Diabetes Care Reimagined: An Integrated System for Real-time Monitoring, Dietary Management, and Personalized Healthcare

Md. Jahidul Hossain Mekat[1], Kazi Samin Nawal[2], Mustaqueem Alam[3], Anika Jasim Ema[4], Mohammed Tashfiq Islam[5], Md. Shahduzzaman[6], and Shahmaruf Siraj Mugdho[7]

Department of Computer Science Engineering, Independent University of Bangladesh

Dhaka, Bangladesh

Emails: {2221395[1], 2220256[2], 2220769[3], 2220661[4], 2221651[5], 2131297[6], 2220644[7]}@iub.edu.bd

***Abstract*—To address the limitations of current diabetes monitoring systems regarding real-time data and personalized care, our study proposes a novel database-driven Integrated Health Monitoring System to address limitations in real-time data access and personalized care for diabetes management. Our solution offers a central database for patient demographics, diagnoses, physician information and medical records. This facilitates a comprehensive patient view, enabling real-time data analysis for personalized dietary and medication recommendations. User-friendly interfaces for both patients and healthcare providers are supported by a secure backend with a scalable database and secure APIs. The focus on usability, scalability, and security ensures efficient data management for an expanding user base. By integrating advanced database techniques, our study seeks to improve diabetes care through real-time, personalized healthcare solutions, ultimately elevating the standards of diabetes management.**

***Keywords*—Diabetes Management, Real-time Health Monitoring, Dietary Recommendations, Data Management, Medical Information Systems, Healthcare.**

I. Introduction

The era of big data is marked by a staggering amount of unstructured data production, particularly in healthcare, driving the need for innovative analytics solutions [1]. In such context, diabetic patients are often facing significant challenges due to fragmented data, lack of real-time monitoring, poor nutritional management, disorganized prescription tracking, insufficient healthcare facility information, and limited individualized recommendations. There is a big absence of personalized education as recommended by clinical guidelines, in current diabetes applications, alongside the underdevelopment of potentially beneficial social media integration, shedding light on how the lack of these core features may impact clinical outcomes [2]. These shortcomings result in a lack of a holistic perspective on patient health, leading to poor adherence to treatment regimens and sub-optimal health outcomes. The increasing prevalence of diabetes worldwide necessitates innovative solutions that can address these issues comprehensively, thereby improving the quality of care and patient well-being. State-of-the-art signal processing and machine learning techniques have significantly improved continuous glucose monitoring systems (CGM) sensor performance and reduced calibration frequency, with advancements paving the way for smarter, more user-friendly diabetes management solutions [3]. This indicates that we need potential advancements in diabetes monitoring systems and highlight the importance of understanding gastrointestinal mechanisms and interventions for improved treatment outcomes in the perspective of the operable nature of Type 2 diabetes [4].

Current diabetes management systems do not combine all components of patient care into a single, solid system. It has underlined that considerable advances in simple, continuous glucose monitoring devices, with a specific focus on alternative physiological fluids like as ocular fluid and sweat, should be made in order to improve diabetes therapy while reducing involvement [5]. This fragmentation hinders effective monitoring and personalized treatment, ultimately affecting patient outcomes negatively. Continuous glucose monitoring systems must be thoroughly evaluated for performance and accuracy, particularly in detecting hypoglycemic episodes, using complete measurement procedures, hypoglycemia tests, and robust data processing tools [6]. We have been using almost similar advanced technology for users to communicate with the physician to enhance patient-doctor interaction in most of the cases [7]. An integrated health monitoring system that consolidates patient demographic and diagnosis data, physician and facility information, and provides real-time tracking can bridge these gaps. By offering unified data access for patients and clinicians, continuous health monitoring, personalized dietary recommendations, and automated medication tracking, such a system can significantly enhance diabetes management.

The primary objective of this work is to develop a comprehensive Integrated Health Monitoring System specifically for diabetic patients. It should have the capability to identify nutrient deficiencies, provide personalized recommendations, and potentially influence health outcomes such as body mass index and blood pressure [8]. It is essential to sort and analyze algorithms for predicting future glucose levels, whether they use simply CGM data or include additional inputs such as carbohydrate intake and insulin dose. Advanced existing solutions declared prediction algorithms based on model structure, distinguishing between physiological and black-box models, and frequently used AI techniques such as neural networks, random forest, and support vector regression to improve glucose prediction accuracy and alerts for hypo/hyperglycemic events [9].Furthermore, there is insufficient evidence of clinical validity, effectiveness, accuracy, and safety in diabetes digital health technology, as well as usability and interoperability issues, highlighting the need for systematic guidelines, improved access to safety reports, increased investment in clinical data collection, improved accessibility and security of diabetes mobile apps, and improved communication and collaboration among stakeholder groups [10]. Therefore our proposed system aims to manage patient demographic and diagnosis data, physician and facility information, and offer real-time health monitoring. Additionally, it seeks to provide individualized dietary and medication recommendations based on real-time data analytics, thus enabling healthcare providers to update patient care plans efficiently. There is also a focus on creating a user-friendly platform that ensures data integrity, scalability, and security which are to be implemented accordingly.

Integration of daily patient inputs is essential for optimizing medication management in diabetes monitoring systems, as it provides patients with enhanced medication recommendations and professional guidance. This makes the job more efficient and effective for both the patients and the system [11]. Using demographic values and health-related data for diabetes management is a very strategic approach. In such an approach, the system collects the data of the patients like the demographic values and the health-related data for analysis and diabetes risk classification. It provides feedback, communication, and data visualization through a web platform from the data that are stored using a database [12]. The system needs to address the critical need for convenient disease monitoring, insulin dosage calculation, and adjustment by providing features such as medical data management, insulin dose calculation, blood sugar statistics review, reminder creation, and food ration management. It is also necessary to focus on data storage, synchronization, and access for users and healthcare professionals, significantly improving diabetes management [13].

II. LITERATURE REVIEW

The development of mHealth interventions and the integration of advanced technologies such as blockchain, IoT, and AI in diabetes management have been the focus of numerous studies where they had to explore the creation of blockchain-based platforms combined with IoT for secure and continuous monitoring of diabetic patients. Such study had underscored the importance of secure, real-time data collection and remote patient monitoring, although it identified a significant gap in efficiently managing and querying the large volumes of data generated by IoT sensors [14]. There are also various diabetes management apps, which highlights the need for a feature-rich, tailored app for users in least developed countries. With the goal to improve diabetic self-management, it has been highlighted that combining features like glucose monitoring, medication tracking, and automatic data transmission is essential. Solid user data collecting and easy technological integration are also crucial [15]. Furthermore, the creation and assessment of a web-based application showed promise for enhanced self-management and real-time monitoring for individuals with diabetes; nevertheless, it also emphasized the absence of an automated insulin dose calculation and extensive nutritional suggestion functionalities [16].

The treatment of diabetes has integrated predictive analytics with state-of-the-art monitoring technologies while more study has been done on this area. In a previous study, the target group was Chinese people with type 2 diabetes, and mHealth was managed using a mobile application when combined with a detachable glucose sensor. This strategy improved the efficacy and accessibility of lifestyle changes by providing real-time feedback and specific recommendations from medical specialists. The findings did support larger sample sizes and enhanced outcomes adaptation in order to more accurately represent the Type 2 Diabetes Mellitus (T2DM) patient population [17]. In another similar initiative, the objective was to use software development and operational research approaches inorder to produce a web-based software solution that would allow diabetes specialists and patients to interact with each other. This platform made it easier to engage in real time, estimate blood sugar levels, and adjust treatment plans. However, it also made it clear that more security, more effective data management, and more extensive health data analytic skills were required [18]. A systematic approach to the enhancing of the explainability of AI in healthcare was also investigated, particularly for diabetes diagnosis and this had highlighted the integration of diverse Explainable artificial intelligence (XAI) tools to improve understanding and trust in AI-based recommendations but noted the absence of a feedback mechanism to capture user interactions for continuous improvement [19].

Advancements in AI and mobile health technologies have shown great promise in diabetes management. Therefore AI applications in diabetes care are able to do prediction, screening, diagnosis, treatment, and the development of an AI-assisted digital healthcare ecosystem. Despite the demonstrated potential of AI, researches have pointed out the lack of clinical integration and adherence, suggesting that these issues could be mitigated through robust data validation processes and seamless clinical workflow integration [20]. There was also a proposed Artificial Intelligence Diabetes

Management (AIDM) system, which had integrated 5G technology and AI and had aimed to manage both acute and chronic diabetes complications with a five-layer architecture for enhanced efficiency. Such system had underscored the need for optimizing data processing and storage methods to handle the massive amounts of patient data collected efficiently [21]. Studying an web-based telemedicine applications for type 1 diabetes self-management was also able to highlight the need for scalability, integration with electronic health records, and additional evaluation of clinical effectiveness in order to ensure greater usability and satisfaction among patients, parents, and physicians [22].

Numerous research had used m-Health and artificial intelligence (AI) technology to examine different facets of diabetes care. An Extreme Learning Machine (ELM)-powered cloud-based e-Health system was able to enhance the ability to diagnose and monitor diabetes early [23]. A smartphone app for gestational diabetes that delivers personalized blood glucose prediction can allow thorough monitoring and tracking as well [24]. An analysis of ten mobile health applications reveals the necessity for broader user representation and seamless integration with healthcare platforms [25]. A remote healthcare monitoring framework consolidates data from multiple devices to predict diabetes risk and enable timely intervention [26]. Diabetes self-management is also enhanced with the use of an AI-driven nutrition management system when combined with ongoing glucose monitoring and physician input [27]. Self-care is improved by an Electronic medical records (EMR)-integrated mobile application for managing type 2 diabetes by providing automated and medical expert feedback [28]. With wearable technology and machine learning algorithms for real-time activity categorization, diabetes self-management and data accuracy can be further improved [29]. The variety of AI applications in diabetes care can also demonstrate the need for better data integration and future validation in order to improve algorithm performance and patient outcomes. Such technologies should include diagnosis, treatment, and prediction [30]

Our study offered an integrated strategy that includes real-time tracking, nutritional management and individualized recommendations, by addressing the difficulties found in earlier studies regarding developing such similar solutions. Our solution is able to satisfy the demand for more reliable user data gathering and seamless technological integration with a feature-rich online mobile app designed for a variety of demographics. It also integrates glucose monitoring, medication tracking, and low-cost data transmission [15]. Furthermore, we improve accessibility and efficacy of self-management, especially for individuals who are marginalized, by integrating real-time feedback systems as well as customized instruction from healthcare experts [17]. Our application also seeks to close the gaps that were left by previous apps by including an automatic insulin dose calculator and a detailed nutritional advice system , in order to eradicate the gaps [16]. To further promote user engagement and adherence, our system interfaces with already-existing electronic medical records, guaranteeing the scalability and the ongoing development through channels for feedback [19]. Through the help of these characteristics, our innovation successfully closes the gaps found in earlier research and offers a reliable diabetes control solution.

III. Problem Statement

A series of studies have been conducted to investigate various aspects of m-Health interventions and big data analytics in diabetes management. The research has highlighted several challenges, including limited long-term follow-up data and unclear effectiveness of apps [31]. In examining m-Health's impact on self-management behaviors among under served populations, a significant gap emerged regarding the lack of studies on the long-term effects of remote health consultations [32]. Additionally, research has focused on enhancing patient self-efficacy and behavior changes through cloud-based services and mobile apps, emphasizing the identification of essential features for tailored Type 2 Diabetes Mellitus (T2DM) self-care apps [33]. Furthermore, investigations into m=Health interventions' effectiveness in managing diabetes and improving patient self-efficacy in metabolic syndrome patients have revealed a lack of recorded reasons for program discontinuation [34]. Moreover, the exploration of big data analytics for healthcare, particularly in predictive modeling of cardiovascular disease risk assessment using machine learning techniques, has underscored gaps in comparing diverse ML algorithms and analyzing the impact of data pre-processing [35]. Furthermore, the potential of a cloud-based m-Health platform in diabetes self-management interventions has been highlighted, revealing gaps in research on low motivation patients and the need for effective adherence management techniques [36].

In response to these identified gaps, our Integrated Health Monitoring System for Diabetic Patients project conducted a comprehensive gap analysis based on the findings of these studies. Through the integration of real-time tracking, dietary management, and personalized recommendations, our system aims to address these challenges by efficiently managing patient demographic and diagnosis data, along with relevant physicians' information. Additionally, our system facilitates the seamless management of hospitals, diagnosis centers, and related facilities information. By providing tailored recommendations for diet and facilities based on individual patient health conditions, and maintaining an updated record of prescribed medications, our system endeavors to bridge the identified gaps and offer a robust solution for diabetes management.

IV. Methodology

A. Rich Picture Existing System (As-Is)

The existing systems for managing diabetic patients present several critical challenges that hinder effective disease management.

1) Fragmented Capabilities: Current platforms lack comprehensive integration, with no single system encompassing all necessary functionalities such as real-time health monitoring, dietary management, and personalized recommendations. This fragmentation results in patients and healthcare providers needing to use multiple applications and tools, leading to inefficiencies and inconsistencies in data management. We tied to study those gaps and analyse those by generating the As-IS rich picture.

2) Manual Data Entry: One of the common issue in the existing solutions is that patients and healthcare providers rely heavily on manual data input for tracking health metrics, which is time-consuming and prone to errors. This manual process often results in incomplete or inaccurate records, making it difficult to maintain a consistent and reliable health monitoring routine.

3) Limited Inter-connectivity: Current systems frequently function independently from one another, allowing little communication between various hospitals, testing facilities, and healthcare professionals. In order to provide complete and coordinated treatment, the smooth sharing of patient information is hampered by this lack of inter-connectivity.

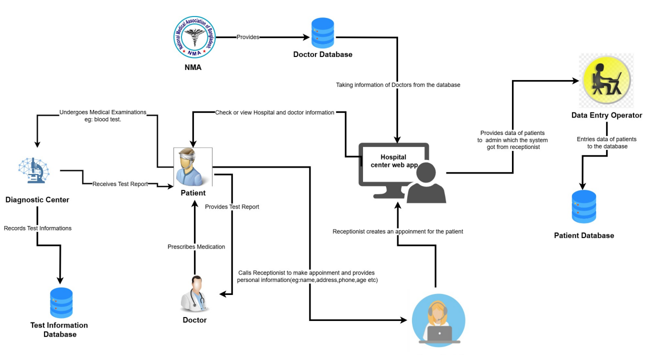

Fig. 1. Rich Picture Existing System (As-Is)

4) Inadequate Data Utilization: Presently available solutions fail to efficiently utilize gathered data to offer patients tailored suggestions or actionable insights. Missed chances for proactive disease management arise from the largely unrealized promise of data analytics and machine learning to improve patient care.

5) Poor User Experience: Many current applications lack user-friendly interfaces, making it difficult for patients to efficiently manage their health data. This poor user experience can lead to reduced engagement and compliance, ultimately affecting the effectiveness of diabetes management.

6) Insufficient Automation: Routine tasks such as appointment scheduling, medication reminders, and dietary advice are not automated, placing an additional burden on patients and healthcare providers. The lack of automation also increases the risk of non-compliance with prescribed health regimens.

TABLE I
Summary of Existing System Challenges

Challenges	**Implications**
Fragmented Capabilities	Inefficiencies and inconsistencies in data management
Manual Data Entry	Incomplete or inaccurate records
Limited Inter-connectivity	Hindered sharing of patient information
Inadequate Data Utilization	Missed opportunities for proactive disease management
Poor User Experience	Reduced engagement and compliance
Insufficient Automation	Increased risk of non-compliance

B. Rich Picture Proposed System (To-Be)

Our proposed web application aims to address the shortcomings of current systems by providing a fully integrated solution with real-time tracking, dietary management, and personalized recommendations.

1) Database Infrastructure: Our system will utilizes MySQL databases for centralized storage of patient demographics, diagnosis data, doctor information, hospital details, and other critical data ensuring data integrity, security, and easy access for authorized users, facilitating efficient data management and retrieval.

2) User Interface: The application aims to use top front-end development to create a user-friendly and responsive interface which will allow the patient portal allow patients to enter health data, schedule appointments, and receive individualized recommendations through a seamless interface, enhancing the overall user experience and engagement.

3) Core Functionalities: Health data management enables patients to log various health metrics, such as blood glucose levels, insulin doses, and dietary intake, which are stored in the MySQL database. The integrated appointment scheduling system allows patients to book appointments with their healthcare providers, ensuring timely medical consultations. The system also aims to generate personalized recommendations on diet and lifestyle changes based on the patient's health data, providing valuable guidance for managing diabetes effectively.

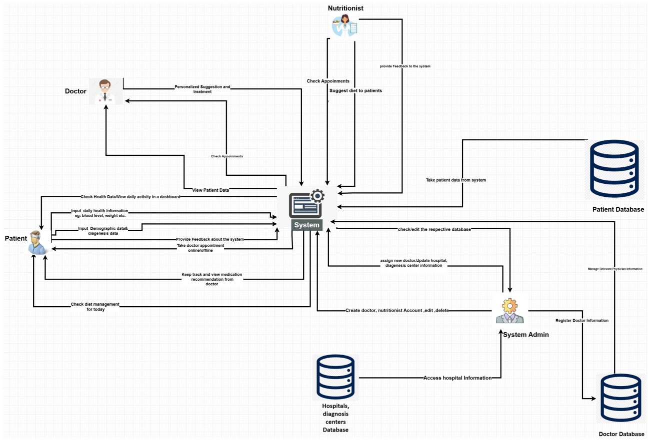

Fig. 2. Rich Picture Proposed System (To-Be)

4) Data Flow and Management: Real-time data syncing ensures continuous synchronization of patient data with the database, keeping all health records up-to-date. The feedback loop enables doctors to access patient data, provide feedback, and prescribe therapies directly through the system. These updates are to be stored in the database for future reference and analysis, ensuring a comprehensive and dynamic health management process.The Dietary management offers dietary suggestions and meal plans customized to the patient's health condition and preferences, promoting better nutritional habits.

5) Administration and Maintenance: System administrators oversee operations, including the creation of doctor accounts and regular updates to the database. Robust security measures are aimed to be implemented to protect patient information and ensure compliance with healthcare regulations, safeguarding sensitive data against unauthorized access and breaches.

TABLE II
SUMMARY OF PROPOSED SYSTEM FEATURES

Features	**Benefits**
Database Infrastructure	Data integrity, security, and easy access
User Interface	Enhanced user experience and engagement
Core Functionalities	Comprehensive health data management and personalized recommendations
Data Flow and Management	Continuous synchronization of patient data and dynamic health management
Administration and Maintenance	Efficient system oversight and robust security measures

C. Entity Relationship Diagram

TBA

D. Normalization

TBA

E. Software Architecture

TBA

F. User Interface

TBA

V. RESULT ANALYSIS

TBA

VI. DISCUSSION

TBA

A. Challenges Faced

TBA

B. Environmental, Social, Ethical issues

Environmental, social, and ethical concerns are raised by the Integrated Health Monitoring System for Diabetic Patients, just like they are by any technical advancement in the healthcare field. The widespread implementation of digital health solutions has brought about the need for a thorough evaluation of the energy and carbon footprint of the system from an environmental perspective. In order to prevent the expansion of already-existing disparities in healthcare, it is crucial to provide fair access to the system for people from a variety of socioeconomic backgrounds. Comprehensive data governance structures and commitment to ethical norms are necessary to ethically protect patient confidentiality and autonomy in the gathering and use of health data.

The previously mentioned environmental, social, and ethical concerns highlight the need of making thoughtful decisions and involving stakeholders throughout the system's development and implementation. In advance addressing these issues would help the project not only reduce possible dangers but also improve its social effect and advance moral and just healthcare delivery.

VII. CONCLUSION AND FUTURE WORK

In the field of technological innovation, the search for novel answers to critical social concerns, such as the treatment of chronic diseases like diabetes, continues. In the framework of this endeavor, the Integrated Health Monitoring System for Diabetic Patients initiative is a key step toward realizing technology's promise to transform healthcare delivery. This project is an example to a intersection of cutting-edge research and practical implementation by combining m-Health treatments, big data analytics, and user center design concepts. However, like with every pioneering attempt, the road is far from over. Looking ahead, possibilities for additional investigation and progress abound, from the integration of wearable devices to the improvement of machine learning algorithms.

From the integration of wearable devices to the improvement of machine learning algorithms, there are several options to further explore and extend the system's capabilities and effect. Furthermore, a strong emphasis on connectivity, scalability, and thorough testing highlights the project's dedication to efficacy and dependability. As this project develops, its story becomes linked with the larger story of technology innovation in healthcare, reaching a connection with the values of collaboration, innovation, and continuous enhancement. Thus, this project is both a memorial to the progress that has been done and a sign of possibilities that have not yet been explored in the catalogs of literature on technology-driven healthcare solutions.

[37] [38] [39] [40] [41] [42]

References

[1] A. Ganjar, S. Muhammad, I. M. Fazal, S. M. Alex, F. N. Latif, and R. Jongtae, "A personalized healthcare monitoring system for diabetic patients by utilizing ble-based sensors and real-time data processing," *Sensors*, vol. 18, no. 7, p. 2183, 2018.

[2] C. Taridzo, F.-L. Luis, Å. Eirik, H. Gunnar, *et al.*, "Features of mobile diabetes applications: review of the literature and analysis of current applications compared against evidence-based guidelines," *Journal of medical Internet research*, vol. 13, no. 3, p. e1874, 2011.

[3] A. Giada, V. Martina, F. Andrea, and S. Giovanni, "Calibration of minimally invasive continuous glucose monitoring sensors: state-of-the-art and current perspectives," *Biosensors*, vol. 8, no. 1, p. 24, 2018.

[4] R. Francesco, "Is type 2 diabetes an operable intestinal disease? a provocative yet reasonable hypothesis," *Diabetes care*, vol. 31, no. Supplement_2, pp. S290–S296, 2008.

[5] B. Danielle, D. Colm, F. Larisa, and D. Dermot, "Glucose sensing for diabetes monitoring: recent developments," *Sensors*, vol. 17, no. 8, p. 1866, 2017.

[6] D. R. in Children Network (DirecNet) Study Group, "Accuracy of the glucowatch g2 biographer and the continuous glucose monitoring system during hypoglycemia: experience of the diabetes research in children network," *Diabetes care*, vol. 27, no. 3, pp. 722–726, 2004.

[7] R. A. Sowah, A. A. Bampoe-Addo, S. K. Armoo, F. K. Saalia, F. Gatsi, B. Sarkodie-Mensah, *et al.*, "Design and development of diabetes management system using machine learning," *International journal of telemedicine and applications*, vol. 2020, 2020.

[8] C. K. Suryadevara, "Revolutionizing dietary monitoring: a comprehensive analysis of the innovative mobile app for tracking dietary composition," *International Journal of Innovations in Engineering Research and Technology*, vol. 10, no. 88, 2023.

[9] M. Vettoretti, G. Cappon, A. Facchinetti, and G. Sparacino, "Advanced diabetes management using artificial intelligence and continuous glucose monitoring sensors," *Sensors*, vol. 20, no. 14, p. 3870, 2020.

[10] G. A. Fleming, J. R. Petrie, R. M. Bergenstal, R. W. Holl, A. L. Peters, and L. Heinemann, "Diabetes digital app technology: benefits, challenges, and recommendations. a consensus report by the european association for the study of diabetes (easd) and the american diabetes association (ada) diabetes technology working group," *Diabetes care*, vol. 43, no. 1, pp. 250–260, 2020.

[11] S.-D. C. Group, A. J. Farmer, J. Allen, Y. K. Bartlett, P. Bower, Y. Chi, D. P. French, B. Gudgin, E. Holmes, R. Horne, *et al.*, "Supporting people with type 2 diabetes in effective use of their medicine through mobile health technology integrated with clinical care (summit-d pilot): results of a feasibility randomised trial," *Pilot and Feasibility Studies*, vol. 10, no. 1, p. 15, 2024.

[12] S. Harshini, "An analytical predictive model and secure wed based personalized diabetes monitoring system using stacking ensemble classification,"

[13] I. Volkov and G. Radchenko, "Diameter: a mobile application and web service for monitoring diabetes mellitus," in *2020 Ural Symposium on Biomedical Engineering, Radioelectronics and Information Technology (USBEREIT)*, pp. 0384–0387, 2020.

[14] D. Khan, L. T. Jung, M. A. Hashmani, M. K. Cheong, *et al.*, "Blockchain enabled diabetic patients' data sharing and real time monitoring," in *CS & IT Conference Proceedings*, vol. 12, CS & IT Conference Proceedings, 2022.

[15] M. A. Basar, H. N. Alvi, G. N. Bokul, M. S. Khan, F. Anowar, M. N. Huda, and K. A. A. Mamun, "A review on diabetes patient lifestyle management using mobile application," in *2015 18th International Conference on Computer and Information Technology (ICCIT)*, pp. 379–385, 2015.

[16] B. Garcia-Zapirain, I. de la Torre Diez, B. Sainz de Abajo, and M. López-Coronado, "Development, technical, and user evaluation of a web mobile application for self-control of diabetes," *Telemedicine and e-Health*, vol. 22, no. 9, pp. 778–785, 2016.

[17] M. Guo, F. Meng, Q. Guo, T. Bai, Y. Hong, F. Song, and Y. Ma, "Effectiveness of mhealth management with an implantable glucose sensor and a mobile application among chinese adults with type 2 diabetes," *Journal of telemedicine and telecare*, vol. 29, no. 8, pp. 632–640, 2023.

[18] L. Grandinetti and O. Pisacane, "Web based prediction for diabetes treatment," *Future Generation Computer Systems*, vol. 27, no. 2, pp. 139–147, 2011.

[19] Y.-C. Wang, T.-C. T. Chen, and M.-C. Chiu, "A systematic approach to enhance the explainability of artificial intelligence in healthcare with application to diagnosis of diabetes," *Healthcare Analytics*, vol. 3, p. 100183, 2023.

[20] G. Zhouyu, L. Huating, L. Ruhan, C. Chun, L. Yuexing, L. Jiajia, W. Xiangning, H. Shan, W. Liang, L. Dan, *et al.*, "Artificial intelligence in diabetes management: advancements opportunities and challenges," *Cell Reports Medicine*, 2023.

[21] H. Ruochen, F. Wei, L. Shan, Z. Changwei, L. Yun, *et al.*, "An artificial intelligence diabetes management architecture based on 5g," *Digital Communications and Networks*, 2022.

[22] H. Ayatollahi, M. Hasannezhad, H. S. Fard, and M. K. Haghighi, "Type 1 diabetes self-management: developing a web-based telemedicine application," *Health information management journal*, vol. 45, no. 1, pp. 16–26, 2016.

[23] S. S. Kumar, Z. A. Taha, A. Ahmed, M. Debendra, A. A. A, P. Nikhat, and A. S. M, "A diabetes monitoring system and health-medical service composition model in cloud environment," *IEEE Access*, vol. 11, pp. 32804–32819, 2023.

[24] P. Evgenii, P. Polina, T. Aleksandra, B. Yana, Y. Zafar, G. Elena, *et al.*, "Development and evaluation of a mobile personalized blood glucose prediction system for patients with gestational diabetes mellitus," *JMIR mHealth and uHealth*, vol. 6, no. 1, p. e9236, 2018.

[25] Å. Eirik, F. D. Helge, S. S. Olav, C. Taridzo, T. Naoe, H. Gunnar, and T. J. T, "Mobile health applications to assist patients with diabetes: lessons learned and design implications," *Journal of diabetes science and technology*, vol. 6, no. 5, pp. 1197–1206, 2012.

[26] J. Ramesh, R. Aburukba, and A. Sagahyroon, "A remote healthcare monitoring framework for diabetes prediction using machine learning," *Healthcare Technology Letters*, vol. 8, no. 3, pp. 45–57, 2021.

[27] S. W. Park, G. Kim, Y.-C. Hwang, W. J. Lee, H. Park, and J. H. Kim, "Validation of the effectiveness of a digital integrated healthcare platform utilizing an ai-based dietary management solution and a real-time continuous glucose monitoring system for diabetes management: a randomized controlled trial," *BMC Medical Informatics and Decision Making*, vol. 20, pp. 1–8, 2020.

[28] E.-Y. Lee, J.-S. Yun, S.-A. Cha, S.-Y. Lim, J.-H. Lee, Y.-B. Ahn, K.-H. Yoon, and S.-H. Ko, "Personalized type 2 diabetes management using a mobile application integrated with electronic medical records: An ongoing randomized controlled trial," *International journal of environmental research and public health*, vol. 18, no. 10, p. 5300, 2021.

[29] M. B. Alazzam, H. Mansour, F. Alassery, A. Almulihi, *et al.*, "Machine learning implementation of a diabetic patient monitoring system using interactive e-app," *Computational Intelligence and Neuroscience*, vol. 2021, 2021.

[30] S. Ellahham, "Artificial intelligence: the future for diabetes care," *The American journal of medicine*, vol. 133, no. 8, pp. 895–900, 2020.

[31] E. Y. Lee, S.-A. Cha, J.-S. Yun, S.-Y. Lim, J.-H. Lee, Y.-B. Ahn, K.-H. Yoon, M. K. Hyun, and S.-H. Ko, "Efficacy of personalized diabetes self-care using an electronic medical record–integrated mobile app in patients with type 2 diabetes: 6-month randomized controlled trial," *Journal of medical Internet research*, vol. 24, no. 7, p. e37430, 2022.

[32] M. Grady, H. Cameron, B. L. Levy, and L. B. Katz, "Remote health consultations supported by a diabetes management web application with a new glucose meter demonstrates improved glycemic control," *Journal of Diabetes Science and Technology*, vol. 10, no. 3, pp. 737–743, 2016.

[33] M. Esmaeil, M. Mohammad, J. Nazanin, K. Amirali, H. Mohammad, M. Pegah, and M. Adele, “Design and development of a mobile-based self-care application for patients with type 2 diabetes,” *Journal of diabetes science and technology*, vol. 16, no. 4, pp. 1008–1015, 2022.

[34] A. J. H, H. Wolfgang, and W. Joerg, “Novel app-and web-supported diabetes prevention program to promote weight reduction physical activity and a healthier lifestyle: observation of the clinical application,” *Journal of diabetes science and technology*, vol. 12, no. 4, pp. 831–838, 2018.

[35] S. K. Dey, A. Hossain, and M. M. Rahman, “Implementation of a web application to predict diabetes disease: An approach using machine learning algorithm,” in *2018 21st International Conference of Computer and Information Technology (ICCIT)*, pp. 1–5, 2018.

[36] C. D. YP, L. T. MY, and M. Wen-Ya, “Enhanced self-efficacy and behavioral changes among patients with diabetes: cloud-based mobile health platform and mobile app service,” *JMIR diabetes*, vol. 4, no. 2, p. e11017, 2019.

[37] E.-G. Omar, T. Prem, N. Nevine, and E. Wael, “Mobile applications for diabetes self-management: status and potential,” *Journal of diabetes science and technology*, vol. 7, no. 1, pp. 247–262, 2013.

[38] B. P. Povalej, R. Eva, P. Majda, and K. Petra, “Mobile applications for control and self management of diabetes: a systematic review,” *Journal of medical systems*, vol. 40, no. 9, pp. 1–10, 2016.

[39] A. Shadi, L. Juan, and P. Vikram, “A personalized recommendation system to support diabetes self-management for american indians,” *IEEE Access*, vol. 6, pp. 73041–73051, 2018.

[40] B. B. Cezar, de Araújo Vânia Eloisa, G. I. Piassi, de Lemos Lívia Lovato Pires, G. Brian, B. Marion, D. L. Mauricio, and J. A. A. Guerra, “Efficacy of mobile apps to support the care of patients with diabetes mellitus: a systematic review and meta-analysis of randomized controlled trials,” *JMIR mHealth and uHealth*, vol. 5, no. 3, p. e6309, 2017.

[41] A. Nariman, B. J. E, D. R. L, S.-N. Arash, *et al.*, “Using a personal health library–enabled mhealth recommender system for self-management of diabetes among underserved populations: use case for knowledge graphs and linked data,” *JMIR formative research*, vol. 5, no. 3, p. e24738, 2021.

[42] X. L. Feng, H. Asmaa, N. Meranda, C. Rosemarie, L. Catherine, D. C. Deborah, and B. Anne-Sophie, “Adaptation of an adult web application for type 1 diabetes self-management to youth using the behavior change wheel to tailor the needs of health care transition: qualitative interview study,” *JMIR diabetes*.