International Journal For Advanced Research In Science & Technology
A peer reviewed international journal www.ijarst.in
ISSN: 2457-0362

THUMB POSITIONING ANALYSIS OF NEW ELLIPTICAL SHAPED MICROWAVE SENSORS FOR NON-INVASIVE GLUCOSE MONITORING

[1]DR.N.SREEKANTH, [2]A.KRISHNAVENI, [3]B.DIVYA, [4]CH.CHARISHMA

[1]Assosiate Professor, Department of Electronics and Communication Engineering, Malla Reddy Engineering College For Women, Maisammaguda, Dhulapally Kompally, Medchal Rd, M, Secunderabad, Telangana.

[2,3,4]Student, Department of Electronics and Communication Engineering, Malla Reddy Engineering College For Women, Maisammaguda, Dhulapally Kompally, Medchal Rd, M, Secunderabad, Telangana.

Abstract

This article offers a through review of diabetic technologies in india.Researchers are continuously integrating new technologies and advancing medical knowledge to improve the quantity of life for individuals with diabetes.It is crucial to engage patients consistently through effective technologies that address specific issues, as many challenges can be tacled with precision.With a large population and an estimated diabetes prevalence of around 8%, where type 2 diabetes makes up a significant portion, India faces a challenge.Additionally , the country's per capita health expenditure remains lower compared to other developing nations.

I.INTRODUCTION

The field of diabetes research in India has made significant progress over the years. The nation currently exhibits a diabetic population of more than 120 million individuals, with projections indicating a substantial increase to surpass 300 million by 2030. Based on data provided by the International Diabetes Federation, it is evident that the prevalence of diabetes in India is 7.4%, a figure that surpasses the global norm by approximately twofold. In the context of India, the management of diabetes can be achieved through the implementation of dietary modifications and engagement in regular physical activity. However, many individuals encounter challenges in adhering to medication schedules and comprehending the therapeutic benefits of their prescribed drugs. Consequently, the use of continuous glucose monitors is of considerable significance for individuals diagnosed with diabetes in India. These devices assist in monitoring blood glucose levels throughout the day and ensuring a continuous supply of

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insulin to prevent depletion prior to its required administration. In a survey encompassing 9581 adult participants (Figure 1) between the ages of 18 and 69, it was found that 9.3% exhibited elevated blood glucose levels, which included individuals using medication. Among this group, 45.8% were cognizant of their elevated blood glucose status. Among those who were aware of their condition, 78.8% were receiving treatment for elevated blood glucose levels, and within this subgroup, 32.7% had effectively managed their blood glucose levels, as evidenced by fasting blood glucose levels below 126 mg/dl. Individuals diagnosed with type 1 diabetes may be required to provide daily insulin injections within the confines of their own residence, whereas alternative treatment modalities such as insulin pumps may be employed by others. Individuals diagnosed with type 2 diabetes are advised to engage in regular physical activity and adhere to a nutritious dietary regimen that includes whole grains, vegetables, and fruits. Continuous glucose monitors (CGMs) are valuable instruments for patients with diabetes to effectively monitor their blood glucose levels throughout the day. If a healthcare professional has recommended the use of such devices, they can facilitate the more precise monitoring of glucose levels compared with the manual process of pricking one's own skin for blood samples at regular intervals throughout the day. Continuous glucose monitoring devices are used to monitor blood sugar levels in patients diagnosed with diabetes. In addition to discerning elevated, diminished, and standard levels, these measurements can provide insights into the efficacy of insulin therapy. The implementation of the device necessitates the insertion of a diminutive sensor beneath the dermal layer. The sensor is designed to periodically assess blood glucose levels at 5-min intervals and transmit the collected data to a glucose monitor via wireless communication. The monitor then presents the information on one of the three available screens, categorized as type 1 diabetes, type 2 diabetes, or pre-diabetes. The prevalence of diabetes in India is increasing. Over the course of the previous two decades, there has been a notable surge of 64% in the prevalence of diabetes among the Indian populace, resulting in a current affliction rate surpassing 16% of the total population. The incidence of type 2 diabetes exhibited a notably elevated rate among the female population, with a prevalence of 30%. Moreover, those of Nigerian descent face the highest susceptibility to

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ISSN: 2457-0362

the development of this ailment. The mean age of diabetes onset in India has exhibited an upward trend, increasing from 37 years in 1990 to 39 years in 2020 (Figure 2). This implies that individuals in younger age groups may face a higher level of vulnerability than those in previous generations, namely, their parents and grandparents. The causes behind this rise remain incompletely understood, while certain scholars posit a potential association with lifestyle modifications encompassing a sedentary existence, excessive body weight or adiposity, heightened stress levels, and insufficient engagement in physical exertion. Nevertheless, the etiology of diabetes is multi factorial, involving a complex interplay of genetic predisposition and environmental influences, including dietary patterns and lifestyle choices, which gradually impact metabolic processes. The healthcare system in India lacks the necessary resources and infrastructure to effectively address the challenges posed by diabetes and its associated ailments. One of the primary challenges encountered by diabetic individuals in India pertains to a dearth of knowledge among patients and their families, coupled with limited financial resources and inadequate availability of high-quality healthcare services. Several organizations are actively involved in enhancing diabetes awareness in India, such as the World Health Organization (WHO), International Diabetes Federation (IDF), and Diabetes Association of India (DAI). However, these organizations have encountered challenges in delivering adequate assistance to individuals afflicted by diabetes.

II.LITERATURE SURVEY

Ellahham S. Artificial Intelligence: The Future for Diabetes Care. The American Journal of Medicine. 2020; 133(8): 895-900. doi: 10.1016/j.amjmed.2020.03.033

Artificial intelligence (AI) is a fast-growing field and its applications to diabetes, a global pandemic, can reform the approach to diagnosis and management of this chronic condition. Principles of machine learning have been used to build algorithms to support predictive models for the risk of developing diabetes or its consequent complications. Digital therapeutics have proven to be an established intervention for lifestyle therapy in the management of diabetes. Patients are increasingly being empowered for self-management of diabetes, and both patients and health

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ISSN: 2457-0362

professionals are benefitting from clinical decision support. AI allows a continuous and burden-free remote monitoring of the patient's symptoms and biomarkers. Further, social media and online communities enhance patient engagement in diabetes care. Technical advances have helped to optimize resource use in diabetes. Together, these intelligent technical reforms have produced better glycemic control with reductions in fasting and postprandial glucose levels, glucose excursions, and glycosylated hemoglobin. AI will introduce a paradigm shift in diabetes care from conventional management strategies to building targeted data-driven precision care. Diabetes, a chronic metabolic condition, is a global health care burden. According to the International Diabetes Federation (IDF), 463 million people between ages 20 and 79 years have diabetes, and 374 million have impaired glucose tolerance.[1] By the year 2045, 693 million people are likely to have diabetes.[2] While 8.8% of the world population was reported to have diabetes in 2017, the numbers are projected to rise to 10% by 2045.[3]

Diabetes is associated with various complications and a significant morbidity and mortality.[4] It is important to intervene not only to treat but also to prevent and make a timely detection of diabetes. Management of diabetes is challenging because 1 of 2 adults with diabetes are undiagnosed, yet 10% of global health expenditure (US$760 billion) are spent on diabetes.[1]

Artificial intelligence (AI) finds widespread use in four key areas in diabetes care, including automated retinal screening, clinical decision support, predictive population risk stratification, and patient self-management tools.[5,6] The purpose of this review is to provide an overview of the scope and utility of AI in the prevention, diagnosis, and treatment of diabetes.

AI has been described as "a branch of computer science that aims to create systems or methods that analyze information and allow the handling of complexity in a wide range of applications."[7] The application of AI to diabetes is feasible and desirable for efficient data handling and the development of tools and devices for its management. To provide safer technology through AI, it is recommended to have safe designs, safety reserves, and procedural safeguards, with all uncertainties identified for all potential technical systems.[8]

Technical advances have introduced wearables, smartphones, and other gadgets that can aid in the continuous monitoring and tracking of patients symptoms and disease status. Physicians and health care professionals should allow patients to choose AI-assisted care for the effective management of diabetes.[9] AI can influence and improve 3 main domains of diabetes care: patients with diabetes, health care professionals, and health care systems (Figure 1). AI has added newer dimensions of self-care for patients with diabetes, introduced rapid and reliable decision making and flexible follow-ups for health care providers, and optimized resource utilization in health care systems.

The US Food and Drug Administration has approved IDx-DR, a device that uses an AI algorithm, to analyze digital retinal images and aids the early detection of retinopathy.[10] The American Diabetes Association (ADA) is supporting the use of AI in diabetes care. The ADA has recognized the use of autonomous AI for the detection of diabetic retinopathy and macular edema.[11]

AI allows patients to be informed and empowered. Digital solutions have a huge impact on health care systems as influences patient comorbidities, behaviors, time spent in health care facilities, and the need for frequent travel to and contact with health care providers.[12] AI has also improved the patient flow to the hospital and patient transfer within a hospital.[13]

Online diabetes communities and support groups offer a chance for patients to connect and learn from the experience of others. This collaborative method of learning more about the various aspects of the disease is engaging for patients and caregivers and has a positive impact on desired outcomes and well-being of patients.[14]

Early detection of diabetic retinopathy using AI is a cost-effective alternative to reduce the ophthalmic complications and preventable blindness associated with diabetes.[15] Continuous glucose monitors (CGMs) have the potential to reduce health care costs for diabetes.[16] The use of image-based screening of retinal changes and diabetic foot ulcers can avoid delays in referral for specialized care and improve the quality of life by enabling earlier and timely intervention.[9]

Several AI-based techniques have been applied in diabetes care. With the advent of AI, the diagnosis of diabetes has evolved beyond a few measurements of

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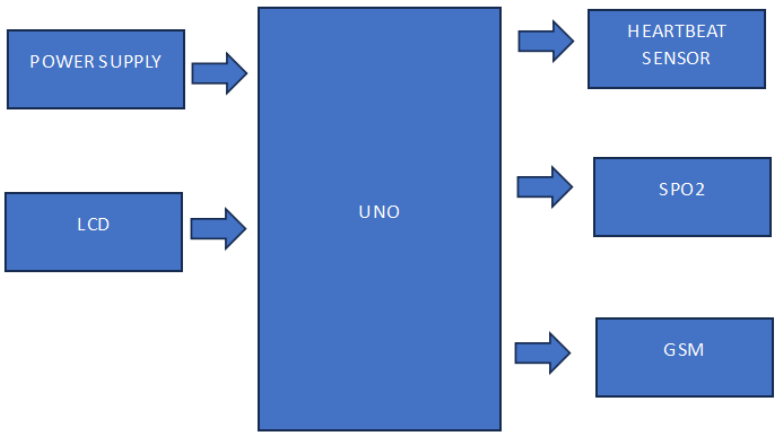
ISSN: 2457-0362

blood glucose levels and glycosylated hemoglobin (HbA1c).

Block diagram



III.PROPOSED SYSTEM

The proposed system for thumb positioning analysis in elliptical-shaped microwave sensors aims to develop a non-invasive method for continuous glucose monitoring, particularly for diabetic patients. The core of this system is the integration of microwave sensors in an elliptical design that can accurately detect changes in blood glucose levels by analyzing the thumb's interaction with the sensor surface.

Sensor Design and Placement:

The elliptical-shaped microwave sensor will be embedded in a compact, wearable device, such as a wristband or a handheld unit. This sensor will interact with the thumb, which serves as the contact point for measurement. The sensor's elliptical shape is designed to enhance sensitivity and ensure uniform detection of glucose levels across the contact surface, allowing for precise monitoring.

Thumb Positioning and Analysis:

The system will include an algorithm that analyzes the exact position and pressure of the thumb on the sensor to ensure consistent readings. Proper thumb placement is critical, as variations in pressure or positioning may impact the accuracy of glucose measurements. The algorithm will guide users through visual or haptic feedback, ensuring correct thumb placement each time a measurement is taken.

Non-Invasive Glucose Monitoring:

The embedded microwave sensors will emit low-power microwave signals that interact with the tissue beneath the thumb. Changes in glucose concentration will cause variations in the dielectric properties of the tissue, which will be detected by the sensor. The system will then process these variations to calculate blood glucose levels, which will be displayed to the user in real-time.

Data Processing and Display:

Once the microwave sensor captures the glucose data, it will be processed using embedded microcontrollers, which will apply advanced signal processing techniques to filter out noise and ensure accurate readings. The system will

wirelessly transmit the data to a smartphone or an external display unit where glucose levels can be monitored.

IV.CONCLUSION

Diabettes continues to be a pressing global issue, with an estimated 366 million people affected worldwide in 2021.This condition poses a particularly acute problem in India, where the prevalence of diabetes is on the rise.While there are some positive developments in managing diabetes, it is crucial to address its negative impacts as well.One major concern is the increasing mortality rate linked to diabetes mellitus.The high prevalence of diabetes is a significant public health challenge today. In india alone, over 4 million people are affected by this condition .According to the world health organization(WHO), it was projected that more than 5% of the indian population would be living with diabetes by the years 2015-2016.

Research on diabetes in india is divided into two main areas: clinical and basic research. Clinical research includes studies conducted in healthcare setting like hospitals, clinics, and universities, focusing on patient care and treatment methods.Basic research, on the other hand , aims to understand the underlying causes of diabetes, develop strategies to reduce its occurrence, and identify effective treatments and preventive measures.

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