**GOVERNMENT COLLEGE UNIVERSITY, FAISALABAD**



**DiabetoPlus (Diabetes Management and Prediction System)**

Supervised by:

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Submitted by:

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**DEPARTMENT OF COMPUTER SCIENCE**

**GOVT. MUNICIPAL GRADUATE COLLEGE. FAISALABAD**

**2020-2024**

**DEDICATION**

This study is dedicated with deep appreciation to our beloved parents, whose unwavering support and encouragement have been our guiding light. With heartfelt gratitude, we also dedicate this work to our esteemed educators, particularly our professor ------? , whose mentorship empowered us to achieve this academic milestone.

**DECLARATION**

The work reported in this project is completed by Talha Khalil (Roll No. 536359) under the supervision of “-------?”, Department of Computer Science at Government Municipal Graduate College, Faisalabad.

I at this moment declare that this project, in its entirety or parts, has not been copied from any other source. Additionally, we confirm that the development of this project and the preparation of the accompanying report were carried out solely through my efforts. Should any section of this project be found to be copied from another source or identified as a reproduction of existing work, I accept full responsibility and are prepared to face the consequences. Furthermore, no part of this work has been submitted as part of any application for any degree or qualification at this or any other university or educational institution.

**Talha Khalil** Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2020-GCUF-065049

**CERTIFICATE**

I certify that the contents and form of the project submitted by Talha Khalil, Roll No. 536359, Registration No. 2020-GCUF-065049 has been found satisfactory and by the prescribed format. I recommend it be processed for evaluation by the External Examiner for the award of a degree in Bachelor of Science (Computer Science).

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Internal Panel:

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Head of Department

Govt. Municipal Graduate College Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

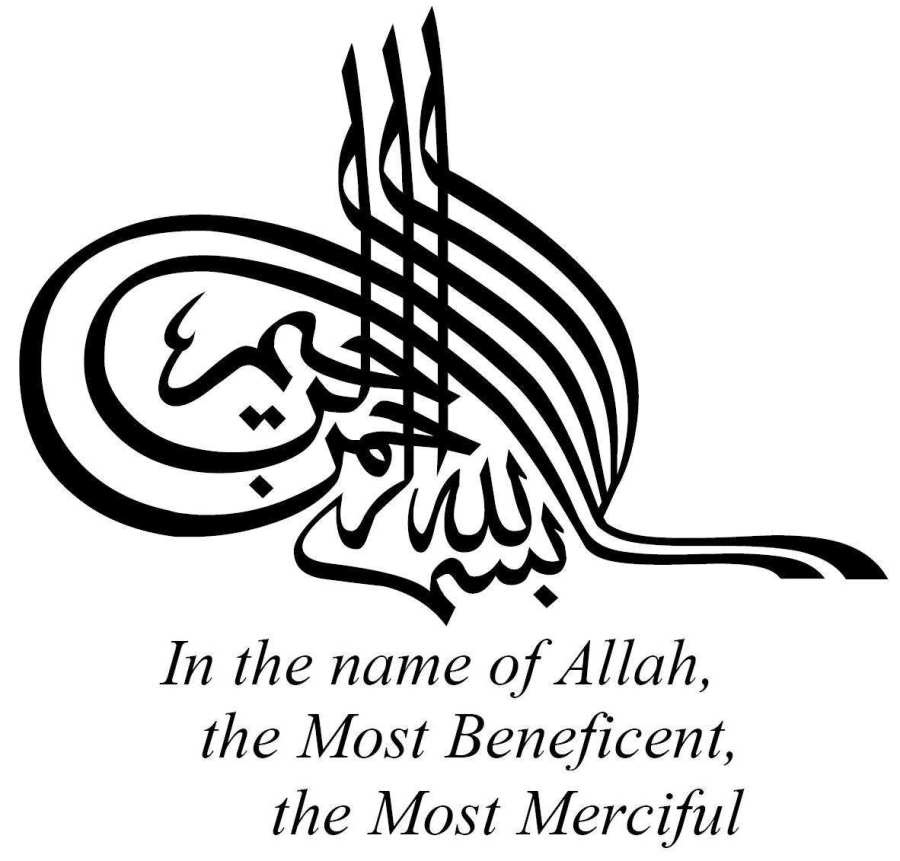


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**ACKNOWLEDGMENTS**

All praise is due to Almighty ALLAH, whose blessings have enabled us to successfully and objectively complete this work. We also send peace and blessings upon Muhammad Mustafa (S.A.W), whose guidance and teachings illuminate our path.

Though only our names are on the cover of this dissertation, many individuals have contributed to its creation. We extend our heartfelt gratitude to everyone who helped make this dissertation possible. However, certain individuals merit special mention.

I deeply appreciate the support and cooperation of our project supervisor, --------?. His constant guidance has been crucial throughout this project.

Our friends brought joy and energy to our work, motivating us to complete it on time, and we are deeply thankful for their love, support, and encouragement during this challenging period.

We express profound gratitude to our parents for their unwavering support and inspiration, which have been invaluable throughout our journey.

**ABSTRACT**

Diabetes is a chronic disease, impacting millions of people who are requiring radically focused control of their blood glucose levels. Diabetes management systems are in no way fully integrated for visitors to health-and-accessible, which increases health risks. DiabetoPlus is an entirely integrated web-based system in diabetes management through the application of an insulin dosage calculator and a prediction system of diabetes and recommendations related to personal diet and exercises. This means that it provides users with logging of their blood glucose level, other given data, predicts the risk of diabetes, and then provides the user with individualized suggestions for the insulin dosage. Additionally, it includes an admin panel for the administrator to be able to access user feedback and manage user accounts, sending newsletters to the subscribed users. Built on Python and Django, using modern web technologies, DiabetoPlus also provides the end-user-applied diabetes education materials empowering them toward condition improvement. Such an approach promises much in enhancement toward diabetes care in pursuit of even better health outcomes.

# CHAPTER 1: INTRODUCTION TO THE PROBLEM

## Introduction

This is one of the major public health problems; millions of people are suffering from diabetes worldwide. It is a chronic disease which fails to maintain the body's blood glucose level through regulation and if not maintained appropriately, creates long-term complications. Most of today's diabetes management practices force patients to depend on a multiple number of tools and platforms to monitor their blood sugar, to calculate insulin dose, and to receive diet and exercise recommendations. Poor management and a greater risk of potentially serious health issues, such as cardiovascular disease, kidney failure, and problems related to vision, arise from lack of integration.

DiabetoPlus offers a full package online that includes various key aspects necessary for managing diabetes well. The portfolio contains: a diabetes prediction system, correct dosage calculation of insulin, and recommended diet and exercise based on your health data.

This system contains facilities for recording a user's blood glucose level readings, forecasting his/her diabetes risk, and best calculating his/her insulin dosage. The system will also provide education in respect of extending the user's information on diabetes and its application to the insulin. Other features offered in the admin panel include checking user feedback, account managing by an administrator, and sending newsletters to subscribers. DiabetoPlus is a web-application developed using all modern web technologies, including Python, Django, and many others, providing the diabetic user with better health management with a nice user experience.

## Background

Today, above 463 million people have diabetes, and all of them have to manage blood glucose and dosages of insulin with appropriate lifestyles. Current solutions for diabetes management are relatively isolated and require the patient to be on separate systems for glucose monitoring and dosage calculations, diet and exercise tracking, and thereby leading to poor control and higher risks.

Existing platforms lack integration and predictive features, leaving users without the support needed for effective diabetes management. DiabetoPlus filled the gap by combining diabetes prediction, insulin dosage calculation, and personalized recommendations into one single module. This integrated approach helps patients manage their condition better and thereby allows them to have fewer complications from their disease**.**

## Purpose

DiabetoPlus is going to be a comprehensive and easy-to-use management and prediction system for diabetes. As it is chronic, diabetes has to be managed carefully and continuously with intelligent regimens to avoid leading into several major health complications. At present, the systems are not offering such an integrated approach with commensurate levels of ease of use from a single point in the condition management.

The DiabetoPlus application helps bridge the gap by offering all-around treatment for diabetes. The application enables self-monitoring of the risk in diabetes, calculation of an appropriate dose of insulin, and recommendations concerning diet and exercise. Moreover, it provides the possibility to log one's glucose levels and track them regularly, maintaining an adequate clear historical record that would be helpful for long-term management.

Apart from the tools, the system includes an administration management interface for DiabetoPlus. The user with administrative rights can view feedback, manage accounts, and submit newsletters to subscribed users about upgrades and enhancements in order for the system to continuously evolve in line with users' needs.

DiabetoPlus aims to simplify the complications of managing diabetes, provide predictive insights, and put health in the users' hands-that is the risks associated with poorly managed diabetes and what could be overall health outcomes

## Scope

DiabetoPlus" project scope Aspects of Developing a comprehensive, Web-based platform with radical change of managing and predicting diabetes the project develops a strong diabetes prediction system wherein user data such as age, BMI, and glucose levels can predict the disease. It will also contain an insulin dosage calculator that will calculate the right amount of insulin accordingly to the user's weight, as well as a secure logging system

where blood glucose levels will be recorded daily. The diet and recommended exercise routine will be customized according to the user's diabetes risk prediction.

The system will comprise such user functions such as the ability to register, profile management, and insulin correction for high blood glucose. Additionally, it will offer learning concerning diabetes and insulin forms as well as provide a PDF downloadable blood glucose log sheet. For administrative purposes, an admin panel will be developed which will manage user accounts, analyze feedback and distribute newsletters to subscribers. In terms of performance, the project should ensure accurate data processing in real-time with scalable performance from a growing pool of users while ensuring that the interface offered is user-friendly and accessible across many devices. Compatibility with major web browsers and adherence to data privacy regulations will be maintained, with ongoing improvements based on user feedback and updates to educational content.

## Objectives

* **Develop a Reliable Prediction System:** Create an accurate diabetes prediction tool that assesses risk based on user inputs like age, BMI, and glucose levels.
* **Implement an Insulin Dosage Calculator:** Design a tool that calculates the appropriate insulin dosage based on user weight and other parameters.
* **Establish a Secure Loging System:** Build a secure system for users to track and record their daily blood glucose levels.
* **Provide Personalized Recommendation:** Generate diet and exercise recommendations tailored to the user's diabetes risk level
* **Create a User-Friendly Interface**: Ensure the platform is easy to navigate and accessible across various devices, offering a seamless user experience.
* **Integrate Administrative Features:** Develop an admin panel for managing user accounts, reviewing feedback, and sending newsletters.
* **Ensure Data Privacy and Compliance:** Adhere to data privacy regulations and handle user data securely.
* **Support System Scalability:** Design the platform to handle a growing number of users without performance issues.
* **Continuous Improvement:** Implement a feedback system to refine and enhance the platform based on user input and evolving needs.

## Intended Audience and Reading Suggestions

### Intended Audience:

* **People with Diabetes:** Those who require planning aids regarding diabetes management: calculating insulin dosage, tracking blood glucose level, and individualized diet and physical activity recommendations.
* **Pre-diabetic Individuals:** People who are likely to get diabetes and can gain from early detection and prevention steps.
* **Healthcare Workers:** Doctors, nurses, and diabetes teachers who may use the technology to assist in patient care management and counseling. Caregivers and family members are people who help diabetes patients. They need to use tools and data to manage the patient's condition.
* **Researchers and Educators:** Individuals conducting research or education related to diabetes, who can utilize the functionality of the system's data and resources for study and training purposes.
* **Administrator and Doctors:** Those individuals who are using an administration panel to monitor user accounts, analyze feedback, and send out newsletters.

### Reading Suggestions

* **Diabetes Basics -** American Diabetes Association:

<https://www.diabetes.org/diabetes-basics>

* **Diabetes and Healthy eating:**

<https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/diabetes-and-healthy-eating>

* **Physical activity and diabetes:**

<https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/diabetes-and-healthy-eating#physical-activity-and-diabetes>

## Document Conventions

* Page size: A4
* Margins: Top (1 inch), Bottom (1 inch), Right (1 inch), Left (1.25 inch)
* Volume of Thesis: 75-100 pages
* Citation style: APA

### Conventions for Main Heading

* Font face: Times New Roman
* Font style: Bold
* Font size: 16

### Conventions for Sub-Heading

* Font face: Times New Roman
* Font style: Bold
* Font size: 14

### Conventions for Body

* Font face: Times New Roman
* Font Style: Simple
* Font size: 12
* Line Spacing: 1.5

# CHAPTER 2: Literature Review



## Introduction

Diabetes is a significant global health challenge that affects millions of people worldwide. According to the World Health Organization (WHO), diabetes was responsible for approximately 1.5 million deaths in 2019, with most deaths occurring in low- and middle-income countries. The complexity of diabetes management requires patients to maintain strict control over their blood glucose levels, manage insulin dosages, monitor dietary intake, and integrate regular exercise into their daily routines. However, these tasks can be overwhelming without the assistance of technological tools designed to simplify diabetes care.

With advancements in digital health technologies, tools like insulin dosage calculators, diabetes prediction systems, and comprehensive logging systems have been developed to assist both patients and healthcare providers in managing diabetes more effectively. These systems aim to personalize diabetes care, offering patients tailored recommendations based on their glucose levels, lifestyle, and medical history. This literature review

explores the evolution of diabetes management tools, focusing on key global studies and their implications for the Pakistani healthcare system.

## Historical Background

### General aspects of Diabetes Mellitus (2014)

Diabetes mellitus is a heterogeneous group of disorders characterized by hyperglycemia due to an absolute or relative deficit in insulin production or action. The chronic hyperglycemia of diabetes mellitus is associated with end organ damage, dysfunction, and failure, including the retina, kidney, nervous system, heart, and blood vessels. The International Diabetes Federation (IDF) estimated an overall prevalence of diabetes mellitus to be 366 million in 2011, and predicted a rise to 552 million by 2030.

The treatment of diabetes mellitus is determined by the etiopathology and is most commonly subdivided in type 1 and type 2 diabetes mellitus. There is a greater propensity towards hyperglycemia in individuals with coexisting genetic predisposition or concomitant drug therapy such as corticosteroids. The screening for diabetes mellitus may either be in the form of a 2-hour oral glucose tolerance test, or via HbA1c testing, as recently recommended by the American Diabetes Association (ADA). Strong associations have been shown in observational studies suggesting poor clinical outcomes both with chronic hyperglycemia and acutely in intensive care settings. However, tight glycemic control in this setting is a contentious issue with an increased incidence of hypoglycemia and possible increase in morbidity and mortality. In a critically ill patient, a glucose range of 140–180 mg/dL (7.8–10.0 mmol/L) should be maintained via continuous intravenous insulin infusion.

### Insulin and Insulin Resistance (2005)

In 1889 German scientists Minkowski and von Mering noted, from their experimental work with animals, that total pancreatectomy led to the development of severe diabetes.4 They hypothesized that a substance secreted by the pancreas was responsible for metabolic control. Others later refined this hypothesis, noting diabetes to be associated with destruction of the islets of Langerhans. While Minkowski, as well as Zuelzer in Germany and Scott in the USA attempted, with inconsistent results, to isolate and administer the missing pancreatic islet substance, Belgian investigator de Meyer in 1909 proposed the name “insuline”, as did British researcher Schaefer in 1916.

Finally in 1921, a decade later, insulin was finally isolated, purified and available in a form capable of therapeutic administration. In May 1921, Toronto surgeon Banting, assisted by medical student Best, and under the supervision of McLeod, Professor of Carbohydrate Metabolism, began experiments in dogs. They administered chilled saline extracts of pancreas intravenously to dogs rendered diabetic by pancreatectomy and observed lowering of blood glucose. In December 1921 this work was presented to the American Physiological Association, and biochemist Collip, who had joined the team, further demonstrated that this extract also restored hepatic glycogen mobilization and the capacity to clear ketones. One month later, in January 1922 the first human experiments began on a 14-year-old diabetic boy whose clinical symptoms and biochemical abnormalities were essentially reversed by administration of the pancreatic isolate. In May 1922, the active component had been named insulin, and the results of these experiments presented to the Association of American Physicians. Eli Lilly subsequently began production of porcine insulin, enhancing purification through iso-electric precipitation, making commercial quantities by early 1923. The Nobel Prize was awarded in 1923 to Banting and McLeod.4

### Standards of Medical Care in Diabetes(2022)

The American Diabetes Association’s (ADA’s) Standards of Medical Care in Diabetes (the Standards) is updated and published annually in a supplement to the January issue of Diabetes Care. The Standards are developed by the ADA’s multidisciplinary Professional Practice Committee, which comprises expert diabetes health care professionals. The Standards include the most current evidence-based recommendations for diagnosing and treating adults and children with all forms of diabetes

### Prevalence of Diabetes in Pakistan (2007)

The WHO has estimated a rise of 170% in the incidence of diabetes in the developing countries. This gives a figure of 228 million people with diabetes and accounts for 75% of the world diabetic population . The greatest increase will be seen in India from 19 million to 57 million. Pakistan will have an increase from 4.3 million in 1995 to 14.5 million in 2025. Thus, by the year 2025 over 75% of all people with diabetes will belong to the developing countries .

It is also been established that the world population is ageing and the number of people over 65 years has risen in the last two decades. This is another cause for the increasing incidence of diabetes, especially in developing countries .

To assess the true picture of the metabolic disorder in Pakistan, the results of the Pakistan National Diabetes Survey, conducted in four phases in both rural and urban areas of the four provinces, published independently have been amalgamated, to achieve a total figure.

### WHO Global report on Diabetes (2016)

The first WHO Global Report on Diabetes was launched on World Health Day 7th April 2016 which was dedicated to Diabetes. Diabetes has been described in ancient scripts and recognized as a serious illness, but it does not appear to have been frequently encountered by physicians or healers. It is in the past few decades that human health and development is increasingly affected by the rising numbers of people with this condition.

Diabetes, together with cardiovascular disease (CVD), cancer and chronic respiratory disease has been targeted in the Political Declaration on the Prevention and Control of Noncommunicable Diseases (NCDs) at the Un High-level Political Meeting in 2011. In 2013, the WHO member states endorsed a global monitoring framework for NCDs, with 9 targets to be reached by 2025. Diabetes and its key risk factors are strongly reflected in the targets and indicators - reduction of exposure to unhealthy diet and physical inactivity, zero rise in the prevalence of diabetes, improved access to treatment, and reduction of premature mortality. As part of the 2030 Agenda for Sustainable Development, Member States have set an ambitious target to reduce premature mortality from NCDs - including diabetes - by one-third; achieve universal health coverage, and provide access to affordable essential medicines - all by 2030

### Improving the Estimation of Mealtime Insulin Dose in Adults(2011)

Although carbohydrate counting is routine practice in type 1 diabetes, hyperglycemic episodes are common. A food insulin index (FII) has been developed and validated for predicting the normal insulin demand generated by mixed meals in healthy adults. We sought to compare a novel algorithm on the basis of the FII for estimating mealtime insulin dose with carbohydrate counting in adults with type 1 diabetes.

A total of 28 patients using insulin pump therapy consumed two different breakfast meals of equal energy, glycemic index, fiber, and calculated insulin demand (both FII = 60) but approximately twofold difference in carbohydrate content, in random order on three consecutive mornings. On one occasion, a carbohydrate-counting algorithm was applied to meal A (75 g carbohydrate) for determining bolus insulin dose. On the other two occasions, carbohydrate counting (about half the insulin dose as meal A) and the FII algorithm (same dose as meal A) were applied to meal B (41 g carbohydrate). A real-time continuous glucose monitor was used to assess 3-h postprandial glycemia.

Compared with carbohydrate counting, the FII algorithm significantly decreased glucose incremental area under the curve over 3 h (–52%, P = 0.013) and peak glucose excursion (–41%, P = 0.01) and improved the percentage of time within the normal blood glucose range (4–10 mmol/L) (31%, P = 0.001). There was no significant difference in the occurrence of hypoglycemia.

An insulin algorithm based on physiological insulin demand evoked by foods in healthy subjects may be a useful tool for estimating mealtime insulin dose in patients with type 1 diabetes.

### Diabetes Prediction with Machine Learning Algorithms (2019)

Diabetes Mellitus is among critical diseases and lots of people are suffering from this disease. Age, obesity, lack of exercise, hereditary diabetes, living style, bad diet, high blood pressure, etc. can cause Diabetes Mellitus. People having diabetes have high risk of diseases like heart disease, kidney disease, stroke, eye problem, nerve damage, etc. Current practice in hospital is to collect required information for diabetes diagnosis through various tests and appropriate treatment is provided based on diagnosis. Big Data Analytics plays an significant role in healthcare industries. Healthcare industries have large volume databases. Using big data analytics one can study huge datasets and find hidden information, hidden patterns to discover knowledge from the data and predict outcomes accordingly. In existing method, the classification and prediction accuracy are not so high. In this paper, we have proposed a diabetes prediction model for better classification of diabetes which includes few external factors responsible for diabetes along with regular factors like Glucose, BMI, Age, Insulin, etc. Classification accuracy is boosted with new dataset compared to existing dataset. Further with imposed a pipeline model for diabetes prediction intended towards improving the accuracy of classification.

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# CHAPTER 3: SOFTWARE REQUIREMENT SPECIFICATION