International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A Review Pepar On Development of Non Invasive System for Real Time Hemoglobin, Glucose and Oxygen Monitoring

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ABSTRACT :

Recent decades have witnessed significant advancements in non-invasive monitoring systems for continuous glucose, hemoglobin, and oxygen levels, which provide accurate measurements of blood glucose and oxygen concentrations. While the traditional finger-prick method is reliable, it is impractical for frequent daily use due to the discomfort it causes and the high cost of test strips. Although minimally invasive and non-invasive alternatives have emerged, they often come with high costs and still necessitate finger-prick calibrations. This review project offers a concise overview of non-invasive glucose measurement technologies and the associated research. The technologies examined include optical, transdermal, and enzymatic methods, with a particular emphasis on Near Infrared (NIR) technology and NIR Photoplethysmography for predicting blood glucose levels. The discussion includes feature extraction from photoplethysmography (PPG) signals and the application of machine learning techniques for glucose prediction. Despite some of these technologies being in use for several decades, their integration into mechanical ventilators and the development of new methodologies may yield valuable clinical insights across a wider patient demographic. The system is designed to monitor vital signs, including blood oxygen saturation, temperature, hemoglobin levels, and blood glucose levels. It is anticipated that this system could eliminate the traditional practice of blood extraction for glucose and hemoglobin testing in the near future. Additionally, the proposed system is engineered to be cost-effective and energy-efficient.

Keywords: Real Time Monitoring, Non-Invasive Monitoring , Near-Infrared Spectroscopy (NIRS), Hemoglobin Monitoring, Glucose Monitoring

INTRODUCTION :

In India, there has been a steady growth in the health care system. India spends about 4.7% of its GDP in health care sector which is abysmally low. For a country which chronically lacks health care the recent advancements and developments haven't met the needs.
At present, invasive blood glucose detection technology is mainstream, convenient and practical, so both hospitals and household glucometers adopt the method of blood sampling first and then analyzing it in vitro for blood glucose measurement. In hospitals, the blood drawn from the subjects on an empty stomach in the morning, and the blood glucose concentration is accurately measured by automatic biochemical analyzer.

Numerous health care monitoring devices have made their way to the bedside; however, a user-friendly and easily portable vital signs monitoring system is still not available for widespread use. Inadequate monitoring and control of blood glucose levels can exacerbate health issues, potentially leading to organ failure and, ultimately, death. Recent studies on noninvasive methods for estimating glucose, hemoglobin, and oxygen have categorized these techniques based on their underlying technologies, primarily including electromagnetic (EM) wave sensing, transdermal methods, and enzymatic approaches.

At present, diabetes is diagnosed and monitored using various Invasive Glucose, Hemoglobin, and Oxygen Sensing Technologies (IGST), which vary according to the type and age of the screening process. Glucose serves as a vital source of energy for cellular metabolism within the human body. Beyond blood, glucose is also present in intracellular fluids, interstitial fluids (ISF), tears, saliva, and urine. Consequently, continuous glucose monitoring (CGM) for individuals with diabetes may offer significant clinical benefits and align more closely with current market trends.

LITERATURE REVIEW :

In is a literature review of Development of non invasive system for real time hemoglobin, glucose and oxygen monitoring. Some following books reviews refer for this project.

C.W. B. F. Elgendi [1]are design "Non-Invasive Blood Glucose Monitoring"in 2020. It consist of the This book discusses various non-invasive techniques for glucose monitoring, including the challenges and advancements in the field.Non-invasive methods eliminate the need for needle pricks or invasive procedures, making them more user-friendly and improving patient compliance, especially for regular monitoring. Non-invasive sensors, particularly those using PPG, are sensitiveto motion, which can lead to inaccuracies if the user is moving or shaking.

C.K. B. R. S. R. S. Rao [2]are design Biomedical Sensors and Instruments in 2017. It consist of a method work covers a range of biomedical sensors, including those for monitoring glucose and other vital signs. Comprehensive Technical Knowledge . Rapid Technological Advances.

R. L. R. P. M. K. W. D. Wu [3]are Optical Methods for the Noninvasive Monitoring of Blood Glucose in 2019. It consist focuses on optical techniques, which are relevant for non-invasive blood monitoring systems.

D C. K. K. T. A. H. Huang [4]are Advances in Non-Invasive Monitoring Techniques in 2019.It consist of This comprehensive text reviews various non-invasive monitoring technologies applicable to different health parameters.

R. H. Moll and J. G. Webster [5]:known for early contributions in medical instrumentation, specifically for pulse oximetry and optical measurement techniques, which are essential in non- invasive oxygen monitoring.

D. L. Wise, D. J. Trantolo, D. E. Altobelli, M. J. Yaszemski [6]: *Biomedical Applications of Controlled Release Systems* (Published in 1998) — This text covers early research into controlled drug release and sensor technology, which relates to continuous glucose monitoring.

Kamalpreet K,aur Deepankar varma [7] Security is most important issue in digital communication. Cryptography and steganography are two popular methods available to provide security. Steganography focuses on hiding information in such a way that the messages undetectable for outsiders and only appears to the sender and intended recipient.

L. A. Geddes and L. E. Baker [8]: *Principles of Applied Biomedical Instrumentation* — A classic reference that discusses the development of various biomedical instruments and provides insight into the basic principles that underpin non-invasive monitoring.

A. Gribbin, D. C. O'Brien [9]: Early optical glucose sensing research — These early studies were among the initial investigations into how optical techniques could potentially monitor glucose levels non-invasively.

Table shows that the name of author, title, advantages and disadvantages are shown below:

Sr. No	Title	Name of Author	Advantages	Disadvantages
1.	Non-Invasive Blood Glucose Monitoring	C.W.B.F. Elgendi	Non-invasive methods eliminate the need for needle pricks or invasive procedures, making them more user-friendly and improving patient compliance, especiallyfor regular monitoring.	Non-invasive sensors, particularlythose using PPG, are sensitive to motion, which can lead to inaccuracies if the user is movingor shaking.
2.	It consist of a method work covers a range of biomedical sensors, including those for monitoring glucose andother vital signs.	C.K. B. R. S. R. S. Rao	Comprehensive Technical Knowledge .	Rapid Technological Advances.
3.	Advances in Non-Invasive Monitoring Techniques	D C. K. K. T. A. H.Huang	consist of This comprehensive text reviews various non- invasive monitoring technologies applicable todifferent health parameters.	Limited Accuracyand Precision
4.	Optical Methods for the Noninvasive Monitoring	R. L. R. P.	It consist focuses on optical techniques, which	Interference from Skin and Tissues

	of Blood Glucose	M. K. W. D. Wu	are relevant for non-invasive blood monitoring systems.	Sensitivity to External Factors
5.	Known for early contributions in medical instrumentation, specifically for pulse oximetry and optical measurement techniques.	R. H. Molland J. G. Webster	which are essential in non-invasive oxygen monitoring.	Technical Complexity Technical Complexity Lack of Practical Examples
6.	Biomedical Applicationsof Controlled Release Systems	D. L. Wise, D. J. Trantolo, D. E. Altobelli, M. J. Yaszi	This text covers early research into controlled drug release and sensor technology, which relatesto continuous glucose monitoring.	Highly Technicaland Specialized Dense Content

Problem Statement :

In our Project we have to use sensor method to sense the fingerprint and show the result in onetime hemoglobin, glucose and oxygen.

Integration of Multiple Parameters

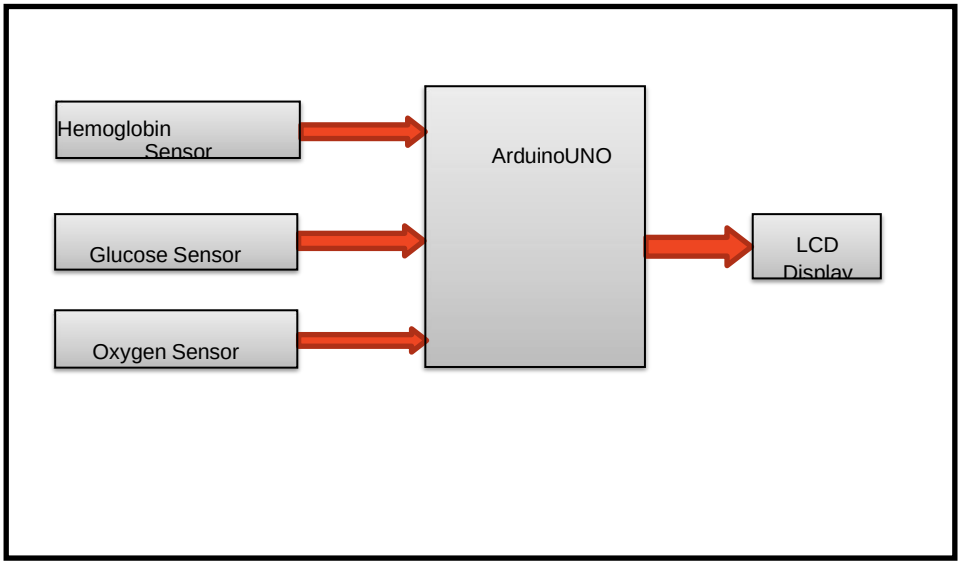
Issue: Most current devices focus on one parameter at a time, limiting comprehensive healthmonitoring.
Goal: Create an integrated non-invasive system capable of simultaneously measuring hemoglobin, glucose, and oxygen levels, offering a holistic view of a patient's health status.

Objectives

1. **Enhancing Patient Comfort:**
   Develop and validate algorithms that improve the accuracy of measurements for hemoglobin, glucose, and oxygen levels across diverse skin types and environmental conditions.
2. **Providing Real-Time Data:**
   Implement a reliable system for real-time data processing and secure transmission of health metrics to healthcare professionals, enabling timely interventions.
3. **Improving Health Management:**
   Integrate features that enhance user comfort and reduce the intrusiveness of the device, thereby improving patient compliance and acceptance.
4. **Cost-Effectiveness:**
   Develop a cost-efficient monitoring solution to make the technology accessible in diverse healthcare settings, including low-resource environments.
5. Seeing your blood glucose and oxygen level in real time can help you make more informed decisions about the food and beverages you consume, the physical activity you do.

Methodology:

Fig: Block Diagram



Technology Selection

- **Sensor Types**: Research and select appropriate non-invasive sensors, such as:
- **Optical Sensors**: Utilize spectroscopy (e.g., near-infrared, Raman) for measuringblood parameters.
- **Electromagnetic Sensors**: Explore alternatives like ultrasound or impedancebasedmethods.

Data Acquisition

- **Signal Collection**: Design circuits for acquiring signals from sensors in real-time.
- **Noise Reduction**: Implement techniques for filtering out noise and enhancing signalquality.

Algorithm Development

- **Data Processing Algorithms:** Develop algorithms for:
- **Calibration**: Adjusting measurements to improve accuracy based on individualcharacteristics.
- **Estimation**: Converting raw sensor data into meaningful health metrics(hemoglobin, glucose, oxygen levels).
- **Machine Learning**: Consider using machine learning models for better prediction andcalibration based on historical data.

IV . Proposed Solution

Technology Selection:

- **Sensor Technology:** Utilize optical sensors (such as photoplethysmography and nearinfrared spectroscopy) to measure physiological parameters non-invasively.
- **Wearable Device Design:** Develop a wearable device (e.g., a wristband or clip) that houses the sensor and is comfortable for continuous use.

System Architecture:

- **Modular Design:** Create a modular architecture that allows for the integration of various sensors for hemoglobin, glucose, and oxygen monitoring.
- **Real-Time Data Processing:** Implement onboard processing to analyze data in realtime, ensuring immediate feedback for users.

V . Expected Results :

Clinical Outcomes:

- **Improved Health Management:** Patients with chronic conditions such as diabetes, COPD, and heart disease will experience better management of their health through timely monitoring and intervention.
- **Reduced Complications:** Early detection of anomalies will lead to fewer complications and hospitalizations, enhancing patient safety and quality of life.

Market Impact:

- **Emergence of New Products:** The technology is likely to stimulate the development of new health monitoring devices and applications, expanding the market for wearable health tech.
- **Increased Investment:** Positive results may attract further investment in health technology and innovation, driving research and development in this field.

VI . Benefits of the System :

- **Diabetes Management:** Continuous glucose monitoring for diabetic patients, allowing for timelyadjustments to insulin or dietary intake.
- **Chronic Disease Management:** Monitoring patients with conditions like COPD or heart disease, providing real-time data on oxygen levels and hemoglobin.
- **Home Healthcare:** Enabling patients to monitor their health from home, reducing the need for frequent hospital visits.
- **Sports and Fitness:** Athletes can track oxygen saturation and glucose levels during training to optimize performance and recovery.
- **Non-Invasive Monitoring:** Eliminates the need for blood draws or invasive procedures, enhancingpatient comfort and compliance.
- **Cost-Effective:** Reduces the costs associated with laboratory tests and frequent medical appointments.

- **User-Friendly:** Devices can be designed for easy use by patients, families, and caregivers, promoting self-management.

Impact on society :Improved Publick Health :

- **Early Detection and Prevention:** With continuous monitoring, potential health issues can be identified early, leading to proactive management and prevention of chronic diseases, reducing the overall burden on healthcare systems.
- **Increased Awareness:** Enhanced accessibility to personal health data encourages individuals to take charge of their health, promoting preventive care and healthier lifestyle choices.

VII . CONCLUSION :

The development of a non-invasive system for real-time monitoring of hemoglobin, glucose, and oxygen levels represents a significant advancement in healthcare technology. By utilizing innovative sensing techniques and algorithms, this system offers numerous advantages over traditional invasive methods, including enhanced patient comfort, reduced risk of infection, and theability to monitor multiple parameters simultaneously..
This system can be further developed into a wearable device for continuous glucose ,hemoglobin and oxygen monitoring.
The development of a non-invasive system for real-time monitoring of hemoglobin, glucose, and oxygen has the potential to revolutionize patient care, improve health outcomes, and reduce healthcare costs.

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IV.Websites

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