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NON INVASIVE CHOLESTEROL AND GLUCOSE DETECTION USING FINGER PRINT

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ABSTRACT

The development of invasive and non-invasive techniques is on the rise in healthcare. At present in health care, we come over with the problems due to cholesterol and diabetes which is the common disease all over the world. The later methods of measurement of cholesterol and glucose are done with the collection of blood samples by invasive method and non-invasive method is achieved by separate devices like cholesterol measurement and glucometer. -The proposed model brings out an idea in which it combines both the measure of cholesterol and glucose non-invasively without the need of blood. It is achieved by IR techniques involving the measure of cholesterol and glucose through the program dumped in Arduino UNO which brings out the value of cholesterol and glucose level. Using Esp Wi-fi module output value is obtained in Web Browser for Checking glucose and cholesterol value in a remote location.

Keywords-: sensor; diabetes; glucometer; non-invasive measurements; IR technique.

1 INTRODUCTION

Diabetes and high cholesterol are two of the most prevalent and life-threatening diseases globally. Currently, it is the prevailing ailment in contemporary society to ascertain an individual's cholesterol and blood sugar levels by the collection of a blood sample. Without causing any bloodshed, piercing of the skin, or causing discomfort or injury. Determining the quantitative values for glucose as well as cholesterol levels is unattainable. The experience is particularly distressing for individuals, especially youngsters, since it causes heightened levels of discomfort. Individuals diagnosed with diabetes and pregnant women may experience fluctuations in their blood glucose levels. The presence of low levels of cholesterol in the bloodstream has been identified as a contributing factor to the development of cardiovascular disease, which is known to increase the risk of stroke and heart attack.

Non-invasive cholesterol and glucose detection represents a significant advancement in the field of medical diagnostics and healthcare technology. Traditionally, monitoring cholesterol and glucose levels has often required invasive blood sampling procedures, which can be uncomfortable and sometimes deter individuals from regular testing. However, with the advent of cutting-edge technologies and innovative research, non-invasive methods have emerged, offering a more convenient and patient-friendly approach to monitoring these critical health parameters. Non-invasive cholesterol and glucose detection techniques leverage various technologies, including spectroscopy, imaging, and wearable devices, to measure these vital biomarkers without the need of blood draws or skin pricks. This healthcare revolution enables people to take an active role in managing overall cholesterol and blood sugar levels, so enhancing their general health and mitigating the likelihood of developing cardiovascular illnesses and diabetes.

This study aims to investigate the domain of non-invasive blood pressure and cholesterol testing, examining recent advancements, benefits, and obstacles encountered in this area. Through the elucidation of these pioneering methodologies, our objective is to emphasize the possibility for enhanced medical results and a more expedient, less obtrusive modality for monitoring two paramount health indicators. This research aims to address the issue of measuring glucose and cholesterol levels using invasive methods. This particular approach eliminates the need of obtaining a blood sample in order to assess glucose and cholesterol levels. This study aims to investigate the use of an electrically powered, LED and photodiode for the purpose of measuring blood glucose as well as cholesterol levels. The sensor requires the fingertip to be placed onto it throughout the procedure. The use of a powerful light-emitting diode (LED) as well as a photodiode, sensors enable the estimation of blood density and thickness via the transmission of the light spectrum. When light is sent to the fingertip, a little amount of electrical current is generated, which is then detected through a photovoltaic sensor. The present output generated by the photodiode is converted into a voltage by passing it via the sensor output. The connections between the sensor outputs and the Arduino Uno are established. The aforementioned approach represents a continuous measuring system that enables painless monitoring of glucose as well as cholesterol levels.

2 RELATED WORKS

[1] This system presents a thyroid monitoring sensor for Internet of Things (IoT) applications. The proposed architecture is efficient and user-friendly. Thyroid monitoring can be done either by monitoring the basal

body conductance or through the blood samples. In this work, basal body conductance is the quantity sensed for thyroid monitoring. The conductance acquisition is performed by an electrode along with an amplifier and a Node MCU.

The designed module implements the conductance acquisition module along with the calibration method to dynamically optimize the sensor design. The sensor should be non-intrusive to avoid possible disturbs and also because the person who wears it could feel uncomfortable. Furthermore, the system acquisition should be designed with wireless technology. Finally, the sampling rate of the acquisition and the material of the sensor have to be revised. A large majority of sensors provide signals with artifacts and out layers that make difficult information ex-traction.

[2] Health has prime importance in our day-to-day life. Sound health is necessary to do the daily work properly. This project aims at developing a system which gives body temperature and heart rate using the mister and pulse sensor respectively. These sensors are interfaced with the controller Arduino nano board. Wireless data transmission done by Arduino through the WI-FI module. WI-FI is used for wireless data transmission on IoT platform i.e. the thing speaks. Data visualization is done on Thing speak. So that record of data can be stored over a period of time. This data stored on a web server so that it can see to who logged.

[3] In their study, Periyasamy and Anand (2016) examined the potential benefits of continuous monitoring of blood sugar in the management and prevention of hypercholesterolemia in individuals with diabetes. The objective of this research was to assess the level of blood glucose by the use of an advantageous non-invasive forearms capacitance measuring method.

[4] In their study, Brince Paul and Melvin P. Manuel (2016) put out the proposition that intrusive procedures are associated with discomfort, time consuming, high expense, and the possible danger of transmitting infectious illnesses. Hence, there exists a significant need for a dependable, cost-effective, and pleasant non-invasive technology that can continually monitoring the blood glucose levels. The proposed technique is based on the hypothesis that aldohexose has a direct influence on the scattering characteristics of the organ.

[5] In a study conducted by Megha C. Pande (2015), an analysis was performed on the use of non-invasive methods for detecting blood sugar levels, specifically focusing on the infrared area as the most suitable location for such measurements. This approach is akin to pulse oxygen measurement and is complemented by infrared light analysis.

[6] In this study, Mohd Norzaliman and Mohd Zain (2014) developed and evaluated a very sensitive visual polarimetry measurement approach that utilizes ratio-metric photon counting detection. The use of photon counting polarimetry technology has great potential in the development of a highly sensitive and effective optical glucose sensor. Researchers have yet to overcome the limitations associated with non-invasive glucose monitoring technologies. Several challenges arise in the context of scanning, including the need to provide appropriate pressure, physiological variations such as tissue breadth, correlation errors, technological sensitivity, and durability.

[7] Yoon and Jeon (2012) conducted a study in which they examined several blood components, including total haemoglobin, Carbohydrates, proteins, and cholesterol, using the technique of optical spectroscopy. The fingernail was exposed to irradiation light, and the resulting transmitted light was quantified. The use

of electronic filtration and outlier identification method was employed in order to mitigate the noise caused by the electrical circuit and the undesired impact resulting from body movement. The accuracy of predictions using serum has been often greater when using the FIR band measurement, with the exception of cholesterol.

[8] In this publication, the authors V. Ashok and A. Nirmalkumar (2011) put forward a technique and apparatus to perform the non-invasive measurement of blood sugar content. The suggested approach involves transilluminated irradiation applied to the finger. The approach relies on the utilization of an optical device operating at a wavelength of 632.8nm, specifically using atomic gas (He-Ne).

3 PROPOSED SYSTEM

In recent years, there has been notable progress in the advancement of numerous non-intrusive methodologies. These include transdermal approaches such as reversing the procedure as well as the impedance of the skin spectral analysis, as well as optical techniques like optical coherence tomography (OCT) and Raman spectroscopy. Nevertheless, these systems include inherent limitations, which have hindered their progression towards becoming a universally used tool for monitoring blood glucose levels. The use of infrared radiation (IR Technique) has great potential in the measurement of blood glucose levels due to its ability to detect the distinctive vibrational modes or 'chemical fingerprints' of glucose particles with exceptional sensitivity. There are existing reports that describe the use of infrared spectroscopy (IR) for the purpose of quantitatively analyzing carbohydrates in filtration fluid, blood, and blood plasma.

In order to ensure the viability of the approach, it is important to use the appropriate infrared (IR) laser in IR spectroscopy. The accompanying attributes are essential for an exemplary infrared (IR) laser to possess: The system has a high programming speed, enabling quick data collecting. Additionally, it demonstrates the capability to effectively tune with sufficient power everywhere the absorption zone of the molecules of glucose throughout the infrared spectrum.

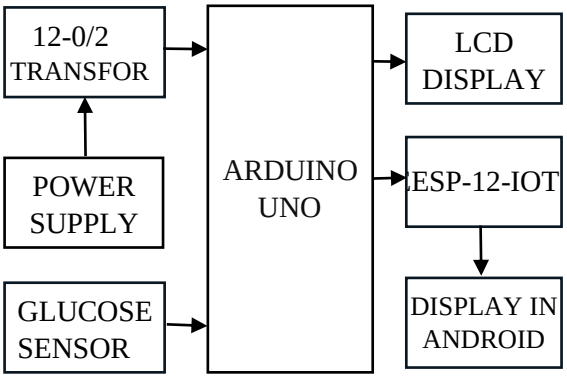


Figure 1: Block Diagram

3.1 WORKING

The detection of cholesterol and blood glucose levels is accomplished by the use of an infrared (IR) sensor as well as a photodiode. The aforementioned procedure involves positioning the fingertip directly on top of the sensor. The concentration combined thicknesses of blood may be determined by using an infrared (IR) sensor as well as a photodiode sensor, which transmit a range of light wavelengths to the blood sample for analysis. The light is transmitted to the finger, resulting in the generation of a little quantity of light which is then
detected through a photo diode sensor. The present output generated by the photodiode is converted into a voltage by passing the current via the sensor output. The connections between the sensors and the Arduino UNO facilitate the transmission of data.

3.2 ADVANTAGES

- Painless
- Cost effective

- This approach does not need the collection of blood samples.
- Less time taken
- It can be used in a remote location too.
- The measured values can be viewed in android using IOT.

4 EXPERIMENTAL RESULTS

The Arduino platform is an experimental framework that is open-source in nature, and it is built around a user-friendly combination of hardware and software components. The system comprises a circuit board, often referred to as a microcontroller, which can be programmed, and a pre-existing software known as Arduino IDE. The Arduino IDE is used for the purpose of writing and uploading computer code to the physical board.

An IR sensor comprises an electrical device that emits infrared radiation in order to detect and perceive certain characteristics of the environment. An infrared (IR) sensor has the capability to quantify the thermal energy emitted by an item, in addition to detecting any movement associated with it. Passive infrared sensors, also known as PIR sensors, only detect infrared radiation without actively emitting it.

The ESP8266 is an affordable Wi-Fi microchip that incorporates TCP/IP networking software and microcontroller functionality. It is manufactured by Systems, a company based in Shanghai, China. The ESP-01 module, manufactured by a third-party company called Ai-Thinker, gained popularity among the two other English speakers maker movement in August 2014, hence popularizing the chip.

A Transformer is an immobile instrument devoid of any mechanical components, designed to convert power from electricity through a certain circuit to another by altering the voltage and current while maintaining a consistent frequency. There are two distinct classifications of transformers based on their operational purpose: the Step-up Transformer and the Step-down Transformer.

The result of the measurement is shown inside the kit and the Android application via the use of the ESP 8266 Wi-Fi Modules. The obtained output is compared with the conventional procedure. The information shown on the screen of the mobile includes both the date and time. The evaluation of invasive as well as non-invasive techniques is computed.

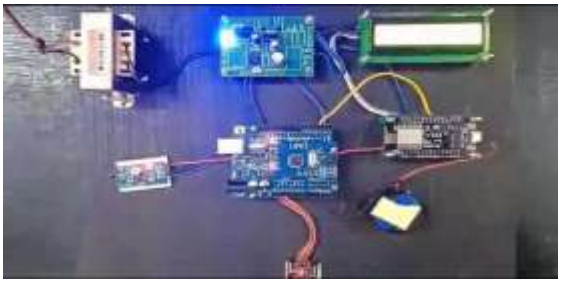


Figure 2: Performance Evaluation

Figure 3: Output LCD display

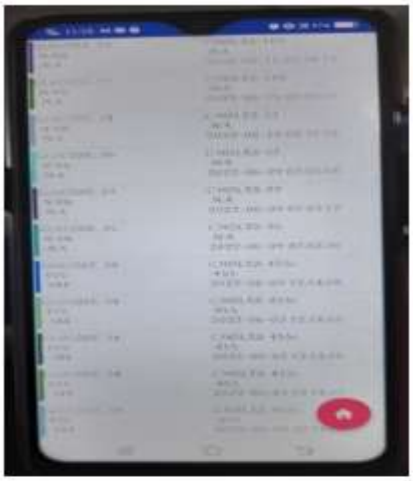
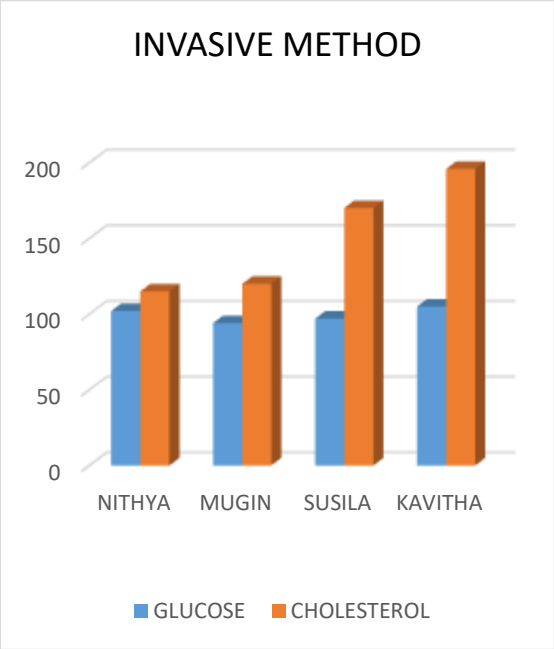


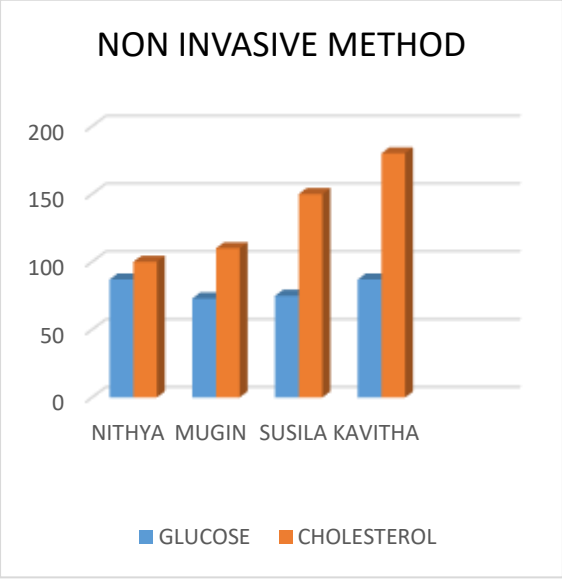
Figure 4: Value Display in Android Application

Table 1: Comparison between Invasive Vs. Non Invasive Methods

The table shows the comparative value with and without the collection of blood samples. The comparative value exposes the error and accuracy between normal and non-invasive method. The value varies with light differences.

Patients Name	Age	Glucose Analysis		Cholesterol Analysis	
		Invasive Method	Non Invasive Method	Invasive Method	Non Invasive Method
NITHYA	13	102	87	115	100
MUGIN	25	94	73	120	110
SUSILA	40	97	75	170	150
KAVITHA	49	105	87	196	180





5 CONCLUSION AND FUTURE ENHANCEMENT

Non-invasive glucose and cholesterol detection refers to a portable assessment method using a device that enables the measurement of cholesterol as well as glucose levels without requiring the use of a skin puncture. The proposed solution offers convenience by enabling users to get measured values on their Android devices via the development of an Internet of Things (IoT) application. Early detection of cholesterol and glucose is absolutely necessary to avoid later stage of health issues like diabetes, hypercholesterolemia, cardiovascular disease and so on. Our address to measure cholesterol and glucose is in fine fettle than invasive. This project describes the feature of the device which performs results in devices like laptops and android.

The future advancement of this project is to bring this kit in a microform able to be placed in smart watches and to create it as a marketed product making medical facilities easy to avail even in a remote location.

REFERENCES

[1] N. Saravanan, G. Sudha, S. Selvarasu, R. Hariprakash, A. Ajaykumar, V. Surjith. A Non-invasive Technique to Detect Thyroid Using IoT. Cardiometry; Issue No. 26; February 2023; p. 569- 572; DOI: 10.18137/cardiometry.2023.26.569572;

[2] Dr.G.Sudha, M.E., M.B.A., Ph.D.,1 ., L.Bhuvaneshwari2 ., J.Deepika3 . Human Wearable Device using IoT. Vol 11, Issue 5, May/2020 ISSN NO:0377-9254

[3] E. Law, M. Kakani, M. Agarwal, dan M. Rizkalla, "Electromagnetic Simulation for the Diagnosis of Lipoprotein Density in Human Blood , a Non-Invasive Approach," hal. 1–11, 2017.

[4] E. V Karpova, E. V Shcherbacheva, A. A. Galushin, D. V Vokhmyanina, E. E. Karyakina, dan A. A. Karyakin, "Noninvasive Diabetes Monitoring through Continuous Analysis of Sweat Using Flow-Through Glucose Biosensor," 2019.

[5] Espinosa, A. H. R., Estevez, A. G., Roche, J. R. F., Figarola, Y. M., & Rodriguez, D. L. (2018). Psychological intervention for development of disease awareness in addicts: Villa Colibri therapeutic community of Santiago de Cuba. International Journal of Health Sciences,2(3),72-80. https://doi.org/10.29332/ijhs.v2n3.232

[6] G. A. Roth et al., "Demographic and epidemiologic drivers of global cardiovascular mortality," N. Engl. J. Med., vol. 372, no. 14, hal. 1333–1341, 2015.

[7] G. Balachander dan K. S. Shankar, "Non-Invasive Blood Glucose Analysis Based On Galvanic Skin Response For Diabetic Patients," vol. 30, no. 1, hal. 1–8, 2018.

[8] H. Ali, F. Bensaali, dan F. Jaber, "Novel Approach to Non-Invasive Blood Glucose Monitoring Based on Transmittance and Refraction of Visible Laser Light," IEEE Access, vol. 5, hal. 9163–9174, 2017.

[9] I. M. M. Yusoff, R. Yahya, W. R. W. Omar, dan L. C. Ku, "Non invasive cholesterol meter using the Near Infrared sensor," Proc. - 2015 Innov. Commer. Med. Electron. Technol. Conf. ICMET 2015, no. November, hal. 100– 104, 2016.

[10] J. Yadav, A. Rani, V. Singh, dan B. M. Murari, "Prospects and limitations of non-invasive blood glucose monitoring using near-infrared spectroscopy," Biomed. Signal Process. Control, vol. 18, hal. 214–227, 2015.

[11] K. J. Lackner dan D. Peetz, "National Cholesterol Education Program," hal. 1723–1724, 2019.

[12] M. A. Al-Dhaheri, N. E. Mekkakia-Maaza, H. Mouhadjer, dan A. Lakhdari, "Noninvasive blood glucose monitoring system based on near-infrared method," Int. J. Electr. Comput. Eng., vol. 10, no. 2, hal. 1736–1746, 2020.

[13] M. A. Al-Rawhani et al., "A Colorimetric CMOS-Based Platform for Rapid Total Serum Cholesterol Quantification," IEEE Sens. J., vol. 17, no. 2, hal. 240– 247, 2017.

[14] E. Aristovich dan S. H. Khan, "Non-invasive measurement of cholesterol in human blood by impedance technique: An investigation by 2D finite element field modelling," J. Phys. Conf. Ser., vol. 459, no. 1, 2013.