Glycemic Stress Analysis and Wellness Monitoring

Arnab Ghosh[1], Pramit Das[2], Soham Ghosh[3], Sibom Singha Roy[4], Mourya Das[5], Dr. Karabi Ganguly[6]
[1,2,3,4,5] B.Tech, Department of Biomedical Engineering, JIS College of Engineering, Kalyani, Nadia, WB
[6] Associate Professor, Department of Biomedical Engineering, JIS College of Engineering, Kalyani, Nadia, WB

***Abstract*—- Considering the prevalence and complexity of diabetes, new surveillance technologies need to be developed to improve both well-being and diabetes management. In this work, we use arduino-based sensor integration to present a unique approach to wellness monitoring and glycemic stress analysis. Our system incorporates sensors to measure heart rate and temperature, providing real-time information on physiological parameters related to glycemic control. Using embedded systems, sensor data is collected and analyzed to detect stress conditions. This allows for aggressive management to reduce glycemic fluctuations. The system's flexible interface, including light-emitting diode (LED) signals and liquid crystal display (LCD), makes it easy to understand sensor readings and stress levels us in accurately detecting glycemic stress and diabetics certified by exhaustive testing. We demonstrate the effectiveness of our proposed monitoring methods and rely on them to support informed decision-making. Our research advances personalized glycemic monitoring programs through potential benefits in diabetes management and enhancing overall well-being.**

***Index Terms*: Diabetes, glycemic, embedded, stress monitoring systems.**

I. INTRODUCTION

Elevated blood sugar levels are a symptom of diabetes, a chronic metabolic disease resulting from decreased insulin production, action, or both. Blood glucose levels should be closely monitored during diabetes therapy to reduce the risk of chronic complications such as heart disease, arthritis, & retinopathy, and to prevent serious complications such as hyperglycemia and hypoglycemia tip. In addition to blood glucose (SMBG) and ambulatory glucose monitoring (CGM), the two most common traditional methods of glycemic follow-up, provide important insights into glycemic control, some major variables can often be missed acute, severe blood glucose changes, . In addition, many external medical variables such as stress, exercise, and diet affect glucose levels and affect glycemic control Newly developed programs incorporating more physiological markers to create glycemic status and the comprehensive assessment of overall well-being has attracted considerable attention in recent years This program uses data analytics, arduino and other microcontroller platforms, and sensor technology advances to provide tailored insights into stress response and glycemic regulation This paper presents a novel approach to glycemic stress assessment and wellness monitoring a using an arduino-based sensor integration method is presented. Temperature, IR and heart rate sensor are important indicators of physiological stress—combine with Arduino microcontroller technologies to provide real-time feedback on stress levels and glycemic status Use intelligent systems to analyze sensor data to explore patterns and developments in glucose control and response to stress.

II. LITERATURE REVIEW

Diabetes with diabetes research to explore different visions and technologies are conducted in this center with many blood sugar tests performed in the field of examination. CGM (continuous-glucose-inspection) using traditional techniques such as, and self-monitoring of blood glucose (SMBG) [2]. Although CGM systems use sensors on the skin to monitor glucose levels between real-time but steady-state blood glucose levels using a handheld glucometer on the SMBG. Although these techniques provide diagnostic data, the limitation of accuracy is frequency may limit its use in clinical settings.

Glycemic monitoring has been transformed by recent advances in wearable implantable sensor technology, which provides continuous non-invasive monitoring of glucose levels Wearable biosensor devices monitor glucose levels in real time using novel technologies such as sweating analysis and electrochemical sensing [3]. On the other hand, implantable sensors can provide continuous data collection and seamless communication with the body while monitoring blood or interstitial fluid glucose levels over time. Glycemic monitoring has been transformed by recent advances in wearable implantable sensor technology, which provides continuous non-invasive monitoring of glucose levels Wearable biosensor devices monitor glucose levels in real time using novel technologies such as sweating analysis and electrochemical sensing [4]. On the other hand, implantable sensors can provide continuous data collection and seamless communication with the body while monitoring blood or interstitial fluid glucose levels over time [5]. The goal of integrated approaches to stress screening and glucose monitoring is to provide a comprehensive picture of an individual's health [6]. These methods use a combination of sensors to monitor stress response and blood sugar levels. Data analysis and learning algorithms are used to identify patterns and trends [7]. These systems enable people to manage their wellness and health by analyzing sensor data, resulting in diabetes care and wellness programs tailored to diabetes.

The use of cellular health (or mHealth) packages has progressed strain evaluation and glycemic monitoring even more, offering gear for diabetes self-control and remote monitoring [8]. With the help of features like glucose monitoring, prescription reminders, or stress management techniques, mobile fitness programs allow customers to music their health in real time and get tailor-made comments [9]. These apps also allow sufferers and healthcare experts communicate, which encourages collaborative care and enhances glycemic results. Diabetes control calls for each glucose tracking and pressure evaluation, and trends in technologies for sensors and records analytics are propelling innovation in these regions [10]. The utilization of wearable sensors, surgically incorporated tracking systems, and cellular fitness applications affords novel potentialities for tailored diabetes care and well being advocacy, in the end improving the fitness and properly-being of diabetics.

III. METHODOLOGY

The block diagram is entailed in figure 1 replicates the work flow and the realistic visualizations achieved through simulation.

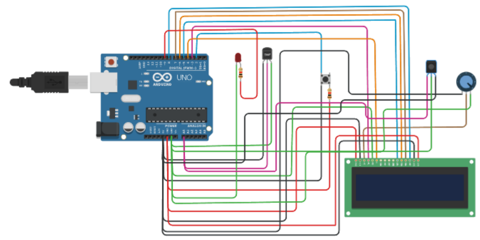

Figure 1: Circuit Diagram

The design and production of a singular circuit for glucose monitoring and strain evaluation in diabetics become the principle emphasis of this take a look at's technique. An arduino microcontroller changed into used to create a custom circuit that incorporated sensors for coronary heart rate monitoring and non-stop glucose tracking. In order to maximise sensor overall performance, lessen power intake, and guarantee compatibility numerous wearable shape factors, the circuit structure became optimized. In order to enable continuous tracking and statistics collecting, vital elements to consider had been sensor cargo, sign conditioning.

The specially designed circuit integrates several important features to enable diabetics to monitor blood sugar levels and analyze their stress. The Arduino microcontroller acts as the central processing unit of the circuit, synchronizing its functions and enabling data collection and processing. Sensors are strategically placed for heart rate monitoring and continuous glucose monitoring to record physiological data in real time glucose sensors [11] use electromagnetic principles to measure glucose levels in urine containing between, while heart rate sensors use photoplethysmography to monitor heart rate in response to blood volume variations through repetitive testing & measurement Demonstrated excellent reliability and accuracy to record glycemic parameters & stress indicators. Their findings showed a significant correlation between participants' heart rate variability and glucose levels, an indicator of their stress response. In addition to clinical applications, this circuit can be used for early intervention strategies for diabetes, personal health monitoring, and remote monitoring. People have the ability to make decisions about their physical and mental well-being through practical insights into stress management and sugar management, ultimately improving outcomes and quality of life.

To mimic the activity of pulse sensor the push button and potentiometer has been included for its enhanced existence and when push button is pressed it shows the presence of stress and has been put into existence with the actual data into real life. Potentiometer is used for stimulation of the temperature sensor. Prior to circuit placement and data collection, informed consent was sought from each participant and ethical approval was received from the review board of the institution.

IV. RESULTS AND DISCUSSIONS

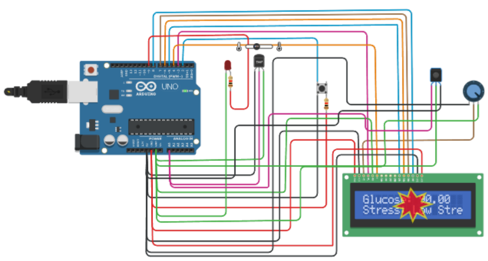

Figure 2 : Circuit working

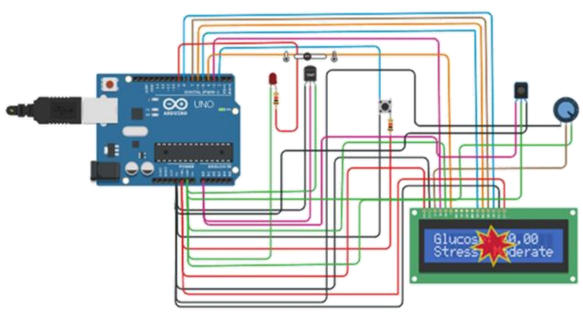

Figure 3: Moderate stress display

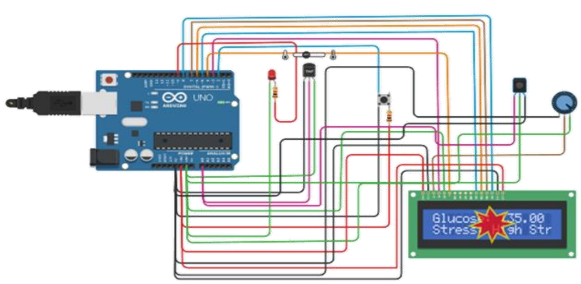

Figure 4: High stress display with signal display from LED

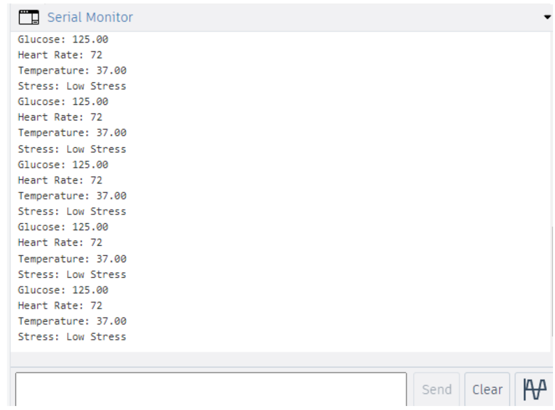

Figure 5: Serial Monitor displaying results for future analysis

```
Stress: Moderate Stress
Glucose: 117.00
Heart Rate: 92
IR Value: 568
Stress: Moderate Stress
Glucose: 143.00
Heart Rate: 76
IR Value: 210
Stress: Moderate Stress
Glucose: 135.00
Heart Rate: 85
IR Value: 620
Stress: Moderate Stress
Glucose: 78.00
Heart Rate: 71
```

Figure 5: Serial Monitor displaying results for future analysis of varying values

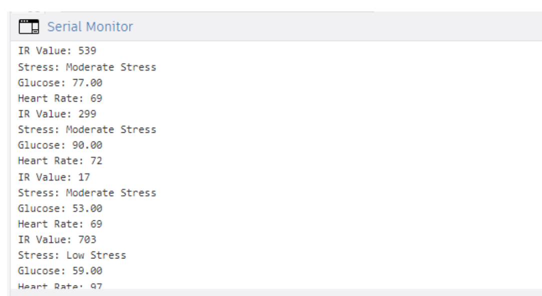

Figure 6: Serial Monitor displaying results for future analysis of varying values

Through this entire work, the different body parameters like body temperature, heart rate and glucose level are measured in accordance with the glucose level to identify and record the glucose levels which is directly associated with these corresponding values. Thus the various stages in result specification proceeds to make the result more contributory.

V. CONCLUSION

The developed system provides an intelligent way to monitor critical health metrics in real-time and analyse stress by combining physiological sensors with Arduino microcontroller technology. It efficiently classifies stress levels according to preset thresholds using advanced algorithmic processing, enabling well-informed decision-making about health management. Moreover, the use of PWM-controlled LED lighting improves user engagement by providing a visual cue for stress levels. This all-encompassing strategy shows how Arduino-based solutions can enable people to take charge of their health and reduce stress-related dangers, which will improve their general wellness and quality of life.

REFERENCES

[1] Ribeiro, G.T., 2021. *Smart System and Mobile Interface for Healthcare: Stress and Diabetes* (Master's thesis, ISCTE-Instituto Universitario de Lisboa (Portugal)).

[2] Lee, T.F., Drake, S.M., Roberts, G.W., Bersten, A., Stranks, S.N., Heilbronn, L.K., Mangoni, A.A. and Burt, M.G., 2020. Relative hyperglycemia is an independent determinant of in-hospital mortality in patients with critical illness. Critical care medicine, 48(2), pp.e115-e122.

[3] Som, A., Thakur, S., Singh, S. and Puthooran, E., 2020. Non Invasive Blood Glucose Monitoring using IoT.

[4] Umami, H., Faroka, G., Isnahardiyanti, F., Muhlis, N. and An-Naafi, R.A., 2023. GLUSENT (Glucose Assistant): Sugar Monitoring System Smart Watch Based on Bioelectronics and Internet of Things to Prevent Diabetes Melitus in The 5.0 Society Era. *Asian Journal of Natural Sciences*, *2*(1), pp.25-34.

[5] Escolar, S., Abaldea, M.J., Dondo, J.D., Rincón, F. and López, J.C., 2016. Early Detection of Hypoglycemia Events Based on Biometric Sensors Prototyped on FPGAs. In *Ubiquitous Computing and Ambient Intelligence: 10th International Conference, UCAmI 2016, San Bartolomé de Tirajana, Gran Canaria, Spain, November 29–December 2, 2016, Proceedings, Part I 10* (pp. 133-145). Springer International Publishing.

[6] Akash, M.R.R. and Shikder, K., 2020, February. IoT based real time health monitoring system. In *2020 Research, Innovation, Knowledge Management and Technology Application for Business Sustainability (INBUSH)* (pp. 167-171). IEEE.

[7] Singh, R. and Rao, R.R., 2023. Optimizing Glycemic Control in Type 1 Diabetic Patients using a Deep Learning-Based Artificial Pancreas with a Secure Glucagon and Insulin Delivery System. *bioRxiv*, pp.2023-12.

[8] Imad, A., Malik, N.A., Hamida, B.A., Seng, G.H.H. and Khan, S., 2022. Acoustic photometry of biomedical parameters for association with diabetes and Covid-19. *Emerg Sci J*, *6*, pp.42-56.

[9] Deshkar, S., Thanseeh, R.A. and Menon, V.G., 2017. A review on IoT based m-Health systems for diabetes. *International Journal of Computer Science and Telecommunications*, *8*(1), pp.13-18.

[10] Cocha, G., Rodriguez, O., Mazzeo, H., Rapallini, J., Amorena, C. and D'Attellis, C.E., 2018, November. Intelligent insulin pump design. In *2018 Congreso Argentino de Ciencias de la Informática y Desarrollos de Investigación (CACIDI)* (pp. 1-4). IEEE.

[11] Isaac, J.S., Stanley, P.K., Daniel, P.V. and Pamela, D., 2019. A Novel Instrumentation System for Monitoring of Foot Ulcer. *Research Journal of Pharmacy and Technology*, *12*(4), pp.1504-1506.