Myglooco: A Holistic Approach to Blood Glucose, Diet, Medication and Exercise Tracking

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Abstract

Diabetes management requires continuous monitoring of blood glucose levels, dietary intake, and physical activity to prevent complications and improve patient outcomes. However, traditional self-management methods are often cumbersome, leading to poor adherence and suboptimal glycemic control. This paper presents the development of an integrated digital diabetes management system that combines blood glucose monitoring, dietary tracking, medication tracking, and exercise tracking into a unified platform. The system leverages cloud-based storage, mobile applications, and real-time analytics to provide users with personalized insights and generate comprehensive health reports.

A user-centered design approach was employed to ensure ease of use, and the system is to be evaluated through usability testing and preliminary clinical trials. In addition, the study will explore data security measures and potential AI-driven predictive analytics to improve personalized diabetes management. Current findings suggest that a holistic, technology-driven approach can significantly improve diabetes self-management, promoting better adherence and improved health outcomes.

The source codes for this work can be found at:
https://github.com/Joemuema/MyGloocoGit.

Keywords: Diabetes management, blood glucose monitoring, diet tracking, exercise monitoring, digital health, mobile health applications, self-management, predictive analytics.

1 Introduction

Diabetes, also known as diabetes mellitus, is a group of common endocrine diseases characterized by sustained high blood sugar levels[1].It affects millions of people worldwide, estimated to be around 830 million, as of 2022. Currently, people living with diabetes are faced with a myriad of challenges, most of which are related to their current help systems. Some rely on manual record keeping for their blood sugar level, which has been shown to be cumbersome, and others have little to no information on diet planning[2], as well as exercise planning, which hinders their overall quality of life.

2 Related Work

Recent years have seen a surge in mobile health (mHealth) applications targeting diabetes management. Systematic reviews [5, 4] have reported improvements in glycemic control and self-management behaviors when patients use mobile apps designed for diabetes care. However, many existing solutions lack comprehensive personalization and often do not integrate multiple aspects of diabetes management into a single platform. MyGlooco distinguishes itself by combining these elements; addressing blood sugar variability through dual-curve visualization, offering culturally relevant dietary guidance, and providing detailed physical activity and medication management modules.

3 Methods

3.1 System Design and Architecture

MyGlooco was developed as a cross-platform mobile application using modern development frameworks. The architecture is modular, allowing for the independent development of features that include:

3.1.1 Blood Sugar Analysis

Users input pre- and post-meal blood sugar readings. The app visualizes these readings on separate curves to facilitate trend analysis and early detection of abnormal fluctuations.

3.1.2 Diet Management

This module logs meal information, utilizes a locally curated food database (sourced from the Kenyan Government's food composition and recipe documents courtesy of Dr. Florence Kimani and Dr. Isaac Oteyo), and enables users to estimate nutritional values based on custom meal assembly.

3.1.3   Physical Activity Monitoring

Users log various physical activities and access categorized exercise routines (aerobic, strength, flexibility) with detailed instructions.

3.1.4   Medication Management

Users record medication details, receive automated refill alerts, and set customizable reminders.

3.1.5   Quality of Life Systems

This module includes report generation, facilitating the sharing of comprehensive health reports with healthcare providers, and an education section that offers resources on diabetes management.

3.2   Business Model

3.2.1   Revenue Generation

Subscription and Freemium Model: MyGlooco can offer a freemium version where core functionalities (e.g. blood sugar monitoring, basic meal tracking and educational content) are free, while advanced features, such as predictive analytics, detailed reporting are available through a monthly or annual subscription. This dual structure encourages widespread adoption while generating recurring revenue from users who need premium features.

3.2.2   Target users

- **Primary Users:** Individuals diagnosed with diabetes (Type 1, Type 2, or gestational) seeking personalized self-management tools.

- **Secondary Users:** Caregivers and family members who support diabetic people, as well as healthcare professionals who might use the app for remote monitoring or consultation.

3.2.3   Market Entry Strategy

- **Initial Launch:** Focus on pilot testing in key urban centers in Kenya, leveraging partnerships with local clinics, diabetes associations, and healthcare providers.

- **User Engagement:** Use targeted marketing campaigns through social media, community health programs, and endorsements from local healthcare professionals to build trust and user engagement.

- **Feedback Loop:** Incorporate extensive user feedback (via in-app surveys and structured questionnaires) to refine the app before a broader roll-out.

- **Expansion:** Once the product is refined and validated, it gradually expands to other East African countries and eventually to international markets, adapting the app to regional dietary and cultural contexts.

3.3 Development and Data Sources

The app was developed using agile methodologies, ensuring iterative enhancements based on user feedback. Data for the dietary module were manually extracted and refined from reputable local sources, while data on blood sugar and medication are provided by the user. One significant challenge encountered was the scarcity of preexisting datasets for developing a predictive blood sugar model, which has necessitated reliance on user data during the public test phase (with informed consent).

4 Implementation

MyGlooco integrates several key modules:

4.0.1 Blood Sugar Module

This feature allows manual input of blood sugar readings and generates visual graphs that plot pre- and post-meal data. The visualization is designed to highlight trends and disparities, alerting users to potential health problems.

4.0.2 Diet Module

In addition to logging meals, users can search for recipes reflective of local Kenyan cultures or create custom meals using a plate method interface that estimates calorie and macronutrient intake.

4.0.3 Physical Activity Module

Users can log exercise activities and view historical data to monitor their progress, supplemented by a library of exercise routines.

4.0.4 Medication Module

The app manages medication intake, including reminders and refill notifications, ensuring adherence to prescribed regimens.

4.0.5 Quality of Life Module

This section generates health reports and provides educational content that supports self-management and professional consultation.

5 Evaluation and Discussion

Preliminary usability testing has shown promising levels of participation, with users particularly appreciating the visual feedback in the Blood Sugar module and the culturally tailored Diet module. However, challenges such as data scarcity for predictive modeling and the need for seamless integration with automatic blood sugar trackers have been identified. These challenges are consistent with findings from related studies [3, 5] that highlight the complexity of developing fully integrated mHealth solutions for diabetes.

User feedback emphasizes the importance of personalization in managing a condition as variable as diabetes. The modular design of MyGlooco allows for future enhancements, such as integrating machine learning for blood sugar prediction and enabling direct communication between users and healthcare practitioners.

6 Future Work

Future development will most likely focus on:

- Completion and validation of the blood sugar prediction model using data collected during extended user testing.

- Integrating with wearable devices for automatic monitoring of blood sugar.

- Implementing direct chat features to enhance real-time support from healthcare professionals.

- Expanding the local food and recipe database to cover a broader range of dietary options.

7 Conclusion

MyGlooco represents an innovative approach to personalized diabetes management, combining multiple health management functionalities in a single, user-friendly mobile app. By addressing key limitations of traditional tools and incorporating culturally relevant data, MyGlooco has the potential to significantly improve the quality of life for individuals living with diabetes. Ongoing evaluation and iterative development will continue to refine the app, with future enhancements focused on predictive analytics and seamless integration with health monitoring devices.

References

[1] Erika F. Brutsaert, MD, New York Medical College. (2023). `https://www.msdmanuals.com/home/hormonal-and-metabolic-disorders/diabetes-mellitus-dm-and-disorders-of-blood-sugar-metabolism/diabetes-mellitus-dm?ruleredirectid=742`

[2] Toumpanakis A, Turnbull T, Alba-Barba I (2018-10-30). Effectiveness of plant-based diets in promoting well-being in the management of type 2 diabetes: a systematic review. BMJ Open Diabetes Research And Care. 6 (1) https://drc.bmj.com/content/6/1/e000534

[3] Free, C., Phillips, G., Watson, L., Galli, L., Felix, L., Edwards, P., Patel, V., & Haines, A. (2013). The Effectiveness of Mobile-Health Technology–Based Health Behaviour Change or Disease Management Interventions for Health Care Consumers: A Systematic Review. *PLoS Medicine, 10*(1), e1001362. https://doi.org/10.1371/journal.pmed.1001362

[4] Hou, C., Carter, B., Hewitt, J., Francis, T., & Mayor, S. (2016). Do Mobile Phone Applications Improve Glycemic Control (HbA1c) in the Self-management of Diabetes? A Systematic Review, Meta-analysis, and GRADE. *Diabetes Care, 39*(11), 2089–2095. https://doi.org/10.2337/dc16-0862

[5] Wu, Y., Yao, X., Vespasiani, G., Nicolucci, A., Dong, Y., Kwong, J., & Li, X. (2017). Mobile App–Based Interventions to Support Diabetes Self-Management: A Systematic Review of Randomized Controlled Trials. *JMIR mHealth and uHealth, 5*(3), e35. https://doi.org/10.2196/mhealth.7073