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Junior Designing Project

Dietary: a Cloud-based Nutriment & Fitness Assistant
(fact-based) Android App for Bangladeshi Youths.

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Abstract

Nowadays the mobile phone is the most serviceable device among mass people. The revolution of technology gives the sustainability of ease, automation of uses of mobile devices, and diminishes the time period of manual tasks. In the field of the operating system, Android is on thriving growth with the suitability of cloud computing, which brought larger prosperity such as application, games, and so on. Hence, this paper with an innovatively thought of a cloud-based android application named “Dietary” provides nutrition guidelines, food recommendations, and fitness instruction based on consumer’s personal details and lifestyle habits. We propose a machine learning approach for food recommendation. Its recommended food meets the calorie needs of consumers using the K-Nearest Neighbour (KNN) algorithm which will be working as a real-life nutritionist. Also going to implement chatbot API for user guidelines and basic questions and answers for nutrition and fitness related facts using natural language processing (NLP) framework. The eventual aim of this research project is to exhort the young generation to consume food with nutriment and maintenance fitness to lead a healthier life.

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Chapter 1: Introduction

In this section, we are going to discuss Cloud-based Systems, Android Application, Nutrition, Fitness, Bangladeshi people in case of health and fitness maintenance and why people need this app.

1.1 Cloud-based System

Cloud computing is an application-based software infrastructure which is able to store data on remote servers. Through the internet those data can be accessed.[4] It simply means that any application deployed in a cloud environment except hosting on a local machine. It refers to various features like resources polling, on demand self service, easy maintenance, large network access, availability, automatic system, security, measured service and so on. Cloud services proved itself as a helping hand for both hosts and consumers. So the popularity of cloud based systems is rising rapidly.[9]

1.2 Android Application

We choose the android Operating system to develop our application. Android is one of the most demanded OS comparatively other OS. Android phones make it easy for company phone manufacturers because of the open-source nature. In the Android OS platform, the code is free for all and can be applied to anyone to their project.[5] This constructs the market for Android devices the largest in the world. “According to statistics, more than 80% of smartphones produced in the world run on Android”. These statistics make a huge local business for android developers and make profitable. Word wide android has a huge market place.[22] Android is also the best-selling OS worldwide. In Bangladesh, Android OS is also very

popular. Accessibility is another reason for choosing the Android Operating system. Any programmer can develop android because it's easy to learn also who has knowledge about java and Android SDK tools. This Android Software Development Kit (SDK) tool is free and anyone can use it quite easily. So, We develop our app in Android Studio.

1.3 Machine Learning

ML is a thing that a computer understands first and adds completely updated data and not any help from humans. It's an emphasis on the improvement of computer programs that can enter data and use it to pursue themselves. It is a way that has ability to learn automatically and extend your ability with no need to programmed. ML is a algo which is compute program and understand the information, it is directly from data and it's not need any depend on formula for a model. These are types of machine learning.

1. Supervised learning
2. Unsupervised learning
3. Reinforcement learning

Now Machine learning is used everywhere. For example, it is used in “speech recognition, medical diagnosis, statistical arbitrage, recommendation, prediction, extraction”, etc. Nowadays, Machine learning is popular because computation is plenty and accessible. [19]

1.4 Chatbot

A chatbot is a software which is part of AI and NL processing to learn what is needed for humans and how they maintain them for better output with a little work.

Kind of a virtual assistant for your viewer. Nowadays, We human need fast work and this work should be perfect. This can be done with technology. That's why nowadays an AI based chatbot is on higher demand and more popular because the recipient wants to know their demanded information any time through the chatbot. [20]

1.5 Nutrition

Good nutrition has a straight influence on our overall health and quality of life. When we follow a healthy diet that builds off all the nutrients our body needs as a proper amount of carbohydrates, protein, vitamins, minerals, and fats. We aren't just satisfying our hunger, we're nutritive about our body too. We all know that good food choices are essential for a healthy body and mind.

Some reasons why nutrition is significant:

1. REDUCING THE CHANCE OF DEVELOPING VARIOUS DISEASES:

Following attribute eating habits can reduce our jeopardy of developing certain diseases that could sharply impact our health.

2. A HEALTHY WEIGHT:

Eating natural food in lieu of processed foods can have a positive outcome on our weight.

3. INCREASES ENERGY LEVELS:

Normally junk foods make our body weak internally where a healthy diet which consists of proper nutrients will increase our energy levels.

4. BOOSTING SYSTEM FOR IMMUNE:

When we try to lead a good healthy nutrition life ,we are always trying to take natural and all kinds of healthy foods that help our body to gain energy.This includes improving our immune system.

So in our app there will be a nutrition guideline feature. It helps to calculate BMI(Body Mass Index). He or she will know whether he or she is overweight or not. Then it gives a proper diet plan accordingly to BMI.[6]

1.6 Fitness

We all know that “Health is wealth”. So it’s a vital fact of our life. Without good health, you will not be able to concentrate on anything.

Health is wealth, without it our life will be miserable. People who are sick in different types of disease their life is very hopeless, frustrating and no joyful also they are not punctual in any activities.Those who has good health and perfect body their life is so joyful and they are punctual in any activities.Good health is a key for a successful life. Only Healthy citizens of people in any country can lead a cheerful life.

So In our app we create Fitness guideline Features, where we will develop yoga exercise with a time counter, full body workout weekly plan with proper instructions. [6]

1.7 Bangladeshi People

Nowadays Most of the people of Bangladesh do not care about their fitness and a healthy lifestyle. Most of them are careless about physical fitness and a healthy food habit. This behaviour causes life-threatening situations like obesity, heart disease, high blood pressure, and sometimes cancer like disease. We are going to make a nutrition & fitness guideline providing an android application which will be user friendly. We are also focusing on user practical situations. If we daily exercise it will improve our body condition as well as our mind too.

1.7.1 Bangladeshi Youth

Our main target is youth generations of Bangladesh because, nowadays most of the young people are leading an unhealthy lifestyle and a tight busy scheduled life which makes them so inactive on the purpose of healthy life. In our system we will provide proper guidelines for a youth to maintain a good healthy lifestyle. Our main focus is on fitness and nutrition. On the nutrition side we will provide a proper diet plan according to their current body condition based on their BMI. On the fitness side we will provide a proper workout plan based on their regular activity. A user also can get the solutions of nutrition related questions by sending messages through chatbot also.

Chapter 2: Literature Review

We study different articles which are related to our project. Some articles are very common with our project. We choose two article papers which take some idea from there for our project.

2.1 Literature Explanation

A study has been done in [2] Robert A. Sowah et al. to design a fitness System which is called design and Development of Diabetes Management System Using Machine Learning. They developed their project with genetic algo where meal number can select and fitness part can calculate by using in calories meals and calories needed for any user. They were satisfied that their project was a very good one because it is an excellent solution for diabetics patients.

Fico et al. [7] give an idea that will construct three parts like exercise ,meals and user's data. It synchronizes them with this item and sends a reminder note to the user. This is the way the system made a relationship with them. System will advise time for exercise, some information about sugar level and food habits.it will not give any advantages of visual interface with a chatbox.

Alotaibi et al. [8] work on this project by using PHP and MYSQL for web version and he also use C for iPhone also use JAVA for android mobile application. System also updated their SMS system to remind patient and AI system that will determine their health condition by using Fuzzy logic. This system also made a well relation with doctor and patient. Doctor will get update of patient. But tracking system does not included in system because monitoring patient activity is very tough for managing patient health.

Phanich et al. use algorithms and maps for grouping foods on a list that is based on their fitness and nutrition topics. They divide food in three ways: limited food, normal food and must avoided food. This system will not give any suggestions for food, it will give advice on healthy food instead of avoidable food. It also gives patients good advice not to take any food which is not good for the patient, for this reason it will not take data from the user. There are disadvantages also different body type people need different charts for their body, their exercise, food suggestions will not be the same for everyone. If weight, height, minimum calories needed for a patient is not implemented in the system, then it will make server issues for patients.

Gu et al. represent an alternative smartphone based system which will monitor glucose blood. Also there is a system that will automatically measure all activity of patients by using smartphone sensors. After examining 112 users they declared that their system accuracy level is 82.14%. There is a lackings in chatbot where patient and doctor can question and give answers to those questions for the patient.

Mokdara et al. presented a system where recommendations system will be there. They will suggest recipes which can be matched with the patient food type or it will be a user's searching dishes, but limitation is there is an issue with chatbot.

Bianchini et al. presented a system that will give a user a healthy menu by taking user's data from account, it can be a patient's personal preference or can be their medical prescriptions. This prescriptions justify user's information which is good for them and which is not, but there is a lackings about Q&A chatbot which give exact education to patient and also a reminder notification on their phone.

In another work Xie et al. work on a mobile base system which can Q&A and also give a warning called DiaAID, which is helping diabetes patients and high risk patients. This system works in a three different way, one is large scale multi language, another is multi fusion framework, one more way is health data process system, but lackings is notification on system on phone, meal suggestion also food synchronization capacities.

After total analysis from these group works we saw some organised shortcomings. Firstly they did not focus on the user's searching meal, there is no health education technology for their patient and also there is no reminder notification on the system which is a must needed scenario in any fitness management system. Even if consider the searching system for food the patient there is no food sustaining capacity which is base on online computer version with helping hand system not offered. Also lack of nutrition concept other system models not enough for this system. This management system app gives some general news search also they ignore a big thing which is counseling their patient also offer medicine, question and answer chatbot in phone apps with data storing. It will be very tough to manage this type of system to manage their patient's health condition.

Chapter 3: Methodology

This chapter provides an overview of the different segments of this project work. It mainly contains the theories, all techniques, and breakdown workflow of this project.

3.1 System Overview

Here is the system overview of this project.

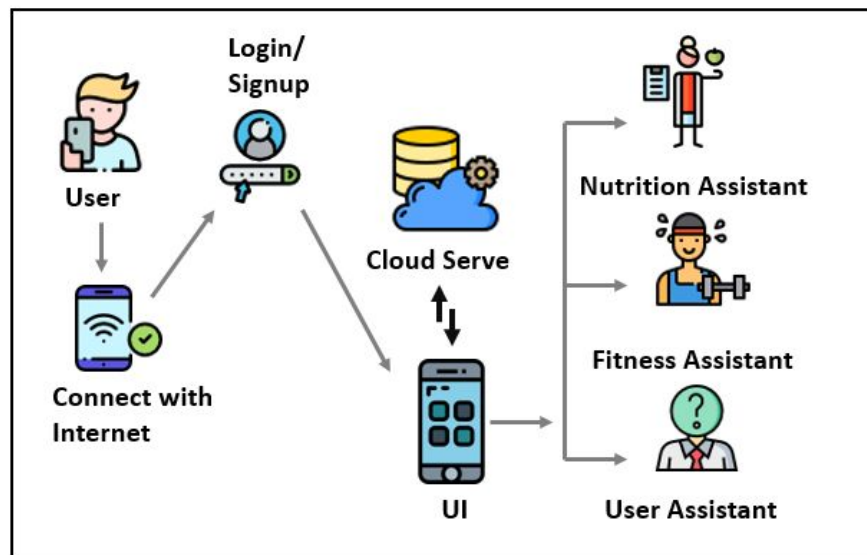


Figure 1: Overall system diagram of the proposed application

This diagram shows the overall system overview. For authentication, the user must need to connect with the internet. After authentication users can experience cloud services like store and retrieve data and also be able to see three virtual Nutrition, Fitness, and User Assistant in User Interface. Health state, food plan based on requirement and nutrition guideline provided by Nutrition Assistant. Fitness Assistant provides users a real lifestyle based workout plan, details and maintaining facilities. As User Assistant there is a Chatbot for timely and efficient

assistant to assist users 24/7 for not only helping in operating the application but also users queries about health and fitness related basis questions.

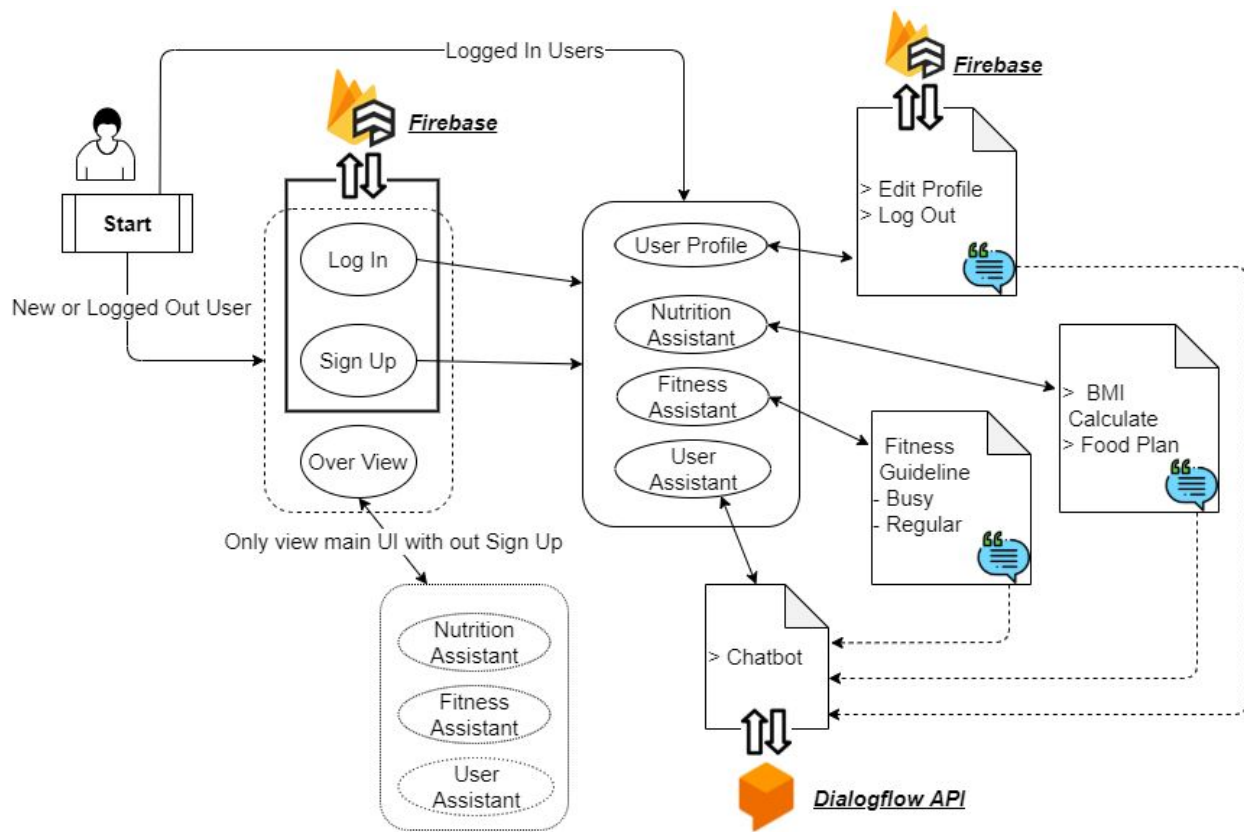


Figure 2: System architecture of the proposed application

This system architecture shows that a new or logged out user when starting this application can see an option based User Interface or activity. Registered users can go to the main application UI after login. Newly users are able to check this application click on Over View option, it shows an non functional prototype of the actual application. After registration/ signup users connect with firebase and enable cloud services provided by this application. Logged In user straight go to the main UI. This app maintains logged in state without logout. Main UI is split into four parts. In User Profile activity, users can create profiles and also store or retrieve data. There is also a logout option inside User Profile activity. Core functionality

of this app Nutrition Assistant, Fitness Assistant and User Assistant also appeared on main UI or activity. Dialogflow API is integrated with User Assistant and holds a link with the overall app to provide Chatbot facility.

3.1.1 Nutrition Assistant

The first option is to calculate the BMI with the following input information like height & weight and provide BMI [1] with a physical state like normal, overweight, underweight as output. So users are able to determine his or her physical state.

$$BMI = \frac{Weight(Kg)}{Height^2(m^2)} \dots\dots\dots(1)$$

Body mass index (BMI) will be calculated using this formula.

Another option of Nutrition Assistant is Food planner or Food recommender will be trained with Machine Learning approach with help of KNN Classifier for food recommendation. [2] Using information like gender, age,height, weight, BMR and calorie per day as input it will make recommendations of food.

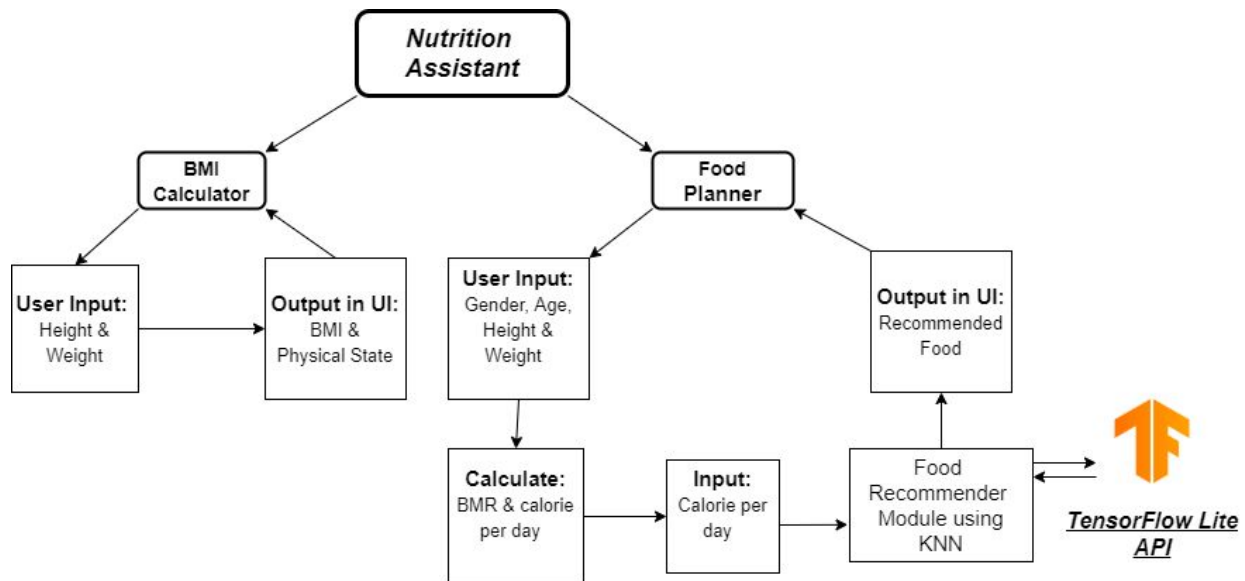


Figure 3: Block diagram of the proposed Nutrition Assistant

Using Harris-Benedict Equation first to calculate the BMR from users gender, age, height and weight. [10]

- **Men BMR** = $66.4730 + (13.7516 \times \text{weight in kg}) + (5.0033 \times \text{height in cm}) - (6.7550 \times \text{age in years})$ (2)
- **Women BMR** = $655.0955 + (9.5634 \times \text{weight in kg}) + (1.8496 \times \text{height in cm}) - (4.6756 \times \text{age in years})$ (3)

The Original Harris-Benedict Equation

This BMR is needed to calculate kilocalories per day from the table below :

Exercise level	Daily Calories Required (Kcal/day)
Little to no exercise	Daily kilocalories needed = BMR x 1.2
Light exercise (1–3 days per week)	Daily kilocalories needed = BMR x 1.375
Moderate exercise (3–5 days per week)	Daily kilocalories needed = BMR x 1.55
Heavy exercise (6–7 days per week)	Daily kilocalories needed = BMR x 1.725
Very heavy exercise (twice per day, extra heavy workouts)	Daily kilocalories needed = BMR x 1.9

Providing daily kilocalories as input of food recommender model will obtain recommended food as output in users UI. It will also provide multiple food recommendations to help users find out his or her appropriate food choices according to his or her tests and also with proper calories. For expected implementation, need TensorFlow 2.0 (Keras API) with a trained dataset. [11]

3.1.2 Fitness Assistant

Fitness Assistant will provide fitness training guidelines based on the user's lifestyles.

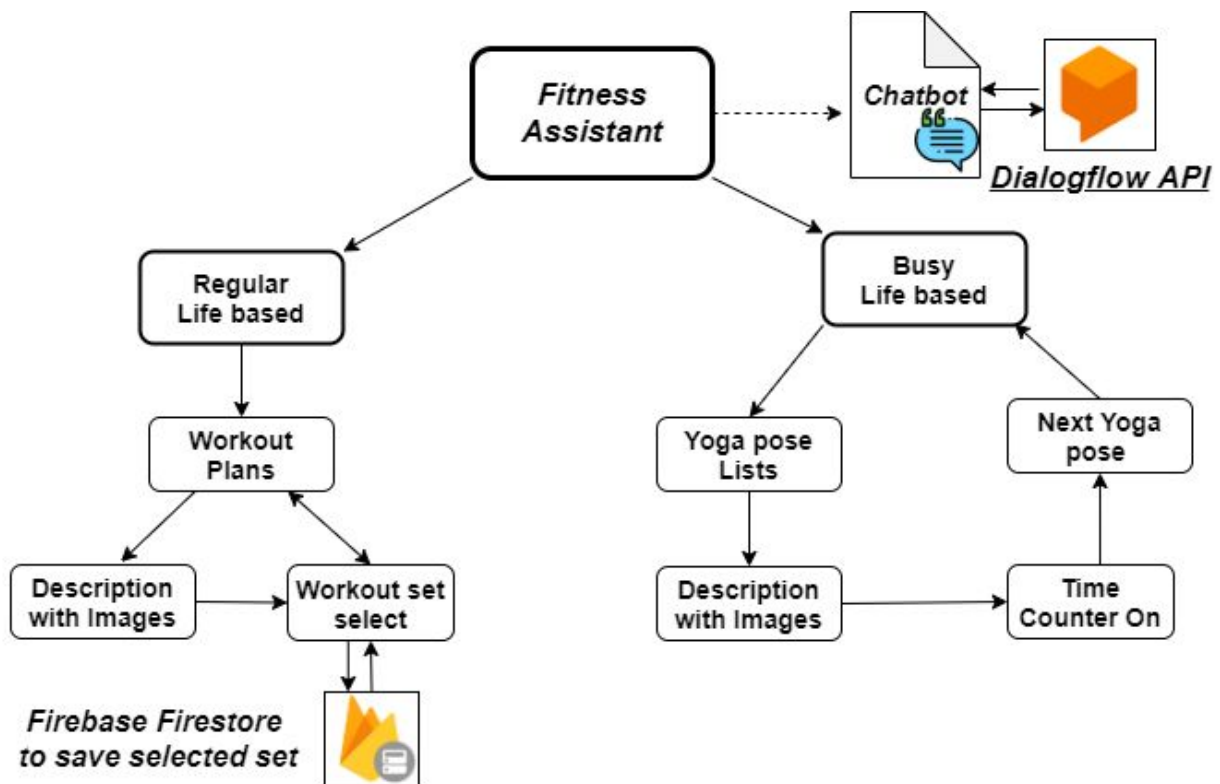


Figure 4: Block diagram of the proposed Fitness Assistant

First, it will provide two modes like Regular Life and Busy life. According to this mode, the user can select his or her appropriate exercise plan with detailed guidance like a description with images and a set routine and save this workout set routine in Firebase Firestore. A proper workout guideline for those users who have regular life. This exercise set routine is especially customized for our country's people and their physical fitness strength.

For busy life users this app has guided simple and efficient guided Yoga. Users also experience a time counter during Yoga session. When given for one Yoga pose session will be done, it automatically goes to the next Yoga pose session. Users also can terminate the process without completing the full Yoga session.

This Fitness Assistant has a link with our User Assistant (Chatbot) for getting help to figure out what to do or not or Q/A for any confusion like a virtual Fitness assistant or coach.

3.1.3 User Assistant

As a User Assistant consumer, get a Chatbot. It is able to provide useful guidelines to operate this entire application and also provides answers for questions asked by users like nutrition and fitness related queries. This Chatbot connected with every functional unit of this application to make it more user friendly, efficient and dynamic.

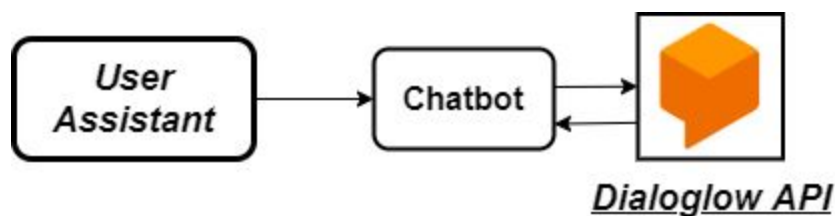


Figure 5: Block diagram of the proposed User Assistant

We used a NLP framework like Dialogflow for our chatbot. Created an agent in Dialogflow console, for integration used created agent's V2 of the API with beta features. Dialogflow agent responds with intent matching. It also acts with action and parameters. This response is defined for the intent. A message will be sent by it and the process will continue until the conversation stops.

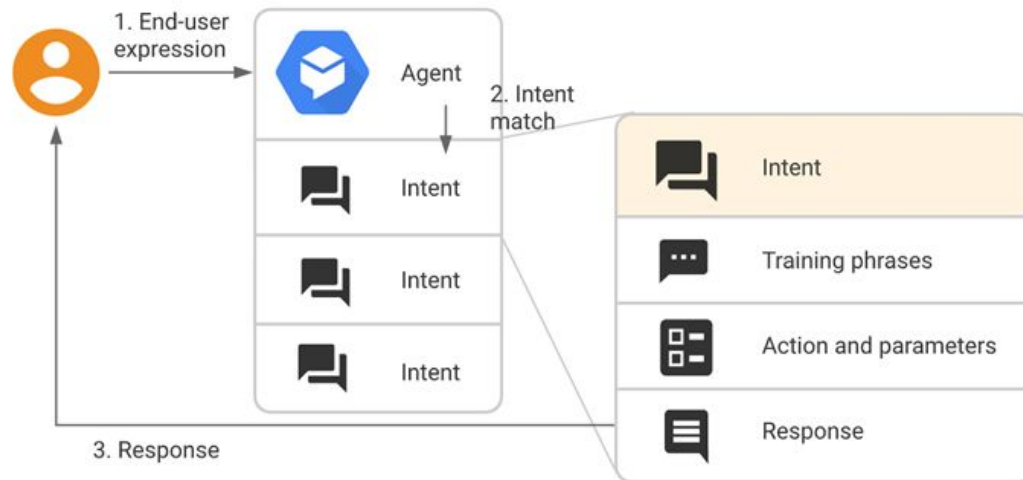


Figure 6: Dialogflow work workflow diagram for intent matching

Using intent classification Dialogflow compare end users expression to the predefined training phrases for each intent to find the best match. [21]

3.2 Cloud Service

This application provides cloud services like authentication, store data, retriever data and data security.



Figure 8: Cloud Firestore work flow diagram

We used Firebase Firestore as our cloud storage service and performed authentication. It caches data from the app which it is actively using. That's why in offline mode this app is able to read, write and query data also. Cloud Firestore synchronizes with all local changes with Cloud Firestore when the device is on online mode.

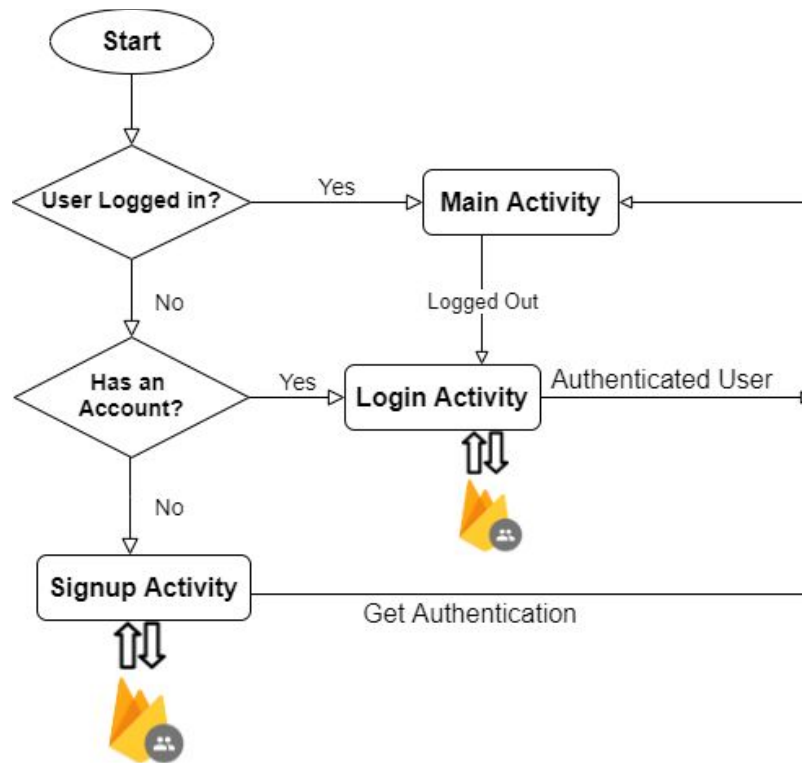


Figure 8: Flowchart of proposed Application using firebase

In this flowchart we can observe first it's asked for login if not then asked for signup. After signup users connect with Firebase Firestore and store authentication related data. Those data are fetched from the Firestore during login. This system only allows authenticated users to experience the main application along with cloud service. It keeps the user logged in state without logout.

3.3 Dataset

Dataset collected from "The USDA National Nutrient Database for Standard Reference (SR). It is the major source of food composition data in the United States and provides the foundation for most food composition databases in the

public and private sectors. This dataset contains data on 8,789 food items and up to 150 food components.” [17]

3.4 Dataset Preprocessing

This dataset contains **41 features**. [like food groups(breakfast, snacks, baby food, lunch etc), their description, and how much kilocalories, carbs, proteins, fats, vitamins, etc.]

We are working on **3 Features**. [like **food group, description & energy in k/cal.**]

Split Data :

- for training 80 %
- for testing 20%

Merge Data :

- Breakfast = 200 data
- Lunch = 200 data
- Snacks = 200 data
- Dinner = 200 data

3.5 Machine Learning Model

The K-Nearest Neighbour (KNN) algorithm is a basic classification algorithm in machine learning.

$$d(x, y) = \sqrt{\sum_{i=1}^n (x_i - y_i)^2} \dots\dots\dots(4)$$

It's considered under supervised learning. It follows the most straightforward classification techniques with similar features. First it trains the dataset and stores all the new cases. We will be going to use a data classification technique using this algorithm. This project is in development mode so we start with this KNN classifier and day by day we will move towards more advanced algorithms for better efficient performance.

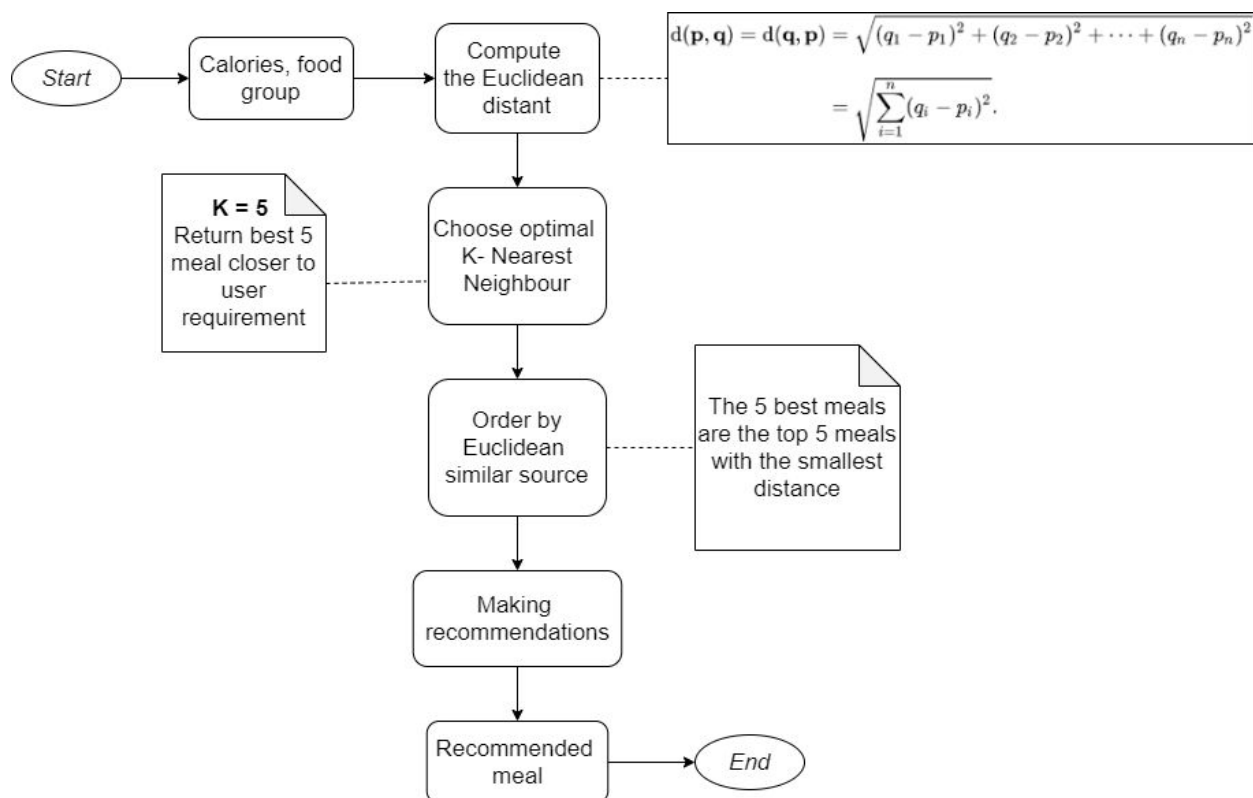


Figure 9: Flowchart for food recommendation using KNN.

The actions taken are shown in the flowchart given above in Figure 9. This flowchart represents the food recommendation system using KNN.

Chapter 4: Result

4.1 Cloud Service

We accidentally use different versions of the android studio,when we merge our code in one computer we face some error for different IDE.It's shows

Run time error :- “More than one file was found with OS independent path META-INF/DEPENDENCIES” [23]

“Error:Execution failed for task ':app:processDebugManifest”.

Possible solution : **configure build.gradle module** [22]

4.2 Main Application

This app will show some tips and guidelines for maintaining healthy fitness.First you have to login ,then it will show daily based workout and weekly based workout,there is a some tips before you start workout,then there is a time duration ,when you complete one pose then its automatically switch to another pose,you can get some help from chatbot massage .

4.3 Model train and implementation

Though it's a cse299 junior design course,machine learning is totally new for us,we will learn about this and we will work on this in future,it's need some time for this.

4.5 Chatbot implementation

For chatbot implementation we use dialoglow API. It's an user assistant service.User can write some things about this application,this chatbot will reply to user with a perfect explanation.

Chapter 5: Conclusion

5.1 Discussion

These days the mobile phone is the most convenient device. In the field of the operating system, Android is the most popular operating system. So, we choose an android operating system to create this app. We choose cloud-based, because cloud service enables remote resources, saving organizations the price of servers and other materials. In this app, there is a Nutrition Assistant which can help the user to calculate BMI and guide diet plan according to BMI. Another feature is the Fitness Assistant where users can choose exercise according to their daily life schedule. User Assistant is another important feature where users can chat through a chatbot. If the user has any queries about this app, they can ask through a chatbot. It is user assistance software that can communicate with a manual direction language via messaging. We use Machine learning algorithms for food recommendation but Machine Learning is a completely new approach, we face some difficulties while implementing so it requires more time for implementation .

5.2 Summary

In our country, most of the people are not health conscious. So, we Introduce an Android application for Nutrition & Fitness guideline, specially dedicated to Bangladeshi Youths. We provide Nutritionists and Workout coaches through virtual assistants in a single app without any cost. Users can maintain proper diet plans through this app and also can-do regular exercise. When a user inputs his height and weight, then he or she calculates his BMI and sees their result. Then we provide a diet plan through Machine learning algorithms according to BMI results. In every feature, we added a chatbot, so users can easily ask any question through the chatbot. It's a fact-based app that gives all services based on every type of user. Using a Machine Learning approach, chatbot, and cloud service (RTD) to develop a more dynamic and efficient application. Lastly, we can say that our app can help to lead a healthy life.

5.3 Future Work

In the future, we will implement a full Machine Learning based app along with food recommendations. We add the Voicebot feature in the user assistant for better user support. We also add a side navigation bar UI for better user experiences. Another feature is Regular notification “Today's Workout Plan” also added in the future.

Appendix

Previous Works

We search some apps mainly native applications in play stores which have almost more than 100K downloads and 4.2+ rating, they are almost similar to our app and most of them are static apps. We find some similarities to our app containing tips like health, nutrition, home remedies, Food recipes, Vitamin sources, Contain BMI, BMR and diet calculator, Calorie chart, Diet Guideline. There is another app “Health Diet Foods Fitness Help[12]” “ক্যালরি ও ডায়েট[13]” “ব্যায়াম - physical exercise[15]” “Health and Nutrition[12]” which features similar to our app like Food recipes, Full of tips like weight gain and loss, home remedies, workout details, Fitness tips, Workout related basic information.

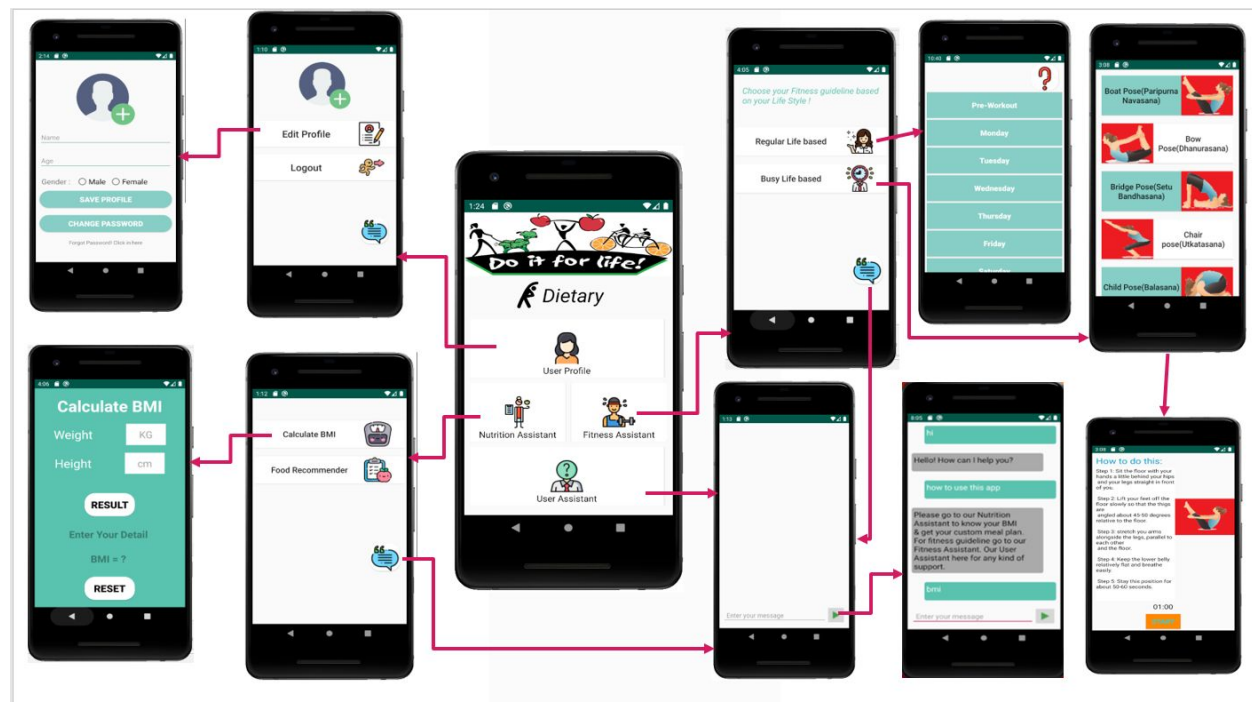
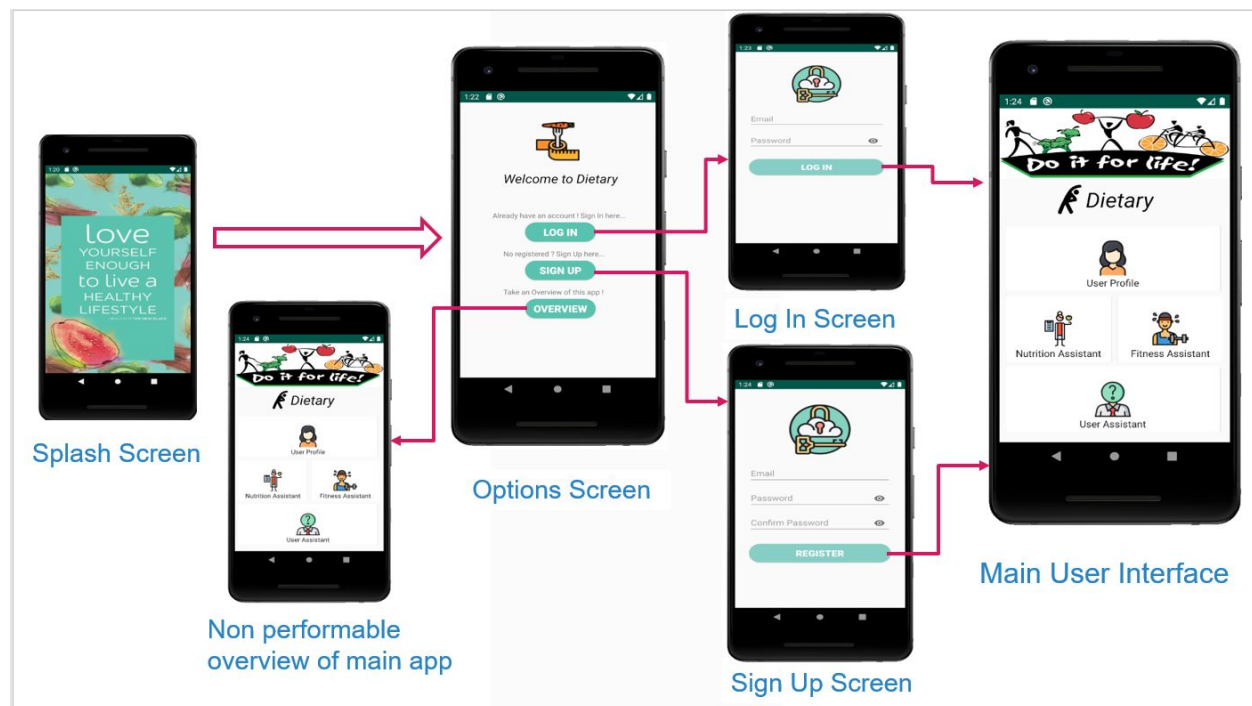
We saw something different from our app, Majority of them are from nutrition guideline apps, then Nutrition and fitness not in a single app, most of them are static apps, also not mention guideline or tips sources. So we decided to build a single app which has both “Nutrition and fitness” sections. Also following valid sources for resources and customize options for all variations of users.

Market Research

Stat counter global stats research shows that almost 77.8% people in bangladesh using android and only 1.49% people using iOS. [16] Another Google trends research shows that android 2019 it was 75% but in 2020 it was hit almost 97% but for iOS it's the same like 6/7%. [18]

Our observation is that there is a huge user base for android, Most of the people in the community use android phones, so there is a huge market for android developers.

Screenshots of Application



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End
