A Smart Blood Bank Appwith Salaiva Testing For Thalassemia(IOT)

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Abstract- *This project presents a low-cost and holistic approach to the early detection of thalassemia using a non-invasive saliva-based method. The system is designed around the principle that iron (Fe) content in saliva, which affects pH levels, can serve as an indicative biomarker for thalassemia screening. A compact sensor node is developed for real-time monitoring of pH variations, indirectly reflecting iron concentrations. The main sensor module consists of a sensitive pH sensor integrated with a microcontroller for data acquisition and processing. Emphasis is placed on affordability, portability, and reliable long-term operation. The sensor values are transmitted to an IoT server for remote access and analysis. This solution enables continuous, non-invasive monitoring and is suitable for large-scale screening applications. The results demonstrate that the proposed system meets the criteria for a low-cost, accurate, and accessible early warning system for thalassemia detection.*

I. INTRODUCTION

Thalassemia is a genetically inherited blood disorder characterized by abnormal Hemoglobin production, leading to Anemia and other health complications. Early detection of thalassemia is crucial for effective disease management and improved patient outcomes. Traditional diagnostic methods, such as blood tests and genetic screening, though accurate, are often invasive, time-consuming, and inaccessible in remote or resource-limited settings. Therefore, there is a growing need for non-invasive, low-cost, and real-time diagnostic alternatives.

Saliva, an easily accessible biological fluid, has gained increasing attention as a non-invasive diagnostic medium due to its composition of biomarkers that mirror systemic physiological states. Notably, iron (Fe) levels in saliva have been associated with thalassemia, and fluctuations in these levels can influence pH values. Monitoring pH variations, therefore, offers a promising indirect method for estimating iron concentration and identifying potential thalassemia cases.

Recent advancements in sensor technologies have enabled the development of compact, cost-effective pH sensors that can be integrated with embedded systems for real-time monitoring. By leveraging these sensors in conjunction with microcontrollers and IoT communication protocols, it is possible to develop an intelligent early warning system for thalassemia screening. Such a system offers significant benefits: ease of use, real-time data access, low maintenance, and scalability for large-scale deployments.

This study proposes the design and implementation of a low-cost, saliva-based thalassemia detection system, using pH sensors to assess Fe content and supported by IoT-based data transmission. The proposed system aims to serve as a non-invasive, scalable, and accessible diagnostic tool for early identification of thalassemia, particularly in rural or underserved communities.

II. LITERATURE SURVEY

Saliva Testing for Thalassmia:

- Thalassemia is a genetic blood disorder that can be diagnosed through DNA testing, which has traditionally required blood samples. Research is ongoing to explore saliva as a non-invasive alternative for DNA extraction and analysis, offering a more convenient and less stressful experience for individuals.
- Advancements in PCR and next-generation sequencing technologies have shown promise in detecting thalassemia genes in saliva, paving the way for potential saliva-based screening tools.

Smart Blood Bank App with IoT:

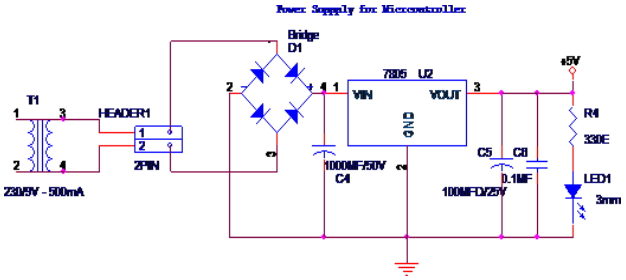
- A mobile application integrated with IoT sensors can provide real-time information on blood stock availability, location of nearest blood banks, and donor details.
- IoT sensors can track blood bag temperature, expiry dates, and other crucial parameters, ensuring safe and efficient storage and distribution.

- The app can also facilitate online requests for blood, streamline the donor registration process, and provide educational resources on blood donation and thalassemia.

Saliva Testing in Blood Banks:

- Integration of saliva testing into blood bank operations could enable faster screening and identification of thalassemia carriers, improving early diagnosis and management.
- This could lead to more targeted screening programs and preventative measures, particularly in regions with high thalassemia prevalence.

BLOCK DIAGRAM



A power supply (sometimes known as a power supply unit or PSU) is a device or system that supplies electrical or other types of energy to an output load or group of loads. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

This circuit is a small +5V power supply, which is useful when experimenting with digital electronics. Small inexpensive wall transformers with variable output voltage are available from any electronics shop and supermarket. Those transformers are easily available, but usually their voltage regulation is very poor, which makes then not very usable for digital circuit experimenter unless a better regulation can be achieved in some way. The following circuit is the answer to the problem.

Components and Functionality:

- **Transformer**
- **Rectifier**
- **Bridge Rectifier**
- **IC Voltage Regulators**
- **Three-Terminal Voltage Regulators**

III. PROBLEM STATEMENT

Thalassemia is a hereditary blood disorder that causes abnormal hemoglobin production, leading to anemia and other severe complications. Current diagnostic methods rely on complete blood counts (CBC), hemoglobin electrophoresis, and genetic testing, which are costly, invasive, and often inaccessible in remote areas due to limited medical infrastructure and expertise. Additionally, the unavailability of real-time blood donor matchmaking systems poses challenges in timely transfusion support for affected individuals. The absence of a non-invasive, real-time, IoT-driven solution for preliminary Thalassemia screening limits early detection and proactive health management. This project addresses these limitations by developing a portable IoT-based system that facilitates saliva pH monitoring, donor-recipient matchmaking, and patient engagement through stress-relief games.

IV. SYSTEM ANALYSIS

4.1 Existing Systems:

The IoT is a revolutionary technology which changed human lives from past decade. The term IoT was first used in 1994 by British technology. IoT stands for Internet of Things or Internet of Everything; it is a proposed set up in which existing, common-day-to-day objects like machines, sensors, appliances and people connect through a network and will able to transfer data over network without human intervention. There are several embedded technologies related to IoT are ubiquitous computing, RFIP, wireless technology and cloud computing. Traditional methods of water quality control involve the manual collection of water samples at various locations and at different times, followed by laboratory analytical techniques in order to characterize the water quality. Although, the current methodology allows a thorough analysis including chemical and biological agents, it has several drawbacks: a) the lack of real-time water quality information to enable critical decisions for public health protection (long time gaps between sampling and detection of contamination) b) poor spatiotemporal coverage (small number locations are sampled) c) it is labor intensive and has relatively high costs (labor, operation and equipment).

4.2 Limitations of Existing Systems:

- High Initial Deployment Costs.
- Data Security and Privacy Risks.
- Power Supply and Maintenance Issues.
- Data Over load and Management.

4.3 Proposed System:

The non-invasive Thalassemia screening system integrates IoT-based saliva pH monitoring with an Android application for blood donor-recipient matchmaking and relaxation games to enhance accessibility, efficiency, and user engagement in healthcare screening. The system is designed to address the limitations of invasive diagnostic methods, offering a portable, cost-effective, and scalable solution for preliminary health screening in remote and resource-constrained areas. The saliva pH monitoring module, powered by Arduino Uno, measures pH levels using an analog pH sensor, displaying real-time readings on an I2C LCD display and triggering a buzzer alert when values fall outside the normal range (6.5 - 7.5). To improve accessibility, the system integrates ESP8266 or ESP32 IoT modules, enabling Wi-Fi/Bluetooth connectivity for real-time data transmission, ensuring that healthcare providers receive automated alerts and logged data for timely interventions.

Role of IoT in Healthcare:

IoT enhances healthcare by improving accessibility to medical attention while reducing maintenance efforts. The advancement of mobile technology and cloud-based health services has significantly improved patient care and communication. IoT integrates a network of connected devices that facilitate remote monitoring, data analysis, and real-time alerts. Its structure includes five essential layers:

- **Perception Layer:** Collects data using sensors.
- **Network Layer:** Manages data transmission.
- **Middleware Layer:** Processes data.
- **Application Layer:** Provides data analytics and insights.
- **Business Layer:** Supports decision-making based on data.

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