however, this tradition has reduced drastically among the populace.

Presently, less and less individuals have the knowledge or the time and confidence to prepare an appropriate meal due to lack of appropriate training or busy schedule [2]. Cooking involves combining appropriate ingredients to prepare suitable meal for consumption. When cooking, a particular recipe is followed. This recipe is a step by step procedure for preparing food in which ingredients to be used and the order of mixture are worked out to produce this meal [3].

Due to the increase of new meal discoveries and decrease in cooking knowledge, people require a guide or tutor to assist them on how to cook [2]. This has brought about the different cookery books sold on the streets, in book shops and even online. These books however, seem not to satisfy the desire for people to learn how to cook and this makes them go to the length of paying a tutor which requires a lot of money, or visiting websites which requires constant internet access. In this age of technology and advanced mobile devices, a lot of human tasks are being delegated to the smart phone with IOS or Android devices. Examples include tutor software, taxi booking software, games, schedule organizers and a host of other applications.

In this light, multitudes of android applications are developed for smartphones and tablet to aid novice and amateur chef [4]. Most of these apps focus on finding recipes of random meals or providing general cooking advices.

Android application is a software application that runs on the android devices. This application extends the functionality of android devices. They are developed using android SDK and often, java programming language. They allow you to download online and offline applications that you can interact with.

This system is an android application meant to act as an expert cook that tells the user which Nigerian meal can be prepared based on the ingredients available. It is expected to accept the user's available ingredients and store them in the database. This is so that subsequently, the user will not have to input ingredients except in the case of addition or subtraction from stock. The saved ingredients are to serve as the condition in which recipes can be generated for the user.

II. EXISTING WORK

There are a lot of work done in the area of recipe recommendation and generating systems. Dandekar and his co-authors in [5] proposed an idea similar to this study whereby the system generates all the possible meals that can be made from available ingredients. Though their approach includes text, audio and image as mediums of input for the ingredient, it was yet to be implemented. In addition, their approach was to input all the ingredients a user has at home at run time (on the go) without actually having a database on which to store the ingredients beforehand. This could be very cumbersome and inefficient because in reality people cannot remember all the ingredients they have at home at a go even if they do, the number might be too much to input on to software at a go. On the other hand, this study is designed in such a way that a user is supposed to stock the mobile database with new ingredients just after shopping so that the system already has knowledge of the users stock and hence it will just generate all the possible recipes that can be developed from them. In addition a user can update the mobile store by adding new ingredients after buying and

removing ingredient when it is finished to reflect the status of the real store.

Jagithlya in [6] analyzed a recipe recommending system based on user review and ingredients. His major contribution was to propose approaches to be devised and algorithms to be implemented. One of the approaches proposed is ingredient-based similarity of recipe where ingredient is considered the primary factor. It recommends recipe with similar ingredients to that of the user's liking.

The second approach is recommendation based on recipe rating which considers user's rating for various recipes. Here, similar recipes related to the rated recipes are predicted using collaborative filtering in recommender system.

The third approach is based on recipe review text where recommendations are based on text review given by the user. The reviews are then analyzed to predict recommendations. This is done using context-based filtering.

The last approach proposed is user recommendation based on liked ingredients as well as user's review text. This hybrid approach combines the similarity between user's liked ingredients and the text review gotten from the user. They got their data from www.allrecipes.com and split it into 70% training set and 30% test set. Various experiments were conducted and it was concluded that recommendation based on review text yielded better results than recommendation based on ingredient similarity.

Maruyama in [7] developed a real time mobile recipe recommendation system using food ingredient recognition. The aim was to design a pictorial mobile application that will assist a user to decide what and how to prepare a meal using object recognition software. The smartphone required a built-in camera and internet connection to be effectively utilized. The system is majorly for use when the user is grocery shopping.

The system recognizes ingredients captured by the Smartphone and searches for recipes online that include the ingredients captured. They used the web APIs of other commercial cooking recipe site instead of developing their database. The system uses a support vector machine, which is the most common image classifier and multiple frame object recognition with single image feature.

The limitation of this work is that the ingredient being captured has to be high resolution before it can be recognized. The system does not recognize ingredients that are packaged or images that are blurred.

Kuo in their work in [8] designed an ingredient menu planning system. They developed the ingredient menu planning system by generating set of recipes that is based on collective knowledge, with a recipe graph developed to match the accompaniment between food sharing websites and recipe on the menu.

They utilized the minimum Steiner tree algorithm to solve menu planning problem and approximate algorithm for the large recipe graph. They also developed recipe equivalence identification to ensure accuracy in recipe recommendation and eliminate recipe repetition. They converted the problem to a minimum Steiner tree problem and generated a menu plan by creating Group Graph Construction, Querying Relevance Graph Construction and using Connector-Steiner tree algorithm to generate the menu plan at a reduced cost.

They gathered recipe and menu from food.com and divide into 70% training and 30% testing set for experiment and limitation of this study is that it takes much time for menu to be generated when graph is large.

Nedovi in [9] designed a learning recipe ingredient space that is using generative probabilistic models. They used two generative latent variable models for modelling ingredient distribution, the Latent Dirichlet Allocation and Deep Belief Network. They aimed at discovering the relationship that exists between various recipes, either implicit or explicit. Their dataset was gotten from numerous recipe depositors but the recipes were documented using its required ingredients, thereby considering the absence or presence of a specific ingredient. They used distributed stochastic neighbor embedding technique to visualize the structure of high dimensional data.

They split their data into 50% training set and 50% test set and used mat lab for dimensionality reduction. Besides providing ingredient substitute, they also aimed at generating new ingredient combinations. They believed that their preliminary results showed promise to their approach.

Ueda in their work in [10] proposed a recipe recommendation system that considers the user's preference and the ingredient quantity of the recipe. The system recommends recipe based on the frequent use of specific ingredients and excludes recipe that user has eaten the past few days.

They establish the user preference by considering user's favorite ingredients and users disliked ingredient, the quantity of ingredient in the recipe as well as the recipe scoring for the experiment. They used recipe extracted from recipe search sites. Prior to the experiment, the users provide their cooking history for a month to calculate their food preference.

They present five randomly selected recipes to the users, they then rank the recipe based on his feeling towards it. Four different ranking types are compared, ranking by method, ranking by food preference, ranking by popular search and ranking by user's view.

Teng in their work in [11] carried out an experiment on recipe recommendation using ingredient network. They downloaded recipes from allrecipe.com and went through their user reviews to shed more light on the user preference. They identified the ingredient from the recipe but missed out some ingredients so they used regular expression matching to extract non-ingredient words from the recipe and considered the remaining to be ingredients.

They measured whether a specific ingredient is important or can be swapped or dropped and also developed two different networks to identify the relationships between various ingredients, the ingredient complement network and the ingredient substitute network.

Both networks encode which ingredient can be substituted for a better result and which ingredient goes together and permit prediction of which recipe will have higher ratings. In this paper, they focused on ingredients and proposed their next paper to focus on recipe gotten from the

ingredients as well as their diet specific and region-specific ratings.

Therefore, the contribution of this paper is the development of a smart application which always reflects the contents of the food stocks available at any particular time in a home and at a click of a button, shows the user all the possible Nigerian dishes that can be prepared from the available ingredients as well as the step by step guide to preparing such a meal.

III. ANDROID APPLICATION DESIGN

In this section, we present the design of the mobile application, namely Smart Kitchen Assistant, in the form of use-case model, packages and classes, mobile database and user interfaces. The use-case, packages and classes are presented using UML in [12] which is commonly used in designing object-oriented application such as application in Android platform.

A. Use Case Model

The new system can suggest to the user the type of meal possible for preparation considering the ingredients available in the user's home. It allows the user to search for random meals in case of learning something new and other functionality as illustrated in Figure 1.

B. Mobile Database Design

In designing the database for a mobile application, it is suggested that the database only manage small size of data most needed by the application. The database was created using SQLite with SQLite Studio and populated directly before being imported into android studio. This is illustrated in Figure 2

C. User Interface

The system uses a simple design interface that anyone can easily get acquainted to upon launching the application. Data acquired includes varieties of Nigerian dishes, the ingredient required to prepare the dishes, the recipe for preparing the dishes as well as the duration required for the dish to be prepared. The data was acquired from Experts, as well as the Internet.

Each page in an android application is referred to as an activity layout which is developed using xml and is linked to a corresponding Java activity that handles the functionalities of the user interface in the activity layout. The Activity layouts developed for this system are shown in figures 3 to 9.

This is the first activity the user interacts with when the application lunches. All other activities are accessed through this activity by interacting with the buttons on this activity. Here the user can access the ingredients, generate recipe, view all recipes, view categories, view favorite or search using the search icon on the taskbar.

1) Ingredient Activity

On clicking the ingredients button on the first activity, the user can access and add new ingredient as illustrated in figure 3. Here the user can type the intended ingredient to see suggestions and add or delete an ingredient by clicking on the add or delete button.

2) Generate Recipe Activity

This is the pivotal functionality of the system. This activity is empty on installation. On clicking on Generate Recipe button, the activity populates all the different types of cuisines that can be made based on the ingredients stored in the ingredient activity. The user is required to input available ingredients in the ingredient activity before clicking on the generate recipe button to see if any meal was generated.

3) All Recipe Activity

This activity contains all the meal type present in the database. The user can view all the recipes in the database here by clicking on the all recipes button. This does not consider the user's available ingredients.

4) Category Activity

Provides meals based on specific categories. This activity can be accessed by clicking on the category button. The category button shows different categories and when a category is clicked, it reveals the meals that are grouped under that category.

5) Favourite Activity

This activity populates meals the user selected as a favourite. The user selects a meal as favourite by clicking on the heart shaped icon. When an icon is black, it is selected as a favourite while if it is transparent, it not a favourite.

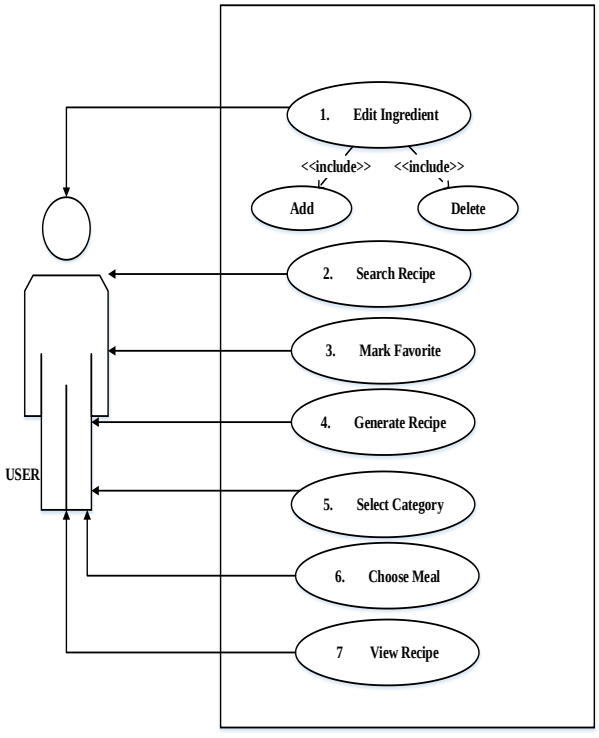

Figure 1. The Use Case Diagram of the System

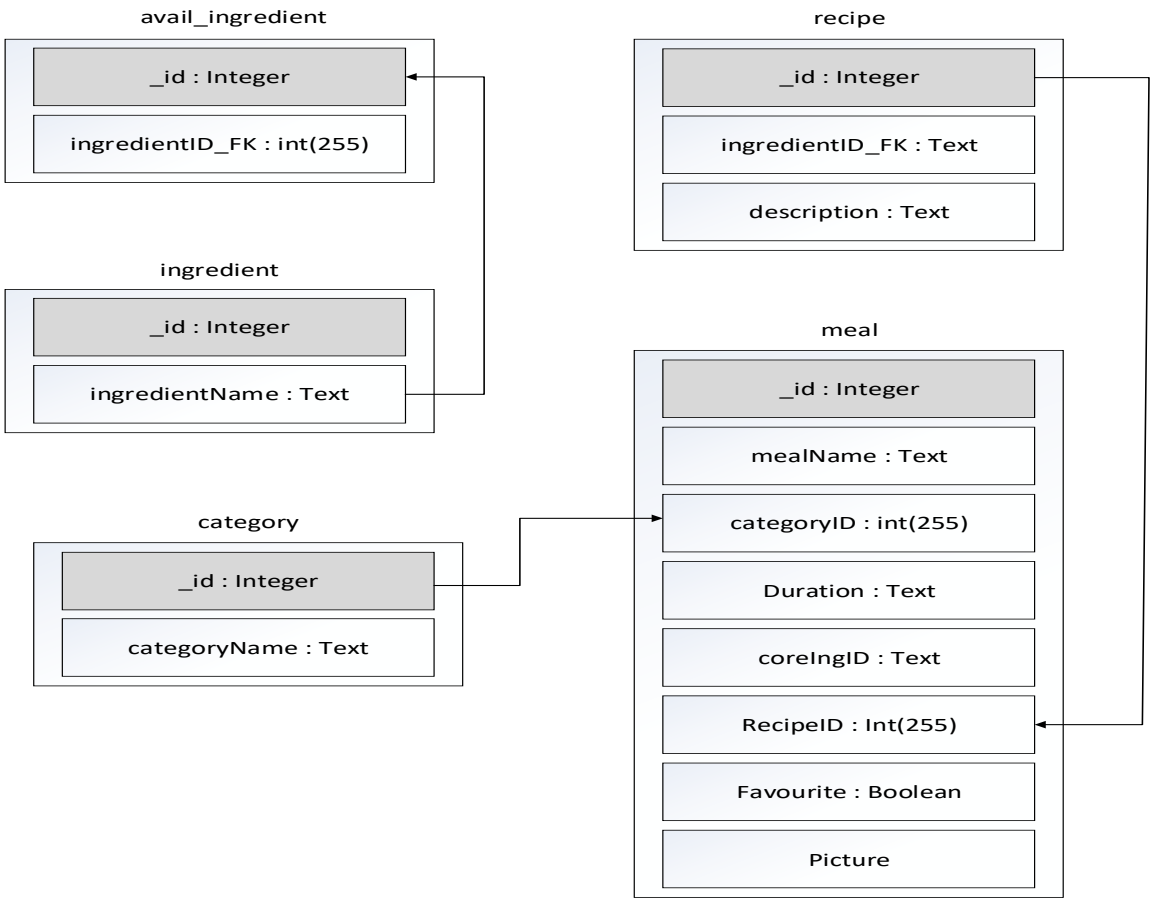

Figure 2. The relational schema of the mobile database

6) Search Activity

This activity populates the meals whose meal names are like the text inserted in the search bar. This is accessed by clicking on the search icon, typing the text to be searched for and clicking search.

7) Recipe Activity

This is an important functionality of the smart app. This activity shows the recipe for preparing a particular meal. This includes the ingredients required for the meal and the steps involved in preparing the meal. This is accessed my clicking the meal of choice. This is illustrated in Figure 9.

D. Logic Layer

While the interface of the application was designed using Android Studio, and Java programming language to implement the interface and functionalities, SQL is used to communicate with the database. One of the primary functions of the application is to collect and store the user's available ingredient. On that note, a function to add and delete certain ingredients was developed and incorporated into the application.

1) Edit Ingredient Flow Chart

Another primary function of the application is to provide the recipe to any dish that the user searches for irrespective of his/her available ingredient and which is available in the system.

The main function of the application is to generate recipe for the user based on the available ingredient the user has. Here the system has to go through the entire ingredient before giving suggestions to the user.

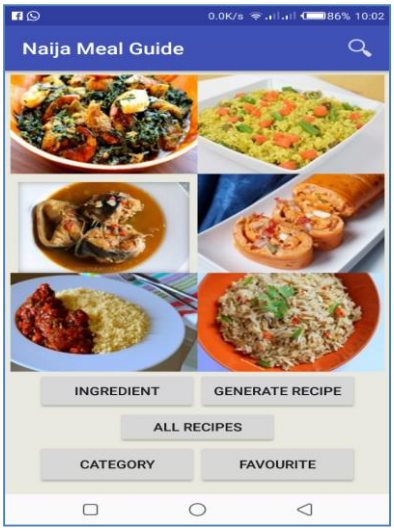

Figure 3. Main Activity

Figure 4. Ingredient Activity

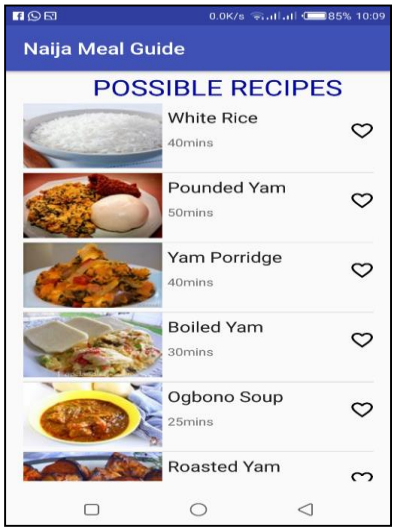

Figure 5. Generate Recipe Activity

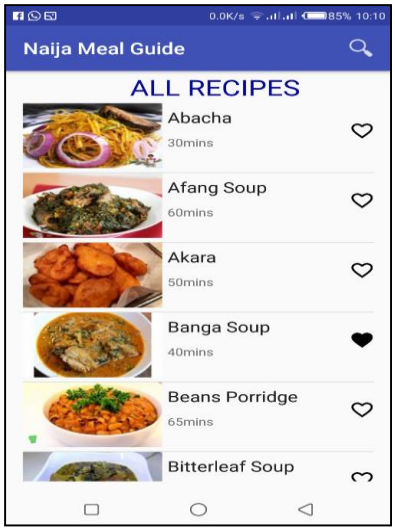

Figure 6. All Recipe Activity

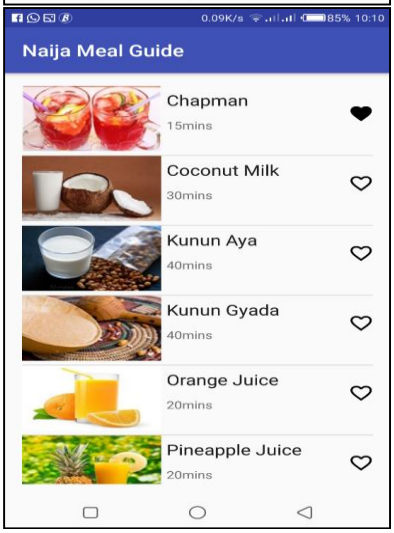

Figure 7. Category Activity

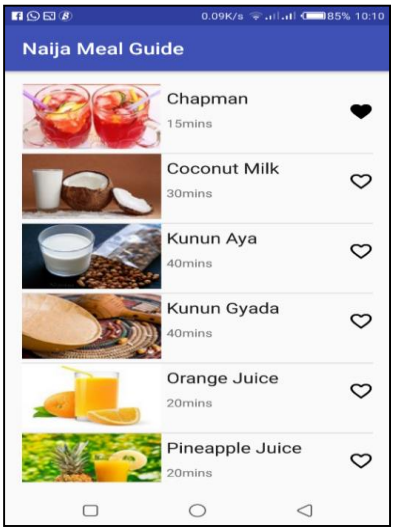

Figure 8. Favorite Activity

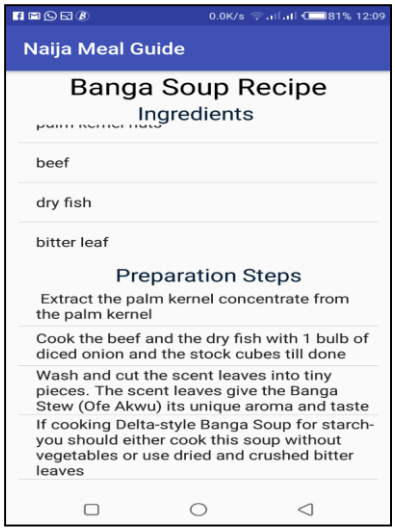

Figure 9. Recipe Activity

GENERATE RECIPE PSEUDOCODE

```
BEGIN
Function generateMeals(){
   CONNECT to database
   FETCH user's available ingredients,
      STORE in array haveArray[]
   FETCH core ingredients
      STORE in hashmap<key,value> needMap
      FOR needMap as integer, string
      SPLIT core ingredients(i.e string) in needMap
      STORE splited ingredient in array needArray
        IF haveArray contains all needArray{
        GET mealName where meal._id = Key(i.e integer)
            }
   CLOSE connection }
CALL function generateMeals()
END
```

IV. EVALUATION AND TESTING

At this phase, the application was deployed on forty different user's mobile devices for testing. The users interacted with the application and gave their respective feedbacks by filling a questionnaire. The feedback is highlighted in Table 1.

The data shown above is plotted into a histogram (Illustrated in Figure 11) which shows the pictorial representation of user's opinion of developed system. The histogram shows the graphical representation of the feedback gotten from the users who interacted with the system during the testing phase. It was plotted having the number of users against their responses and has the blue bar as the positive feedbacks, the pink bar as the neutral feedback and the green bar as the negative feedback.

The result obtained from the user feedback suggests that the users find the application to be novel, useful, user Friendly, fast and accurate at an acceptable level.

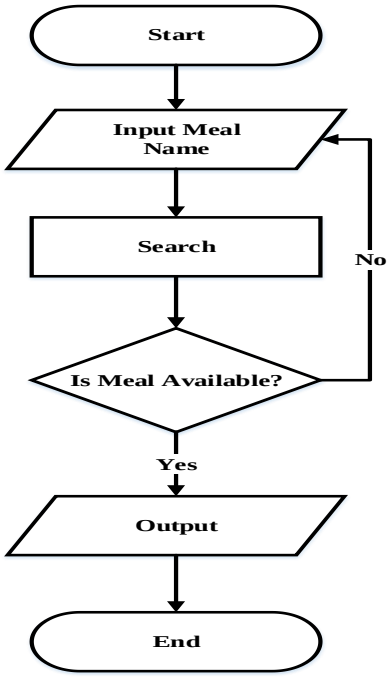

Figure 10. Search Function Flow Chart

TABLE I. FEEDBACK FROM USERS OF THE APPLICATION

Feedback Requirements	Number of positive feedbacks	Number on neutral feedbacks	Number of negative feedbacks
1. Have you used this type of application before?	35 => No	0	5 => No
2. If yes, would you say this is better?	40	0	0
3. Do you consider this application useful?	40	0	0
4. How would you grade it in terms of user friendliness	39	1	0
5. How would you grade it in terms of query output speed	40	0	0
6. How would you grade it in terms of query result accuracy	38	2	0
7. Overall comment about the application	34	5	1

V. SUMMARY

This study introduces android systems and how they could be useful to people in terms of meal preparation. The objective of the study was to design an android Nigerian recipe generating system that considers available foodstuff, implement it and test the system based on its accuracy. The data used was acquired from experts and recipe websites and was stored in SQLite database that was built using SQLite studio. The application was developed using android studio and the database was incorporated into the android studio. The interface was designed using xml while its functionality was implemented using java programming language, which

is the official language for android development. The system was deployed on different user's mobile devices and got an overall positive remark.

VI. CONCLUSION AND RECOMMENDATION

The recipe generating system turns any android phone housing it into a meaningful kitchen helper. It satisfies its main purpose of being able to help citizens who want to learn how to cook, foreigners who want to learn Nigerian recipes, catering schools, homemakers and the public at large. The recipe generating system was designed and implemented on an android device. It satisfies the primary purpose of its development and more, though, there is room for more features to increase the standard and functionality of the application. Some recommendation for this system includes creating an avenue for users to be able to add their personal ingredients and recipes. The users should also be able to rate each meal and share their ratings on social media whenever internet access is available. The system should also provide basic food preservation methods to help tackle the problem of food wastage.

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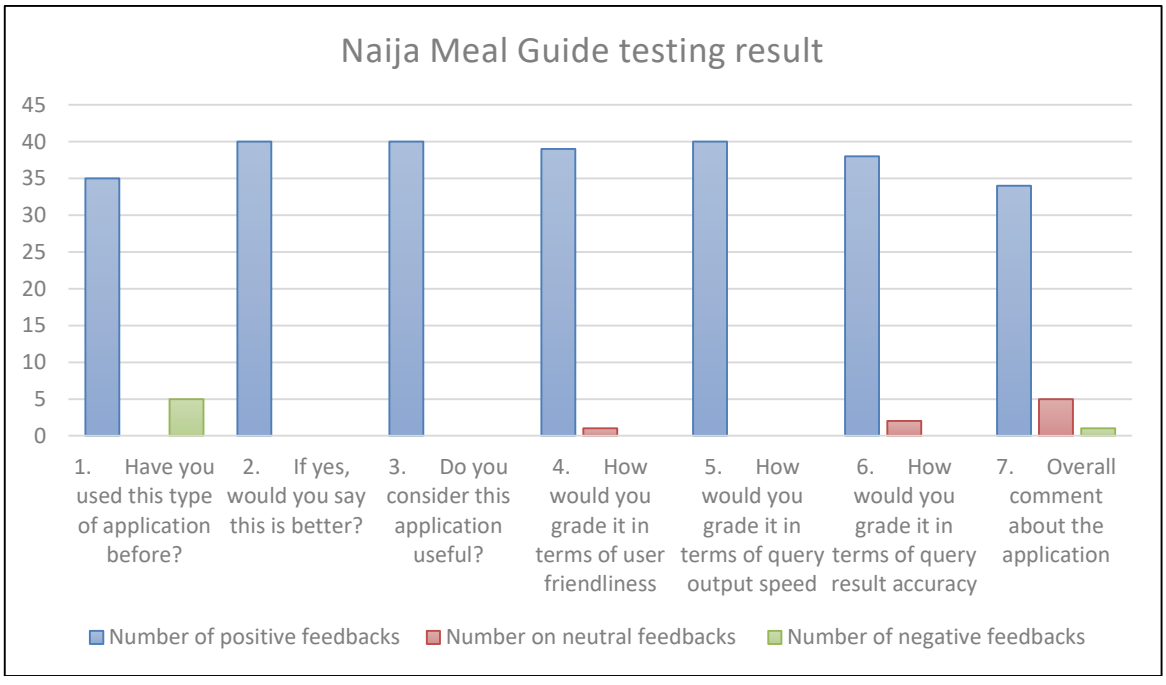

Figure 11. System testing result histogram