



## NutriMax: an Android Based Personalized Nutrition Management System

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### Abstract

Personal nutrition management is very important for the sustenance of good health, there are a lot of health complications that occur in the human body when certain food nutrients are insufficient, this results in nutritional deficiencies which are very life-threatening for health vulnerable individuals such as pregnant women, sick people, children and the aged. This research focused on the development of mobile application software with an algorithm based on machine learning of data mining principle to learn, train and analyze the challenges of malnutrition and how to effectively manage it. The mineral value content of one hundred and twenty (120) assorted commonly available Nigerian food substances was collected and contrasted with standard dietary benchmarks. Factory processed foods were not be considered. Hence, a list of daily requirements of food nutrients by the human body was sourced together with a selected number of nutritional deficiencies to create a mobile application powered by an algorithm that establishes a relationship between nutritional deficiencies and their requirements to suggest daily meals for users. The data obtained was uploaded to a real-time database and integrated with Android Studio to build a working Android application interspersed with Java programming language. The food guide application was named NutriMax.

**Keywords:** Nutrition, Nutrients, Malnutrition, Nigerian foods, Machine learning, Data mining.

### Introduction

Food is next in importance after air and water for human life sustenance. Food main elements include carbohydrates, proteins, and fats with some negligible components of minerals, vitamins, and trace elements which are essential for upholding health in a corporeal body (Salau and Hasan. 2019; Hassan *et al.*, 2019; Salau and Hasan, 2014). Humans eat food in the form of grains, pulses, fruits, vegetables, oils, meat and so on. In addition to life sustenance, food gives energetic vigour through the process of oxidative phosphorylation to generate energy. Nigeria as a country is blessed with a variety of readily available foods that are rich in a variety of food nutrients (Matemilola, 2017; Ene-Obong *et al.*, 2013)

Mineral malnutrition is estimated to be 11 per cent of the global burden of diseases. Food mineral deficiency is the number one risk to health worldwide (Salau and Hasan, 2014; Black *et al.*, 2008). It is also implicated in about 40 per cent of the 11 million deaths of children under the age of 5 years in developing countries (UNICEF, 2010). However, countries may lose an estimated 2-3 percent of their Gross Domestic Product (GDP) as a result of food minerals deficiencies such as iron, iodine, and zinc (Horton, 2008). Lai, *et al.* (2008) and Lau, *et al.* (2001) wrote that a lot of reported cases of mineral deficiency disease emergencies have been reported, for instance, there were nearly about one million cases of anaemia due to iron deficiency. In the same study, osteoporosis due to calcium, magnesium, and phosphorus balance deficiencies were reported to be up to 2.5 million cases as in 2009. Quite often, Osteoporosis was prevalent among the elderly (Lai *et al.*, 2010). Osteoporosis has symptoms of weak and easily fractured bones of the spine, hip, wrists, and arms, especially in the aged population. According to Mafauzy (2000), it was projected that by the year 2020, this ailment would increase by 3.3% as more of the world's population attain the age of 65 years. By 2050, the global incidence of osteoporosis in men is projected to increase by 310% and 240% in women over 1990 figures (Wallace *et al.*, 2020). Such a situation requires a proper nutritional plan to avert such ugly incidence.

The World Health Organization (WHO, 2018), reported that in recent decades, hunger has decreased globally but the number of undernourished people in the world has increased since 2016 resulting in

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Stunting (low height for age), especially in children under the age of five. In addition, eating unhealthy diets is one of the causative factors of malnutrition (Webb *et al.*, 2018).

Food nutritional type and quantity requirement vary from one individual to another depending on the individual's age, gender, health status and blood type (cite). Therefore, it is important to study the nutritional requirements of different individuals and provide recommendations and daily guides accordingly. Gibney, et al (2009). Personal nutrition is a methodology that helps people in accomplishing enduring dietary conduct necessary for wellbeing. The personalized food sustenance covers related terms such as nourishment exactness, nutrigenomics, nutrigenetics, wholesome genomics, and so on Ordovas, et al (2018).

There are many Android applications on the App Store that has to do with nutrition planning. Yet, Hindy (2019) reviewed some of them, such as the Calorie Counter by FatSecret which keeps track of dietary intake along with their nutritional value and the calories expended through a weight tracker; Fooducate (cite) counts diets calories, monitoring weight loss, and tracks exercises performed. What distinguishes Fooducate is that it not only seeks to count calories but also helps evaluate the value of the calories a person consumes.

Lose It! is another application reviewed by Hindy (2019). Lose it! performs calorie counting and it comes with a repertoire of foods for dietary plans. MyFitnessPal has a database of over five million foods where one can determine calorie counts of different food items and their mixture, in addition to aerobic and strength training features. MyPlate Calorie Tracker contains a calorie counter, food monitoring and a spa feature to monitor workouts, as well as water intake.

NutriSonic web applies systems for nutrition counselling, nutrition education, and meal management (Hong *et al.*, 2008) and (Lee *et al.*, 2008). In related work, the Mineral Deficiency Diseases-Food Guide (MDD-FG) was reported by Salau and Hasan (2019) which is an interactive informatics software constructed on the simple database and data mining principle. It aimed at encouraging the administration of normally eaten foods among Malaysians to confront the reports on challenges of diseases which are of mineral malnutrition origin in terms of remedy, prevention, and health maintenance. It is, however, noted that these software applications were not freely available to manage the mineral deficiency diseases, cumbersome to use and are not easily adaptable to the mobile application, unlike NutriMax that has Nigerian food items peculiarity.

There is no agreed meaning of personalized nutrition yet, meanwhile, for this study, personal nutrition is viewed as a means of using data on food qualities of an individual to focus on dietary exhortation or administration. The proposed *NutriMax* would learn individual nutritional requirements and generate meal suggestions for breakfast, lunch and dinner, from diet history.

## **Methodology**

### ***System architecture***

This is the graphical representation of the system architecture which indicates the various components of the system and how they interact, pass data and logic flow from one model to another.

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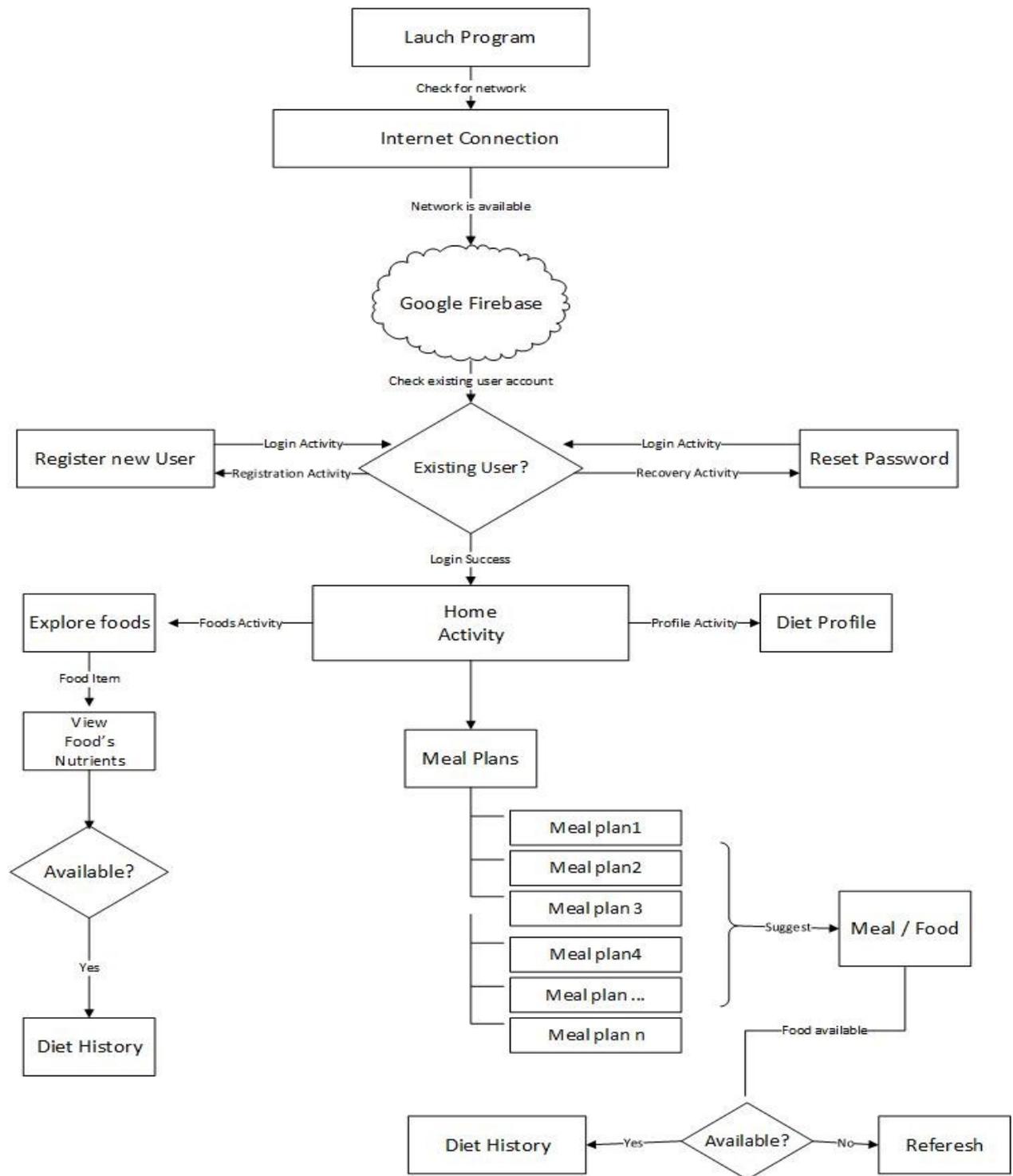


Figure 1: NutriMax System Architecture

*Software structure*

The structure of this application and the relationships with the patterns that correlate among different entities or models are stated in *system architecture* section. The major classes in the system that makes it possible to get the required functionality are Profile Model, User Model, Food Model, Deficiency Model, Requirement Model and the Diet History Model.

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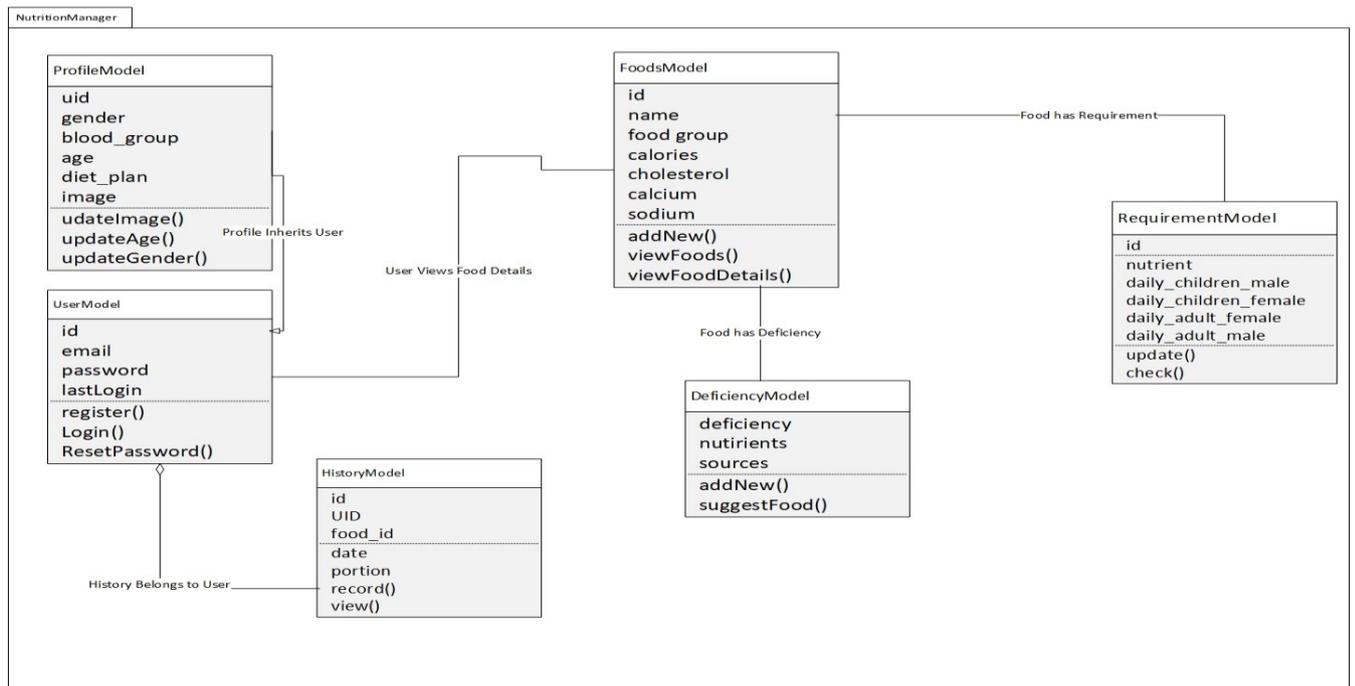


Figure 2: Class Diagram of the System.

### Work flow diagram

This system is a 3-tier application with various components that interact and send data to and from the internet. The workflow begins at the client-side sending and requesting data from the server.

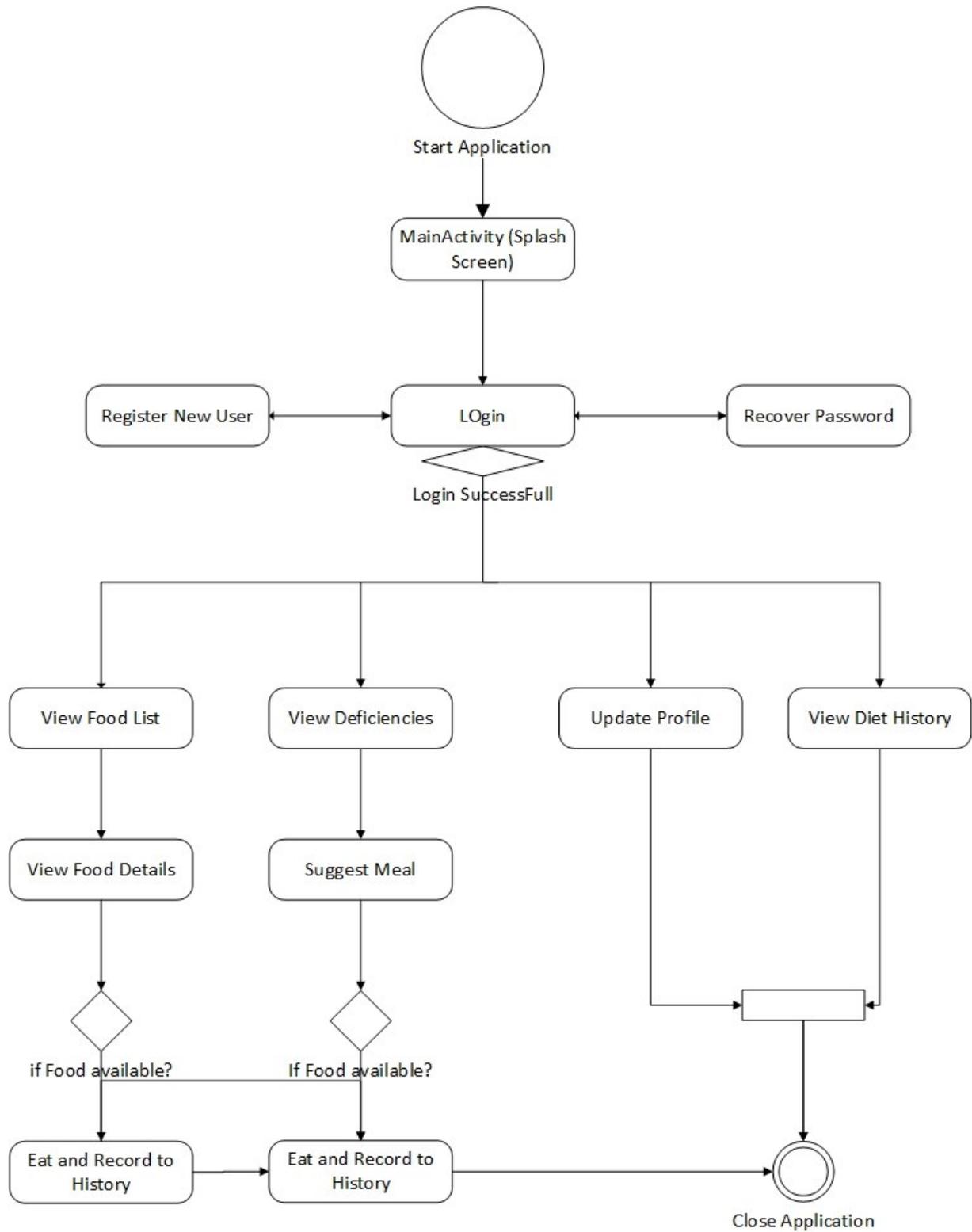


Figure 3: Activity Diagram.

## Results and Discussion

### System Menu

NutriMax application was designed for mobile phones that run on the Android operating system. User authentication is very important, for keeping track of the user's choices which will further aid in meal suggestions. A diet history is also possible with the implementation of individual user accounts. The authentication is comprised of Register, Login and Recovery Activities which aids users to create new accounts, login into their accounts, and recover.

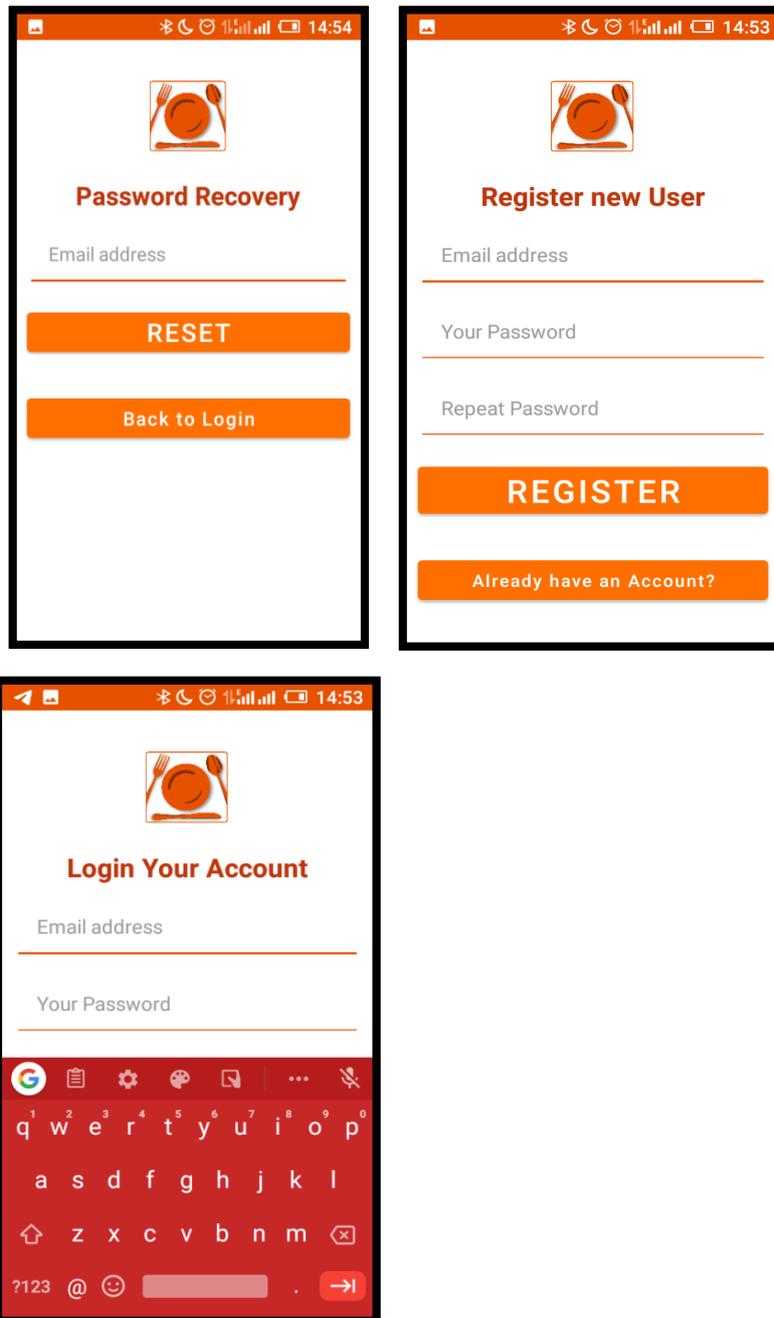


Figure 4: NutriMax user authentication interfaces.

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### *NutriMax Software Implementation*

This software was designed for mobile phones that run on the Android operating system. The Popup menu was designed with the material design toolbar popup menu and icons. This contains a list of menu items including; Add New Foods, New Deficiencies, Diet Requirements, About the App, Logout. See Figure 5.

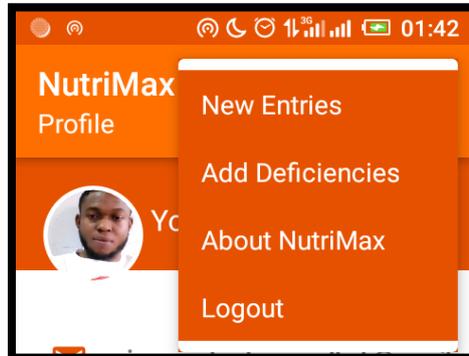


Figure 5: The NutriMax Popup menu

The Popup menu contains New Entries ((to add new food items); Deficiencies ((to include diet deficiencies and quantity requirements); About NutriMax (contains system information about NutriMax application); and Logout (to exit the Application).

Next is the NutriMax main menu, which consists of the following fragments: Foods fragment, Deficiencies Fragment, History Fragment, and Profile Fragment, see Figure 2.



Figure 6: NutriMax Navigation menu.

### *Foods Fragment*

Foods fragment displays a list of all food items in the NutriMax database collection.

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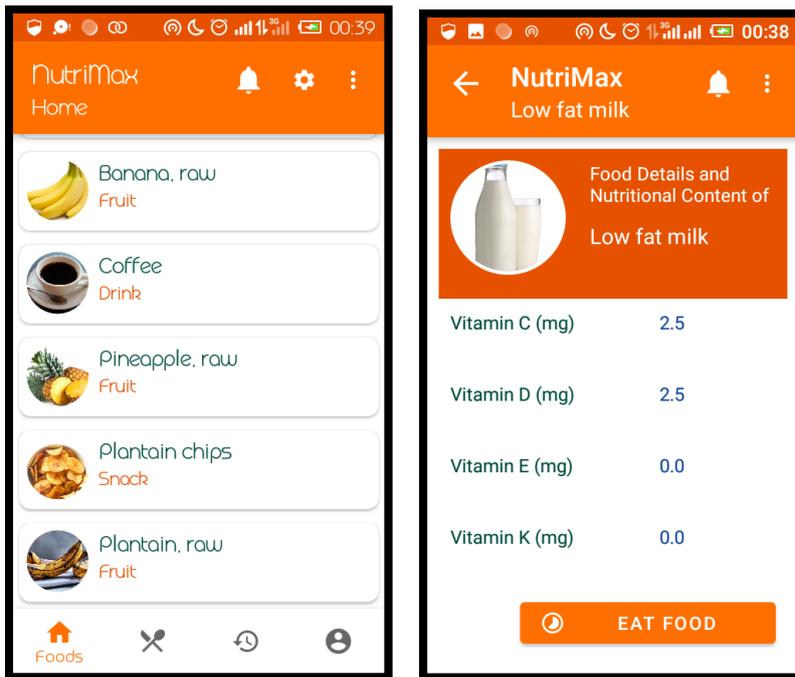


Figure 7: Foods Fragment and Food details Activity.

*Deficiencies Fragment*

This invokes a method that generates a meal that contains the nutrients needed to remedy specified deficiencies or sickness.

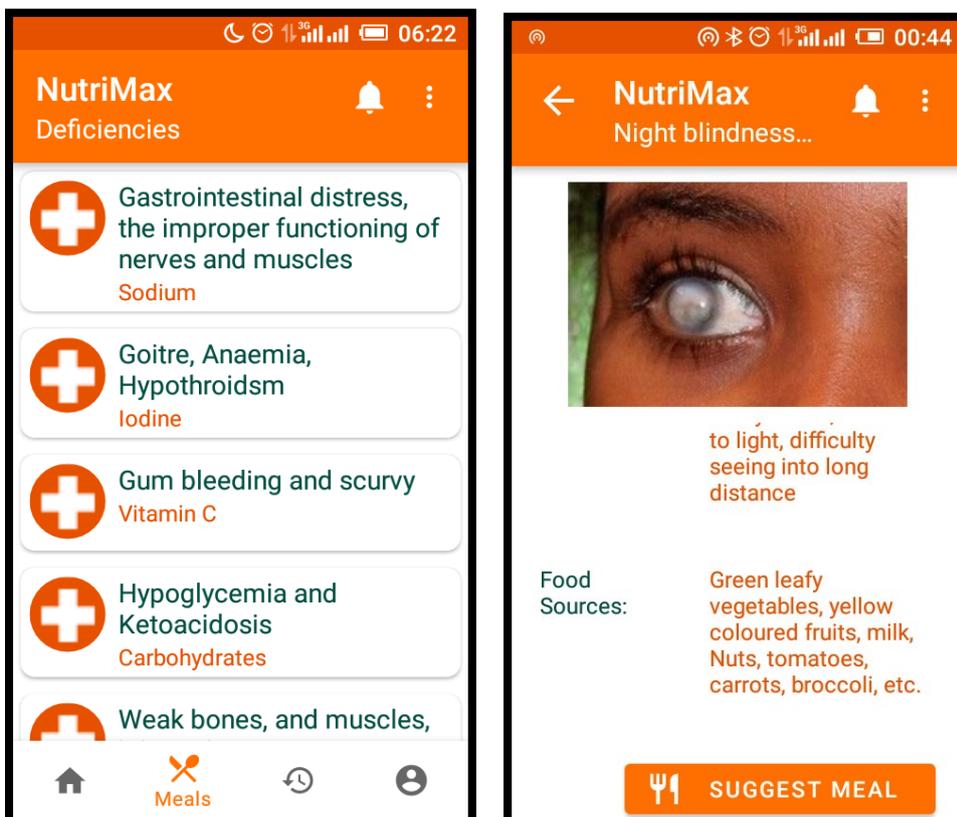


Figure 8: Deficiency Details and Suggested Meals.

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### History fragment

The history fragment consists of a bar chart and pie chart that displays the statistical distribution of the user's diet history. Records of food history can be bulky if accumulated over a period of time. This is for easy graphical interpretation of diet records by the user.



Figure 9: Diet History fragment.

### Profile Fragment

The profile fragment enables users to update their bio-data which facilitates the application's decision making in selecting the right diets that suits a specific individual. The user can optionally add their picture as part of the profile update.

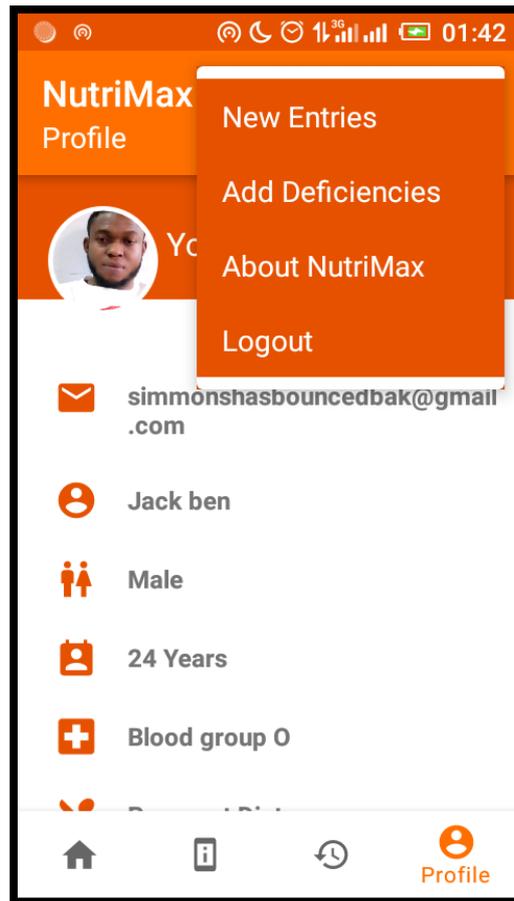


Figure 10: The User Profile Fragment

#### *Database store*

No-SQL databases store data were used instead of relational database tables which only allow access to data when the programming language issues requests and receives the data in JavaScript Object Notation (JSON) format as opposed to the Structured Query Language (SQL) used by relational database management systems. In this research Google's real-time database called Firebase was used to store data, which is why persistent internet access is needed to use the application.

#### **Conclusion and Recommendation**

The NutriMax application was successfully developed, thereby making it possible to obtain information about Nigerian foods that can help in managing malnutrition personally by The system also facilitates the familiarity of the users with the various Nigerian foods and their role against nutrient deficiency diseases. In addition, NutriMax compares well with existing food guide nutrition software as it works on the Android platform.

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