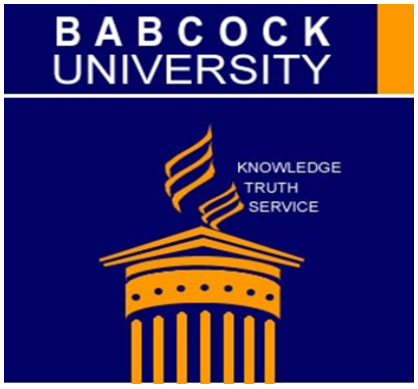

DESIGN AND IMPLEMENTATION OF A DIET SYSTEM FOR DIABETIC PATIENTS

BY:

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A PROJECT WORK

SUBMITTED TO THE DEPARTMENT OF COMPUTING AND ENGINEERING SCIENCES , BABCOCK UNIVERSITY, ILISHAN-REMO, OGUN STATE, NIGERIA. IN PARTIAL

FULFILLMENT OF THE REQUIREMENTS

FOR THE AWARD OF BACHELOR OF SCIENCE (B.Sc.) DEGREE IN COMPUTER SCIENCE (COMPUTER SCIENCE)

SUPERVISED BY:

DR F.KUYORO

DECLARATION

We declare that the project work, ‘Design and Implementation of a Diet System for Diabetic Patients’ was carried out by the following people:

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CERTIFICATION

This certification page is to certify that this project was carried out by the following students under my supervision in the Department of Computer Science, Babcock University, Ilishan-Remo, Ogun State, Nigeria.

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EXTERNAL EXAMINER DATE

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CHAPTER ONE

1.1 BACKGROUND TO THE STUDY.

The use of ICT has rapidly improved in all sectors of healthcare, improving previous manual processes, and making it easy for health practitioners in their respective fields of study. There are smart systems that predict diabetes and help in the management of diabetes. A major management factor is having a healthy diet. Dietetics can be defined as the science of applying nutritional principles to the preparation of food and regulation of diet in relation to both health and diseases. Planning therapeutic or special diets tend to be more stressful compared to regular or normal diets. Ojofeitimi and Fakunle (2021) *Nutrition and Dietetics: A Guide For Professionals*. Diabetic diet refers to the diet recommended for patients diagnosed with diabetes mellitus (a condition where the body does not produce enough insulin needed in metabolism.) Management of diabetes includes the use of an exchange list because foods are grouped according to type, nutrients, and calories and patients are allowed a certain number of items from each exchange list according to individual needs. Diabetes (also known as diabetes mellitus) is a group of metabolic diseases, each characterised by chronic high blood glucose (hyperglycaemia) and disturbance in the metabolism of carbohydrates, protein and fats. Ojofeitimi and Fakunle (2021) *Nutrition and Dietetics: A Guide For Professionals.* According to WHO (2021), hyperglycemia also called raised blood glucose or raised blood sugar is caused by either defects in insulin production or insensitivity to insulin or both.

1.2 STATEMENT OF THE PROBLEM.

Dieticians based on their discipline perform quite a number of functions, which can be energy sapping, and creating diets for different patients everyday can be exhausting. Design of a diet plan system for diabetics with diabetes mellitus, will help reduce the workload of dieticians. The problem facing the current system is that it is manually calculated and planned by dieticians which can be tasking for an average human. This overwhelming job can lead to mistakes on the part of the dietician in coming up with a diet plan for patients with diabetes which can lead to a worsening of the health status of such individual, therefore there is a need to design a software to function as a bridge between the dietician and diabetic patients, also patients information can be lost since it is manually stored, therefore the proposed system will be able to store user's information. Hence, this study focuses on a diet system for diabetic patients.

1.3 AIM AND OBJECTIVES OF THE STUDY.

The aim of this project is to create a diet plan system for diabetic patients. The specific objectives are to:

I. collect information of diabetic patients in a database .

II. develop a diet application that plans a diet accurately for patients with diabetic mellitus.

1.4 METHODOLOGY OVERVIEW.

In achieving the specific objectives of this study, an automated diet plan system will be implemented. This system will take in patients records such as weight, height, age, type of diabetes, contact number, email address and other essential information and store them in the database. Values used in calculating the Basal Metabolic Rate (BMR), the range for different activity levels, the total percentage of carbohydrate, fat, protein, vitamins, and water intake would also be stored in the database. This application will be able to calculate the daily calorie with (BMR) using the Harris Benedict formula, the system will calculate calorie and kilo-calories, convert each kilo-calorie for each micro molecules to grams, use the food composition table and calculate the protein, carbohydrate, and fat value using the already calculated gram, after the system would be able to create a balanced diet meal.

The system will be developed and designed using the agile SDLC model, Python, Django, HTML, CSS, JavaScript, and MySQL.

1.5 SCOPE OF STUDY.

This study is focused on the design and implementation of a diet plan system for patients with the three main types of diabetes mellitus, Type1, Type2 and Gestational. The department of Nutrition and Dietetics in Benjamin Carson Senior College of Health and Medical Sciences, Babcock University Illisan-Remo, Ogun State, Nigeria, will provide data of diabetic patients for this study. This system would be used by diabetic patients to plan their daily meals with the aim of managing their blood-sugar level and by dieticians to provide professional help if needed.

1.6 SIGNIFICANCE OF THE STUDY

This study would be of better benefit to both the dieticians and patients than the existing system in place which is manually oriented. This is as a result of a system that calculates the BMR using patients BMI record and grants patients the ability to select food from the food exchange list also calculating each gram of carbohydrate, fat, and protein in the food, using the patient's BMR. The system will calculate a well rationalised meal from selected foods. It will also have a proper database that has an effective and efficient way to store and manage the records of patients, store information on food lists of local foods in Nigeria and their composition and grams. The application would be easy to use by the patients at any time. It will provide a recommendation system that will recommend meals to the user, and also a means for users to reach out to dieticians using the provided emails.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, a review of literature on the diet plan system is presented, focusing on its benefits to diabetic patients and dieticians, as well as its various applications. The challenges encountered by users of the platform are also highlighted. The study emphasises the importance of an automated diet system for people with diabetes and for dieticians. Dieticians, who are medical practitioners with a recognized qualification in Nutrition and Dietetics, plan and oversee the preparation of diets, both therapeutic and regular, for individuals or groups in various settings such as hospitals, institutions and other establishments. They provide instructions on the selection and proper preparation of food according to dietetic principles and may also be responsible for food purchasing on behalf of an organisation.

2.2 HISTORY OF DIABETES MELLITUS

The first recorded mention of diabetes symptoms dates back to ancient Egypt, where physicians noted excessive urination and named the condition "water taker." In the following centuries, many medical scholars studied diabetes and attempted to understand its causes and treatments. In 1921, the Canadian scientists Frederick Banting and Charles Best discovered insulin, a hormone that regulates blood sugar levels, and began using it to treat patients with type 1 diabetes.

In the decades that followed, researchers made significant progress in understanding the underlying mechanisms of diabetes and developing new treatments. The 1950s saw the introduction of oral medications to lower blood sugar levels, while the 1980s saw the development of synthetic insulins that could be more easily produced in large quantities. In recent years, advances in technology have led to the development of continuous glucose monitoring devices and insulin pumps that provide more precise control over blood sugar levels.

Despite these advances, diabetes remains a significant public health concern. In 2019, the International Diabetes Federation estimated that over 463 million adults worldwide were living with diabetes, and the condition was responsible for 4.2 million deaths. However, ongoing research into the causes and treatments of diabetes continues to offer hope for better outcomes for those living with the condition.

2.3 TYPES OF DIABETES MELLITUS

There are three main types of diabetes mellitus namely: Type 1, Type 2 and Gestational.

2.3.1 TYPE 1 DIABETES

Type 1 diabetes is a condition that can occur at any age, but is more common in children and adolescents. Individuals with this type of diabetes have low insulin levels, and need to receive insulin injections regularly to control their blood sugar levels. The reason for this condition is an autoimmune response where the body's immune system attacks the insulin-producing cells. The specific causes of this condition are still unknown, but are believed to be a combination of genetic and environmental factors. Although anyone can develop type 1 diabetes, it is most

commonly found in young adults and children. Insulin injections are necessary to prevent death. Family history, environmental factors, and exposure to certain viruses have been linked to an increased risk of developing type 1 diabetes .This type of diabetes is an autoimmune disease that occurs when the immune system attacks and destroys the insulin-producing cells in the pancreas. People with type 1 diabetes require insulin injections or an insulin pump to control their blood glucose levels.

A. SYMPTOMS OF TYPE 1 DIABETES

The most common symptoms of type 1 diabetes include:

i. Abnormal thirst and dry mouth

ii. Sudden weight loss

iii. Frequent urination

iv. Lack of energy, fatigue

v. Constant hunger

vi. Blurred vision

vii. Irritability

viii. Slow healing of wounds and sores

In some cases, individuals may also experience nausea and vomiting, as well as a fruity odour on their breath. These symptoms can develop quickly, often over the course of a few weeks, and can be severe enough to require medical attention. Diagnosing type 1 diabetes can be difficult so additional tests may be required to confirm a diagnosis.

B. MANAGEMENT OF TYPE 1 DIABETES

The management of type 1 diabetes involves several strategies, including insulin therapy, blood glucose monitoring, physical activity, healthy eating, and education.

Insulin therapy is the primary treatment for type 1 diabetes. People with type 1 diabetes need to inject insulin multiple times a day to keep their blood glucose levels within target range. There are several types of insulin available, including rapid-acting, short-acting, intermediate-acting, and long-acting. The type of insulin and the number of injections needed will depend on individual needs.

Blood glucose monitoring is also an essential part of managing type 1 diabetes. People with type 1 diabetes need to check their blood glucose levels regularly to adjust insulin doses and manage their diabetes effectively. Several types of glucose monitoring devices are available, including glucose meters and continuous glucose monitoring systems.

Physical activity is also important in managing type 1 diabetes. Regular exercise can help improve insulin sensitivity and lower blood glucose levels. However, physical activity can also increase the risk of hypoglycaemia, so careful management of insulin doses and blood glucose levels is necessary.

Healthy eating is also crucial in managing type 1 diabetes. A balanced diet that includes a variety of foods can help regulate blood glucose levels and maintain overall health. People with type 1 diabetes need to monitor carbohydrate intake and adjust insulin doses accordingly.

Education and support are also essential in managing type 1 diabetes. People with type 1 diabetes need to learn about their condition and how to manage it effectively. They also need to have access to support and resources to help them cope with the challenges of living with diabetes. Diabetes education programs, support groups, and online resources can provide valuable information and support for people with type 1 diabetes.

C. TYPES OF INSULIN

i. Rapid-acting: usually taken just before or with a meal. These insulins act very quickly to limit the rise in blood sugar, which follows eating. It is essential to avoid over-dosage to minimise the risk of low blood sugar (hypoglycemia). .

ii. Short-acting: usually taken before meals. These insulins are also called regular or neutral insulins. They do not act as quickly as rapid-acting insulins and therefore may be more appropriate in certain people.

iii. Intermediate-acting: often taken together with a short-acting insulin. Intermediate-acting insulins start to act within the first hour of injecting, followed by a period of peak activity lasting up to 7 hours.

iv. Long-acting: insulins that are steadily released and can last in the body for up to 24 hours. They are commonly taken in the morning or in the evening, before going to bed.

Two common insulin treatment plans include:

a. Twice-daily insulin: using both short-acting and intermediate-acting insulin.

b. Basal bolus regimen: short-acting insulin taken with main meals (usually three times a day) and intermediate-acting insulin given once or twice daily (evening or morning and evening).

D. SELF-MONITORING

i. People with diabetes who require insulin need to check their blood glucose levels regularly to inform insulin dosage. Self-monitoring of blood glucose (SBMG) is the name given to the process of blood glucose testing by people with diabetes at home, school, work or elsewhere. SMBG helps people with diabetes and their healthcare providers understand how their blood glucose levels vary during the day so that their treatment can be adjusted accordingly. People with type 1 diabetes are usually advised to measure their blood glucose level at least four times a day.

ii. Healthy nutrition: Healthy nutrition — knowing what and when to eat — is an important part of diabetes management as different foods affect your blood glucose levels differently. A healthy

diet for all people with diabetes includes reducing the amount of calories if you are overweight, replacing saturated fats (cream, cheese, butter) with unsaturated fats (avocado, nuts, olive and vegetable oils), eating dietary fibre (fruit, vegetables, whole grains), and avoiding tobacco use, excessive alcohol and added sugar.

iii. Physical activity: Regular physical activity is essential to help keep blood glucose levels under control. It is most effective when it includes a combination of both aerobic (jogging, swimming, cycling) exercise and resistance training, as well as reducing the amount of time spent being inactive.

E. PREVENTION OF TYPE 1 DIABETES

Despite numerous clinical trials aimed at halting the autoimmune destruction of pancreatic beta cells, there is currently no effective and safe intervention to prevent type 1 diabetes. However, some evidence suggests that being overweight and having a high growth rate in childhood may increase the risk of developing type 1 diabetes. Therefore, a healthy lifestyle that includes avoiding overeating and a sedentary lifestyle is recommended for high-risk groups such as siblings of children with type 1 diabetes. Other factors that have been implicated include not being breast-fed, being first-born, being born by caesarean section, and having an older or obese mother.

While researchers actively seek a cure for type 1 diabetes, preventing or delaying its onset in high-risk individuals, slowing down the autoimmune destruction of beta cells in those already diagnosed, and protecting those cells that are still active are likely to be more achievable goals in

the foreseeable future. However, convincing achievement of these goals has not been reported yet. Currently, several studies are being conducted using interventions such as oral insulin in individuals with markers of islet autoimmunity, trialling drugs already used in other conditions such as psoriasis to prolong beta cell life, and peptide immunotherapies to retrain killer T cells, which are closely involved in the underlying mechanism of type 1 diabetes.

2.3.2 TYPE 2 DIABETES

Type 2 diabetes is a more prevalent form of diabetes and typically develops in adults, making up approximately 90% of all cases. In this type of diabetes, the body does not utilise insulin effectively, leading to high blood sugar levels. This type of diabetes is often associated with obesity, physical inactivity, and a poor diet. A healthy lifestyle is the primary approach for managing type 2 diabetes, which includes regular physical activity and a nutritious diet. However, many people with type 2 diabetes will eventually require oral medications and/or insulin to regulate their blood glucose levels. Typically, type 2 diabetes is characterised by insulin resistance, where the body does not fully respond to insulin. If not managed well, the pancreas may become exhausted, leading to the body producing less insulin and even higher blood sugar levels. While type 2 diabetes is most commonly diagnosed in older adults, it is now becoming more common in younger adults, adolescents, and children due to factors such as sedentary lifestyles, poor diet, and rising obesity rates.

A. RISK FACTORS

Several risk factors have been associated with type 2 diabetes and include:

i. Family history of diabetes

ii. Overweight

iii. Unhealthy diet

iv. Physical inactivity

v. Increasing age

vi. High blood pressure

vii. Ethnicity

B. SYMPTOMS OF TYPE 2 DIABETES

The symptoms of type 2 diabetes are similar to those of type 1 diabetes and include:

i. Excessive thirst and dry mouth

ii. Frequent urination

iii. Lack of energy, tiredness

iv. Slow healing wounds

v. Recurrent infections in the skin

vi. Blurred vision

vii. Tingling or numbness in hands and feet.

These symptoms can be mild or absent and so people with type 2 diabetes may live several years with the condition before being diagnosed.

C. MANAGEMENT OF TYPE 2 DIABETES

The management of type 2 diabetes primarily involves a healthy lifestyle, including a balanced diet, regular physical activity, and maintaining a healthy body weight. This may be sufficient to keep blood glucose levels under control for some people. However, most people with type 2 diabetes will require medication or insulin therapy to keep their blood glucose levels in the target range.

Oral medications for type 2 diabetes include metformin, sulfonylureas, DPP-4 inhibitors, GLP-1 receptor agonists, SGLT2 inhibitors, and thiazolidinediones. These medications work by either increasing insulin production, improving insulin sensitivity, or reducing glucose absorption in the kidneys.

In some cases, insulin therapy may also be necessary to control blood glucose levels. Insulin can be injected using a syringe, pen, or pump. The type and dose of insulin will depend on individual needs and blood glucose levels.

Regular monitoring of blood glucose levels is also essential in the management of type 2 diabetes. This may involve self-monitoring at home or regular testing at a healthcare facility. Additionally, people with type 2 diabetes should receive regular check-ups to monitor their overall health and manage any complications that may arise.

D. PREVENTION OF TYPE 2 DIABETES

The development of type 2 diabetes is influenced by various factors, with lifestyle behaviours associated with urban living having the most significant impact. Research suggests that adopting healthy habits such as a balanced diet and regular physical activity can prevent a majority of cases of type 2 diabetes. A healthy diet should entail reducing calorie intake for overweight individuals, substituting saturated fats with unsaturated fats such as nuts, avocados, and vegetable oils, consuming dietary fibre from fruits, vegetables, and whole grains, and avoiding tobacco use, excessive alcohol consumption, and added sugars. To keep blood glucose levels under control, regular physical activity that combines both aerobic and resistance training is crucial, along with reducing sedentary behaviour.

2.3.3 GESTATIONAL DIABETES

Gestational diabetes (GDM) is a type of diabetes that occurs during pregnancy and can lead to complications for both the mother and child. Although GDM typically goes away after childbirth, women and their offspring affected by the condition have a higher risk of developing type 2 diabetes later in life.

Gestational diabetes is a serious health concern for pregnant women and their babies, as it can lead to high blood pressure, large birth weight babies, and obstructed labour. Roughly 50% of women with a history of GDM go on to develop type 2 diabetes within 5-10 years after giving birth.

The risk of hyperglycemia in pregnancy, or high blood glucose during pregnancy, increases with age and is most prevalent in women over the age of 45. In 2019, an estimated 223 million women (aged 20-79) worldwide were living with diabetes, and this number is projected to reach 343 million by 2045. Approximately 20 million live births (or 16%) were affected by hyperglycemia in pregnancy, with gestational diabetes accounting for around 84% of cases. In low- and middle-income countries, where access to maternal care may be limited, the vast majority of cases of hyperglycemia in pregnancy occur.

Women with diabetes in pregnancy or GDM should closely monitor and manage their blood glucose levels to reduce the risk of adverse outcomes during pregnancy, with the support of their healthcare provider.

2.4 THE NEED FOR A DIET SYSTEM FOR DIABETIC PATIENTS

In every diabetes management or care a healthy diet is always a factor. Dieticians help to calculate the right portion of food for patients suffering from diabetes or any other health issue. This system will help reduce workload for dieticians and create easy access for users to plan their daily diet and store important information like their blood sugar level.

2.5 REVIEW OF CLOSELY RELATED LITERATURE

2.5.1 FOOD RECOMMENDER SYSTEM FOR DIABETES TYPE 2 PATIENTS.

This article was written by Kariuki, E. M. (2021).

The aim of the study was to develop a food recommender system for type 2 diabetes patients to help them make better dietary choices and manage their condition.

The problem this study is designed to solve is the risk of developing complications increases with a poor diet quality and insufficient physical activity. The disease prevalence is still increasing due to the rise of obesity and unhealthy lifestyle. The study used a mixed-methods research approach that involved the development of a food recommender system using a decision tree algorithm, followed by a user study to evaluate the system's effectiveness. The user study involved 100 participants who were type 2 diabetes patients, and data were collected using a survey and semi-structured interviews.The two main components of a sufficient diabetes management are adherence to a healthy diet and regular physical activity. These lifestyle components are important for both glycaemic control and in maintaining long-term health which includes the prevention of micro and macrovascular complications. The risk of developing complications increases with a poor diet quality and insufficient physical activity. This study did not evaluate the long-term effectiveness of the food recommender system, and the sample size used in the user study was relatively small and it served as the weakness of the system. However, the results of the project found that the food recommender system was effective in improving participants' dietary choices and helping them manage their diabetes. The system was found to be

easy to use, and most participants found the recommendations provided by the system to be helpful.

2.5.2 INTELLIGENT NUTRITION DIET RECOMMENDER SYSTEM FOR DIABETIC'S PATIENTS

This article was written by Tabassum, N., Rehman, A., Hamid, M., Saleem, M., Malik, S., & Alyas, T. (2021).

The aim of the study was to design and implement an intelligent nutrition diet recommender system to help diabetic patients manage their dietary needs. The authors aimed to use machine learning techniques to personalise dietary recommendations based on patients' individual health data and preferences.

The methodology involved the development of a hybrid recommender system that combined content-based filtering and collaborative filtering. The system was designed to analyse patients' health data, such as their body mass index (BMI) and blood glucose levels, and make personalised dietary recommendations using machine learning algorithms. The system was tested on a sample of 50 diabetic patients, who provided feedback on the effectiveness of the recommendations.

One weakness of the system was the lack of real-time data collection, which meant that recommendations were based on patients historical health data rather than their current health status and did not consider users dietary habits and preferences. Additionally, the system was

limited to providing recommendations for meals, and did not account for snacks or other dietary choices that patients might make throughout the day.

The system was designed to address the problem of managing dietary needs for diabetic patients, who often struggle to maintain a healthy diet due to the complexity of managing their condition. The results of the study showed that the intelligent nutrition diet recommender system was effective in providing personalised dietary recommendations to patients, with an accuracy rate of 86%.

2.5.3 DIGITAL HEALTH TECHNOLOGY AND MOBILE DEVICES FOR THE MANAGEMENT OF DIABETES MELLITUS: STATE OF THE ART.

This article was written by Rongzi, S., Sudipa, S., & Seth, S. M. (2019).

The aim of the study was to provide an overview of the current state of digital health technology and mobile devices for the management of diabetes mellitus. The authors conducted a literature review of articles related to digital health technology and mobile devices for diabetes management.

The methodology used in the study involved a comprehensive search of electronic databases, including PubMed, Embase, and Cochrane Library. The search was conducted using specific keywords related to digital health technology and mobile devices for diabetes management. The authors screened the articles based on predefined inclusion and exclusion criteria and finally selected 67 articles for the study.

The article discussed various digital health technologies and mobile devices used for diabetes management, including blood glucose metres, continuous glucose monitoring systems, insulin pumps, and mobile applications. The authors also highlighted the potential benefits and limitations of these technologies.

The weakness of the system highlighted in the article was the lack of standardisation in digital health technologies and mobile devices for diabetes management. This lack of standardisation creates a challenge for clinicians to select appropriate technologies and devices for their patients.

The problem that the system was designed to solve was to provide an overview of the current state of digital health technology and mobile devices for diabetes management. The results of the study showed that digital health technology and mobile devices have the potential to improve diabetes management by providing real-time feedback, promoting self-management, and improving patient outcomes.

This study focused on the use of various digital health technologies and mobile devices, these technologies have the potential to improve diabetes management by analysing large amounts of data and providing personalised recommendations for patients.

2.5.4 DIETSENSOR: AUTOMATIC DIETARY INTAKE MEASUREMENT USING MOBILE 3D SCANNING SENSOR FOR DIABETIC PATIENTS

This article was written by Sepehr, M., Mukund, B., Benjamin, E. A., Igor, V. N., & Alexander, V. M. (2020).

The aim of the study was to develop a mobile-based system that can automatically measure the dietary intake of diabetic patients using a 3D scanning sensor. The objective of the study was to evaluate the accuracy of the system in measuring dietary intake.

The methodology used in the study involved the development of a mobile application called DIETSENSOR that can be used to automatically scan food items and estimate the nutritional value of the meal. The study involved 24 participants who were diabetic patients, and the data were collected by conducting experiments in a controlled environment. The participants were asked to consume a meal, and the system was used to scan the food items and estimate the nutritional value of the meal.

The weakness of the system is that it requires users to manually scan the food items, which can be time-consuming and may require some level of expertise. Moreover, the system may not be able to accurately estimate the nutritional value of meals that are not included in its database.

The problem that the system was designed to solve is the difficulty faced by diabetic patients in measuring their dietary intake accurately. The system can help diabetic patients in monitoring their dietary intake and can also help healthcare professionals in providing personalized dietary recommendations.

The results of the project showed that the DIETSENSOR system was able to estimate the nutritional value of meals with an average error rate of 8.1%. The system was also found to be highly accurate in estimating the nutritional value of meals that were included in its database.

The project involves the use of machine learning algorithms to develop a database of food items and their nutritional values. The system can learn from user inputs and improve its accuracy over time.

2.5.5 DESIGN AND DEVELOPMENT OF DIABETES MANAGEMENT SYSTEM USING MACHINE LEARNING

This article was written by Sowah, R. A., Bampoe-Addo, A. A., Armoo, S. K., Saalia, F. K., Gatsi, F., & Sarkodie-Mensah, B. (2020)

This paper describes the design and implementation of a software system to improve the management of diabetes using a machine learning approach and to demonstrate and evaluate its effectiveness in controlling diabetes. The proposed approach for this management system handles the various factors that affect the health of people with diabetes by combining multiple artificial intelligence algorithms.

The aim of the study was to design and develop a diabetes management system that can accurately predict blood glucose levels and provide personalised dietary recommendations using machine learning algorithms.

The methodology involved collecting data from diabetes patients using continuous glucose monitoring systems and activity trackers. The data were then preprocessed and used to train machine learning models to predict blood glucose levels and provide dietary recommendations.

The system was tested on a small group of participants, and its performance was evaluated based on its accuracy in predicting blood glucose levels and providing dietary recommendations.

To evaluate the food recognition model, cross-entropy metrics were employed to support validation using neural networks with a backpropagation algorithm. The model was trained with local Ghanaian dishes that have specific nutritional value and essence in managing diabetes, and it provided accurate image classification with given labels and corresponding accuracy. The model achieved specified goals by predicting labels of new images with high accuracy levels of over 95% for specific calorie intakes.

The performance of the meal recommender model and question and answer chatbot were tested with a cross-platform user-friendly interface, using Cordova and Ionic Frameworks for software development for both mobile and web applications. The system recommended meals that meet the calorific needs of users using KNN and answered questions asked in a human-like way.

Overall, the implemented system would solve the problem of managing activity, dieting recommendations, and medication notification of diabetics. Additionally, providing diabetic patients with a data visualisation tool to display their data in tables, charts, and educational programs for newly diagnosed and ongoing diabetes treatment is valuable for the treatment and management of diabetes.

The weakness of the system was that it was tested on a small group of participants, which limits the generalizability of the results. In addition, the study did not take into account individual differences in response to dietary interventions.

The problem the system was designed to solve is to provide personalised diabetes management that is tailored to individual needs and preferences. The system uses machine learning algorithms to predict blood glucose levels and provide personalised dietary recommendations to help patients manage their diabetes.

The results of the project showed that the system was able to accurately predict blood glucose levels and provide personalised dietary recommendations. However, further testing is needed to validate the performance of the system on a larger sample size.

CHAPTER THREE

SYSTEM ANALYSIS AND DESIGN

3.1 RESEARCH DESIGN

This chapter describes the functionalities and implementation of the system. The objectives are outlined and carefully documented. The requirements are carefully outlined in a table format. The overall system analysis and design is explained using Unified Modeling Language (UML) diagrams. The diagrams shown in this chapter should be able to provide a comprehensive grasp of the inner workings of the system.

3.2 SYSTEM REQUIREMENTS

System requirements refer to a specific set of specifications that define the characteristics and capabilities required for a system to meet the needs and expectations of its intended users or stakeholders. These requirements outline the system's functionality, behaviour, and interaction with other systems and users, as well as its performance, security, scalability, and other technical aspects. They are created based on the user requirements and are critical in designing, developing, testing, and maintaining the system throughout its lifecycle. The different types of system requirements include hardware and software requirements, performance and reliability requirements, usability and accessibility requirements, and security and privacy requirements. Ultimately, system requirements ensure that the system meets the expectations of stakeholders, is

reliable, secure, and scalable, and can be effectively maintained and improved over time. The purpose of the application is to provide Diet system for patients with different types of diabetes mellitus, to input their blood sugar level, BMI values with other required information, and create a meal plan that is healthy in order to manage their health.

3.2.1 FUNCTIONAL REQUIREMENTS

S/N	REQUIREMENT	DESCRIPTION	PRIORITY
i.	Registration	The system will allow users to register.	High
ii.	Login	The system shall grant registered users access to the website.	High
iii.	Add / provide required information.	The system will allow users to input the required information needed in the system, like the blood sugar level and so on.	High
iv.	Pick meal options.	The system will allow the user to pick meals that fit into the plan.	High

v.	Review information	The system will allow the user to update his/her information, saving the previous information and the new one.	High
vi.	View previous picked meals	The system will allow users to check meal plans created on previous days.	Medium

Table 3.2.1 User Requirements

S/N	REQUIREMENT	DESCRIPTION	PRIORITY
i.	Check client details.	The admin will have access to registered users information and can modify it if necessary.	High
ii.	Accept and publish different meal types	The admin will publish different meals using the Nigerian local food list.	High
iii.	Send email notifications	The admin should send emails confirming the user's registration and	High

		receiving feedback. With other desired information.	
iv.	Get backups and restore backups.	The Administrator shall download system backups as individual tables or as a whole database. If necessary, the administrator can also restore data to the database.	Medium to high.
v.	Calculation	The system will be able to calculate the BMR of patients and calculate the food grams required for the particular meal.	High.
vi.	Store information	The system shall store user data on a relational database like MYSQL and Django database .	High

Table 3.2.2; Administrator Requirements

3.2.2 NON-FUNCTIONAL REQUIREMENTS

1. The system shall Encrypt all user passwords to ensure security.

2. The database shall have no redundancy; therefore, it shall not take up any additional memory.

3. The system shall grant users the privilege of recovering their forgotten passwords by using a password recovery facility.

4. The System shall be available 24/7.

3.2.3 PERFORMANCE REQUIREMENTS

1. The System shall respond quickly.

2. The System shall be able to manage a high volume of traffic.

3. The System shall function on any platform that satisfies its basic requirements.

3.2.4 SAFETY REQUIREMENTS

1. The System, as well as any data, shall be protected.

2. Within a few seconds, modified database data shall be updated for all users.

3.2.5 SOFTWARE AND HARDWARE REQUIREMENTS

The software and hardware requirements for the user's device:

1. Smart-devices with a screen resolution of 480x720 pixels or higher.

2. Web browser

3.2.6 DESIGN AND DEVELOPMENT TOOLS

Framework: Django

Database: MYSQL, DJANGO ADMINISTRATION

Languages: HTML, CSS, JavaScript, Python

3.3 SOFTWARE DEVELOPMENT LIFE CYCLE MODEL

A software development life cycle (SDLC) model is a conceptual framework describing all activities in a software development project from planning to maintenance. The SDLC model adopted in the development of this project is the AGILE MODEL.

3.3.1 AGILE METHODOLOGY

The Agile methodology is a flexible and iterative approach that emphasises customer satisfaction through continuous delivery of working software. It involves breaking the project into small

iterations, with each iteration being treated as a mini-project. Each iteration focuses on delivering a working product incrementally, with feedback and input from stakeholders incorporated along the way. This approach allows for greater flexibility and adaptability to changing requirements and priorities**.** Once the work begins, our team cycles through the process of planning, executing, and evaluating. There must be continuous collaboration between both the stakeholders and the team members. The Agile methodology is a suitable SDLC model for developing a diet plan system web application for diabetic patients as it offers flexibility, continuous feedback, and faster delivery of working software.

Some benefits of agile methodology:

a. It makes it easier for organisations that work in a fast changing environment.

b. This methodology makes use of integrated testing which produces a superior quality product.

c. It allows managers or admins to have better control over the project due to transparency feedback integration and quality control features.

d. It makes visibility, predicting risk and coming up with effective mitigation plans easier.

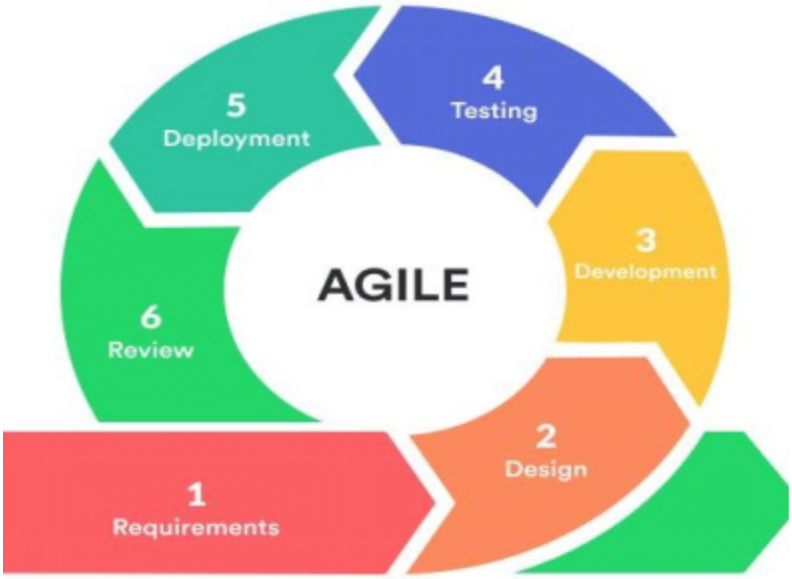

Fig 3.1 Agile Model (OKEKE 2021)

3.3.2 STAGES IN AGILE DEVELOPMENT

1. Requirements or Planning: This involves identifying the project requirements, goals, and stakeholders. The team creates a product roadmap, prioritises the features to be developed, and creates a plan for the first iteration.

2. Analysis and Design: This step involves creating user stories, wireframes, and mockups that describe the system's functionality and user interface.

3. Implementation: The development team begins working on the product, implementing the features identified in the plan. They develop code, perform unit testing, and integrate the features into the system.

4. Testing: In this step, the team conducts testing to identify and resolve any defects or issues. Testing can include unit testing, integration testing, and user acceptance testing.

5. Deployment: The product is delivered to the customer or stakeholder for feedback and evaluation.

6. Feedback and Review: The team receives feedback from stakeholders and uses it to refine and improve the product. They repeat the steps above, iteratively developing and delivering product increments until the project is complete.

3.3.3 ADVANTAGES OF AGILE MODEL

1. Greater flexibility and adaptability to changing requirements and priorities.

2. Continuous delivery of working software, allowing stakeholders to provide feedback and evaluate the product at each iteration.

3. Greater collaboration and communication between the development team and stakeholders.

4. Reduced project risk through early and continuous testing and feedback.

5. Faster time-to-market, as the iterative approach allows for quicker delivery of working software.

3.4 SYSTEM DESIGN

System design is the phase in software development where the structure, behaviour, and data flow of a system are defined to meet specific requirements. It involves identifying the components and how they interact with each other and creating documentation such as diagrams and models to describe the system's architecture.

3.4.1 USE CASE DIAGRAM

The use case diagram depicts the various tasks that can be accomplished with this application. It is a visual representation that shows the interactions between actors and a system and the use cases that describe those interactions. It is a way to model and communicate the functional requirements of a system.

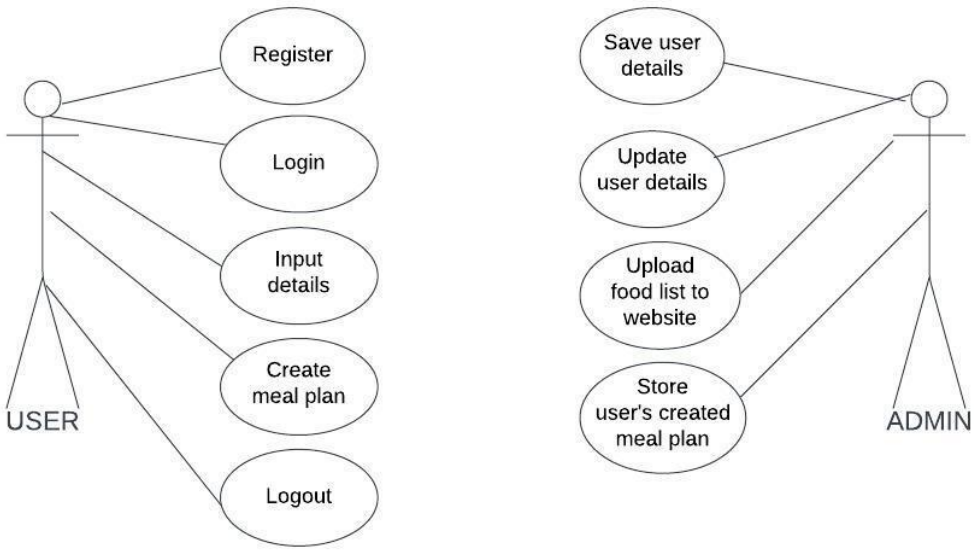

Figure 3.1 Use case Diagram

3.4.2 FLOWCHART DIAGRAM

The flow diagram shows the process a user will follow to use the system.

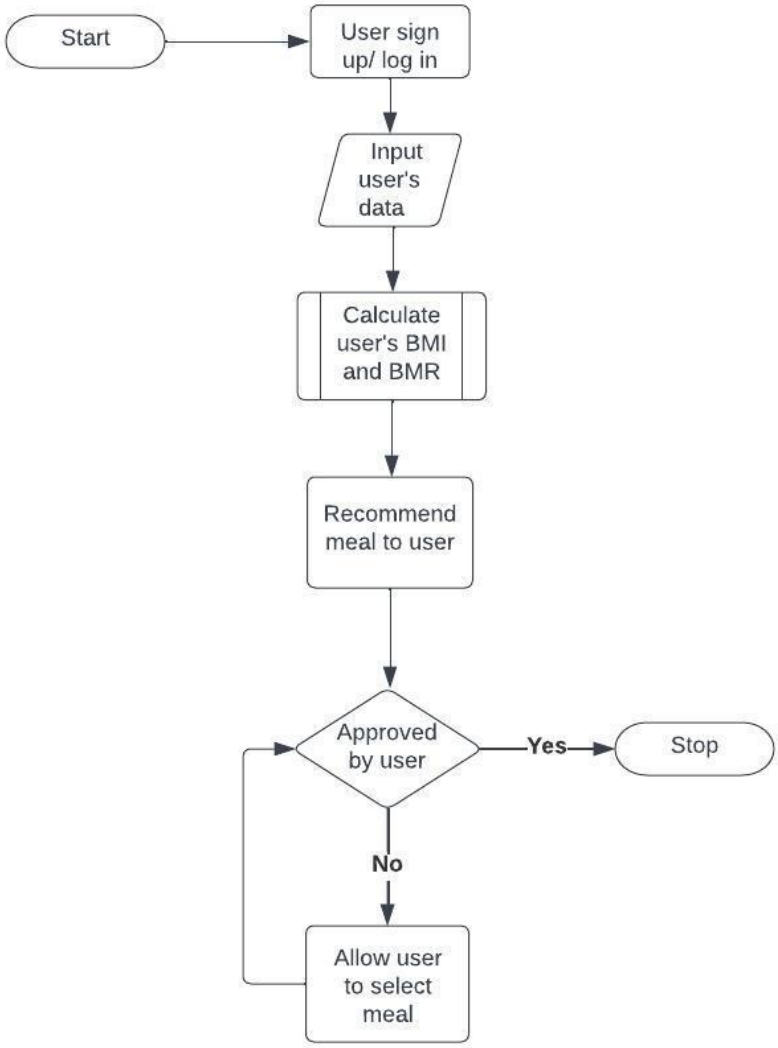

Fig 3.2 Flowchart of the system

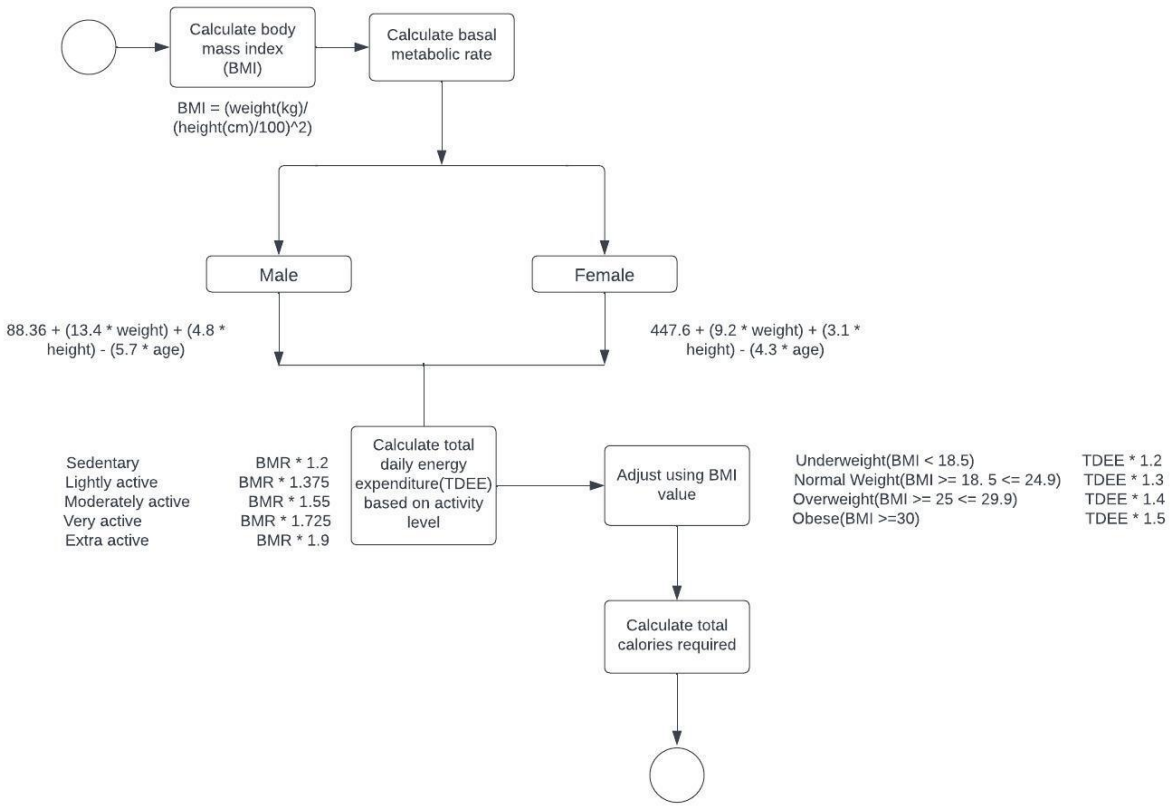

Fig 3.3 Flowchart for calorie requirements determination using the Harris Benedict's equation.

3.5 ETHICAL CONSIDERATIONS

Some ethical considerations were considered when developing this software:

1. Informed Consent: Obtain informed consent from all participants in the research process. This includes informing them about the purpose, risks, and benefits of the research, as well as their right to withdraw from the study at any time.

2. Data Privacy: Protect the privacy of the participants by implementing appropriate data security measures, such as encryption and access controls, and adhering to relevant data protection regulations.

3. User Safety: Ensure that the software is designed and tested to be safe for use by its intended users. This includes addressing potential safety risks such as software bugs, security vulnerabilities, and potential misuse.

4. Transparency: Provide transparency in the development and use of the software. This includes making the software's source code and documentation available to users, and clearly disclosing any limitations or known issues.

5. Responsible Use: Promote responsible use of the software and take steps to prevent any misuse or unintended consequences. This includes providing appropriate guidance and training for users, monitoring usage of the software, and being responsive to any issues or concerns that arise.

CHAPTER FOUR

IMPLEMENTATION AND RESULT

4.1 INTRODUCTION

This chapter is centred around the implementation and deployment of a web-based software solution that reduces the stress on dieticians and provides a diet plan for users. The section provides an outline of the implementation process, the technologies and tools employed, and the difficulties encountered. Additionally, it offers an analysis of the outcomes and results achieved. The primary aim of this section is to provide a detailed account of the project's execution, assess its effectiveness, and exhibit the capacity of the web-based software to serve the interests of users.

4.2 BROAD DESCRIPTION OF THE SYSTEM

The system developed in this project is designed to provide a personalised diet and meal plan for diabetic patients, based on their individual health needs and goals. The recommendations would incorporate relevant medical and dietary guidelines, as well as the latest scientific research on diabetes management and nutrition. The system would allow new users to register by providing basic information like name, age, gender, height, and weight. The system would calculate the user's Body Mass Index (BMI) using the height and weight provided during registration. The system would calculate the user's Basal Metabolic Rate (BMR) using the Harris Benedict

equation. This calculation takes into account the user's age, gender, height, and weight, and provides an estimate of the number of calories the user burns while at rest. Based on the user's BMR and activity level, the system would calculate the user's daily calorie needs. The system would recommend meals that align with the user's daily calorie needs. This could include meal plans with recommended portions and nutritional information.The system would allow users to track their progress over time, including blood sugar levels, and other relevant metrics.

4.3 IMPLEMENTATION OF THE APPLICATION

4.3.1 HOME AND ABOUT PAGE

The home page provides the guidelines and an easy access to the system. The page shows a brief description of the system, how the system works, a contact us form that requires the users information and users testimonials. The about page shows the description of the system.

4.3.2 SIGNUP AND LOGIN PAGES

The sign up page for this system is designed to allow new users to register into the system. Once the user registers into the system the user details are saved into the django administration database. The log in page allows already registered users to log in and access the system.

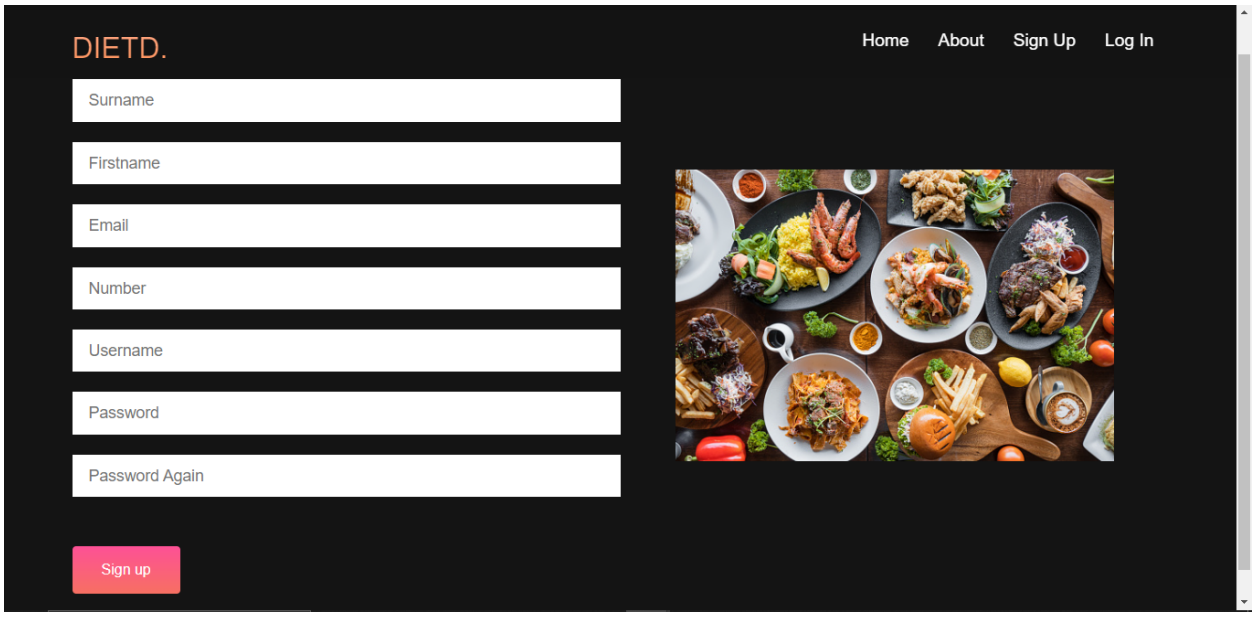

Fig 4.1 Sign up Page

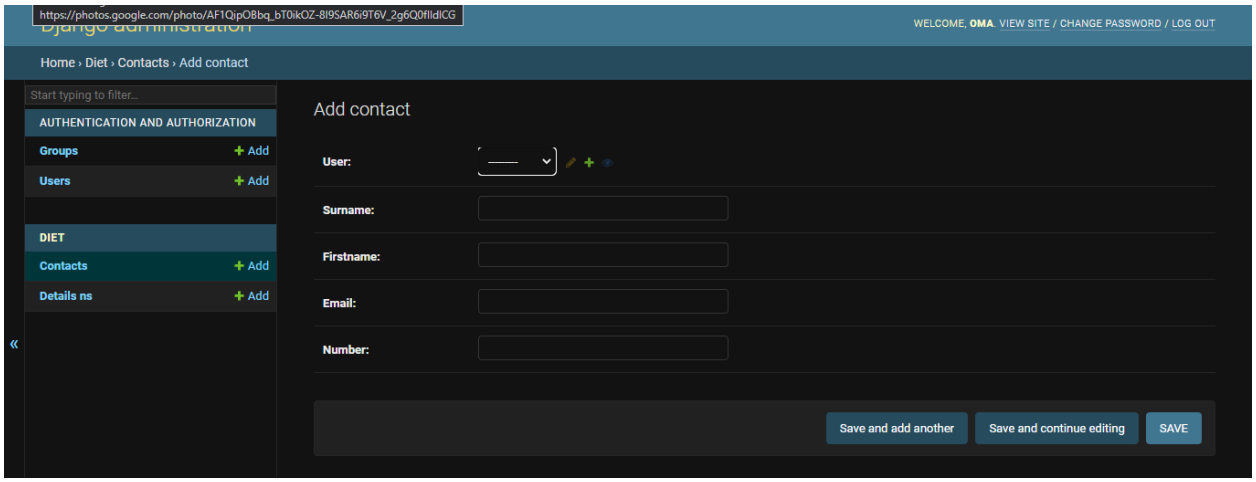

Fig 4.2 Database for newly registered users

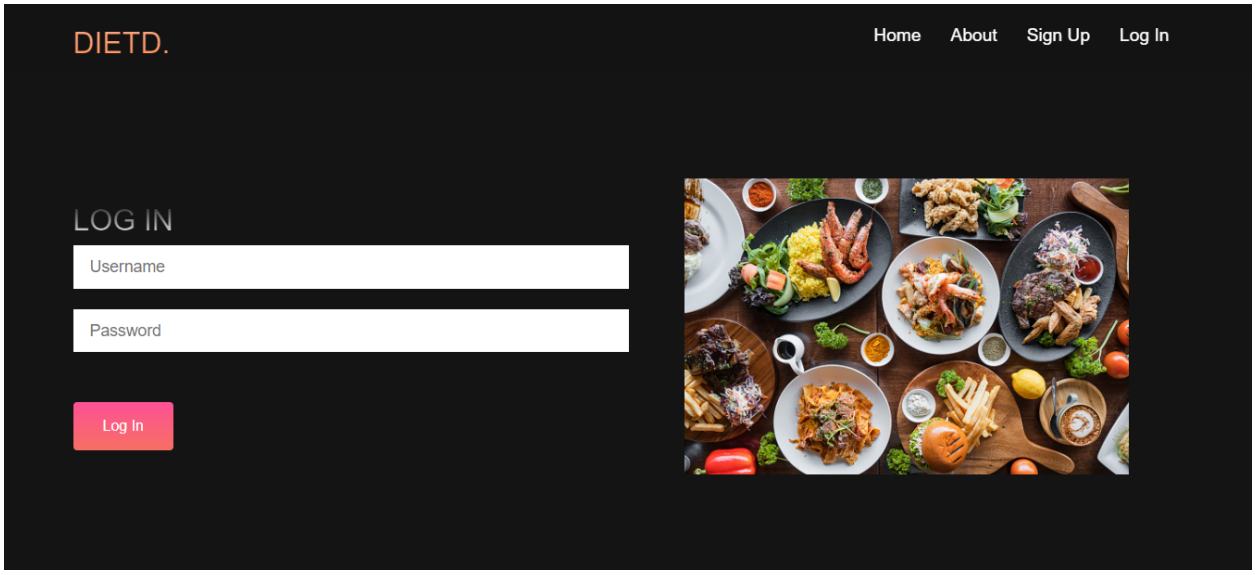

Fig 4.3 Log In page

4.3.3 DETAILS PAGE

The details page is available for only registered users. This page allows registered users to enter their relevant information like their age, weight, height and so on. After the user enters their details, the details are saved to the admin database. If a user logs out and log in relevant information entered when providing their details will be shown to the user.

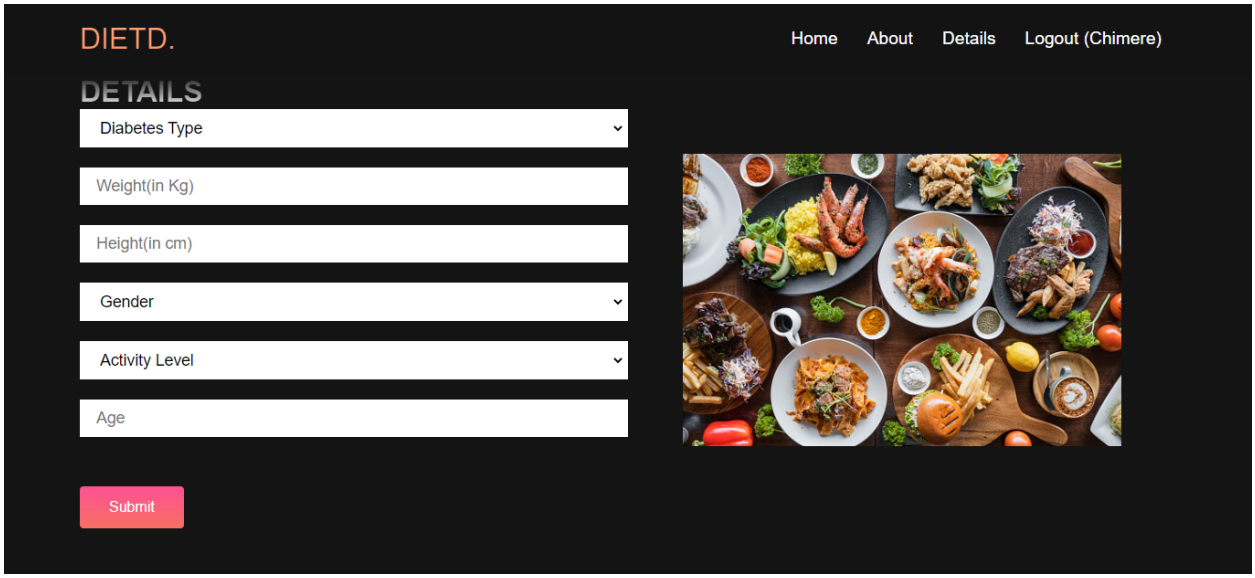

Fig 4.4 Details page

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