Gluco-Lab : An Advanced Glucose and Diet Tracking Mobile Application for Improved Diabetes Management

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***Abstract*—Diabetes is a developing global health issue that necessitates continual monitoring of blood glucose levels and nutritional consumption. This research describes a smartphone application that allows diabetic patients to quickly track their glucose levels and food. Users can use the app to log blood sugar levels, record meals, and keep track of their carbohydrate intake. It also generates individualized insights and notifications based on the information submitted. By simplifying the diabetes management process, this software promises to increase patient adherence to treatment plans and overall quality of life. Initial user testing yielded good results in terms of usability and perceived benefits. Further research is needed to determine the app's long-term influence on diabetes management outcomes.**

***Index Terms*—Diabetes, Blood glucose levels, Dietary intake, Glucose monitoring, Personalized insights, Treatment plans, Quality of life, User testing.**

I. Introduction

Diabetes is a chronic metabolic condition marked by high blood glucose levels. According to the World Health Organization, the number of persons with diabetes has increased from 108 million in 1980 to 422 million in 2014, and this figure is anticipated to rise further in the coming years. To properly manage diabetes, blood glucose levels must be monitored on a regular basis, as well as nutritional intake, particularly carbohydrate consumption.

Many diabetes people find it difficult to track their blood glucose levels and food on a daily basis. Traditional approaches, such as paper logbooks, are sometimes inefficient and might result in poor adherence to management goals. In recent years, mobile health (mHealth) technologies have emerged as promising solutions for diabetic self-care.

Our project solves this requirement by creating a smartphone application for diabetes patients that monitors blood glucose levels and diets. This software attempts to simplify the process of monitoring crucial health data, allowing patients to better manage their condition. Our mobile application has the following key features:

- Easily log blood glucose levels
- Food diary with built-in carb counting.
- Personalized insights and trend analysis
- Personalized reminders and alerts
- Ability to share data with healthcare providers.

By incorporating these capabilities into a user-friendly smartphone platform, we hope to increase patient involvement in diabetes self-management. This, in turn, could lead to better glycemic control, a lower risk of complications, and a higher quality of life for those with diabetes. In this article, we will go over the development process for our mobile application, its important features, and its potential influence on diabetes control. We will also provide preliminary results from user testing and explore future directions for research and development in this field.

II. Literature Review

Several research have looked into several techniques to better managing blood glucose levels in diabetes patients, with an emphasis on self-monitoring, prediction, and control methods. An autonomous prediction model based on Support Vector Regression has showed promise in forecasting blood glucose levels and averting hypoglycemia incidents, but its precision remains restricted, with the majority of false alarms happening in near-hypoglycemic areas [1]. The efficacy of self-monitoring of blood glucose (SMBG) was assessed in a large cohort, and patients who adhered to prescribed monitoring frequencies had better glycemic control than those who did not [2]. A mathematical optimization of glucose and insulin dynamics resulted in the invention of a semi closed-loop algorithm for continuous insulin administration, which outperformed previous hyperglycemic management approaches, especially when insulin infusion was synchronized with meals [3].

SMBG is considered vital for insulin-dependent patients since it helps to monitor insulin doses and prevent hypoglycemia, especially in individuals with changing blood glucose levels [4]. However, the significance of SMBG in

type 2 diabetes is debatable, with data indicating advantages primarily in certain subgroups like as insulin users and pregnant women, while the general application lacks strong clinical effectiveness. Despite the widespread use of SMBG, particularly in type 2 diabetes, further study is needed to improve its usage and ensure that resources are used efficiently [5].

Mobile health (mHealth) applications have showed great potential in controlling diabetes and increasing glycemic control. Several research investigated the advantages and disadvantages of various technologies. A major national survey found that 60% of users indicated that mHealth applications helped them reach their health objectives [6], demonstrating their usefulness in promoting health behavior and medical decision-making. Similarly, mHealth applications have arisen as tools for connecting patients and physicians, providing real-time data collecting, decision assistance, and individualized education, however the therapeutic efficacy of many such apps is unknown [7]. A comprehensive review and meta-analysis demonstrated that smartphone applications can lower HbA1c levels, however the therapeutic importance of this decrease is limited [8]. Furthermore, web-based surveys demonstrated that diabetic apps, together with continuous glucose monitoring (CGM) devices, can enhance glycemic management, particularly by lowering hyperglycemia [9].

More than 55,000 individuals with diabetes (PWDs) reported that integrating a blood glucose meter with an app resulted in statistically significant improvements in glycemic control over six months. This was especially evident among older patients, who demonstrated increased engagement with the app and concomitant improvements in blood glucose measurements [10].

III. Methodology

Diabetes is an emerging global health challenge, requiring continuous monitoring of both blood glucose levels and dietary intake. This research presents Gluco-Lab, a smartphone application aimed at improving diabetes management through efficient tracking of glucose levels, meal intake, and providing actionable insights.

To ensure the app meets the needs of its intended users, we conducted a comprehensive survey involving 27 respondents, the majority of whom were aged 18-25, predominantly male, and primarily students. Respondents included individuals from various occupational backgrounds such as service holders, unemployed individuals, and business owners. Most participants did not have other chronic conditions and their usage of health-related apps was varied—ranging from frequent to rare use. Furthermore, glucose monitoring was predominantly done rarely, either through personal meters, hospital visits, or not at all, with satisfaction levels for current methods being moderate.

Key insights from the survey indicated that users expected the app to predict future glucose levels accurately and provide alerts when levels were predicted to spike or drop. There was a strong desire for meal and activity logging features, dietary alerts, and the ability to share data with healthcare providers and caregivers. Participants also emphasized the importance of trend analysis over time, clear and understandable insights, and educational resources related to diabetes management. A community feature, allowing interaction with others, was also seen as highly valuable.

Building on these requirements, we designed a prototype with a focus on user-centric features:

- Health Insights: This section provides weekly glucose level trends and allows users to share their data with healthcare providers.
- Health Logs: Users can track glucose levels, meal intake, and activities.
- Glucose Level Prediction: Using historical data, the app predicts glucose levels for the next six days, giving early warnings if levels are expected to spike or drop.
- Dietary Alerts: The app provides feedback on dietary habits from the past week, offering alerts when patterns indicate potential health risks or stability.
- Community Sharing: This feature fosters interaction, enabling users to share their experiences and advice within a community of individuals managing diabetes.

Preliminary user testing of the prototype demonstrated positive results, particularly in usability and perceived benefits. However, further research is required to assess the long-term impact of the application on diabetes management outcomes. To view the prototype, please visit this link.

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