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The Wireless Health Monitoring for Neonatal Care

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Abstract: ***The wireless health monitoring for neonatal care project addresses the critical need for advanced and non-intrusive health monitoring solutions for newborns in neonatal care settings. Approximately 10% of newborns require assistance at birth, and preterm infants often require specialized stabilization or resuscitation. Traditional monitoring methods, such as electrocardiography (ECG) and pulse oximetry (PO), face challenges in electrode application, delayed HR readings, and potential inaccuracies in assessing cardiac output. This project aims to develop a wireless health monitoring system that overcomes these limitations and offers real-time and accurate monitoring of vital parameters, with a focus on heart rate. The proposed system leverages wireless technology to enable continuous and non-intrusive monitoring, enhancing the efficiency of neonatal care in delivery rooms and neonatal intensive care units (NICUs). By incorporating state-of-the-art sensors and communication protocols, the system aims to provide timely and reliable data on neonatal vital signs. The wireless nature of the solution eliminates concerns related to electrode application difficulties, equipment availability, and the risk of hypothermia.***

I. INTRODUCTION

About 10% of newborns require assistance during birth to initiate breathing, with 3% necessitating more prolonged stabilization or resuscitation. Premature infants, in particular, often demand advanced stabilization or resuscitation while also needing protection against hypothermia, a factor known to elevate mortality rates. The infant's clinical status and the effectiveness of interventions are primarily gauged by heart rate (HR), identified as the most sensitive predictor. International guidelines propose the use of electrocardiogram (ECG) monitoring in the delivery room for this purpose. However, challenges arise in electrode application, the inconsistent availability of ECG monitors, and the fact that electrical cardiac activity may not always correlate with efficient cardiac output.

Although pulse oximetry (PO) is prevalent in neonatal intensive care units (NICUs), its adoption in the delivery room is not universal. This may be attributed to the delay in obtaining a reliable HR after birth due to factors such as poor peripheral perfusion and motion. Consequently, PO tends to underestimate HR when compared to ECG during the initial minutes of life. In light of these challenges, there is a need for a non-intrusive, wireless, and easily applicable HR monitoring system that mitigates the risk of hypothermia. Such a system could prove advantageous in delivery room settings, providing timely and accurate HR monitoring without compromising the infant's well-being.

II. BLOCK DIAGRAM

The neonatal emergency unit in a healing facility takes care of the necessities of fundamentally ill infants, some of whom are conceived premature. Continuous wellbeing checking is essential for the survival of the baby and fragile babies conceded at neonatal intensive care unit (NICU). For parents or relatives who are anxious to bring their little one home, a stay in the neonatal emergency unit feel a bit overwhelming. Vital signs for NICU monitoring include temperature of the body, electrocardiogram (ECG), respiration of the infant, and blood oxygen saturation SPO2.

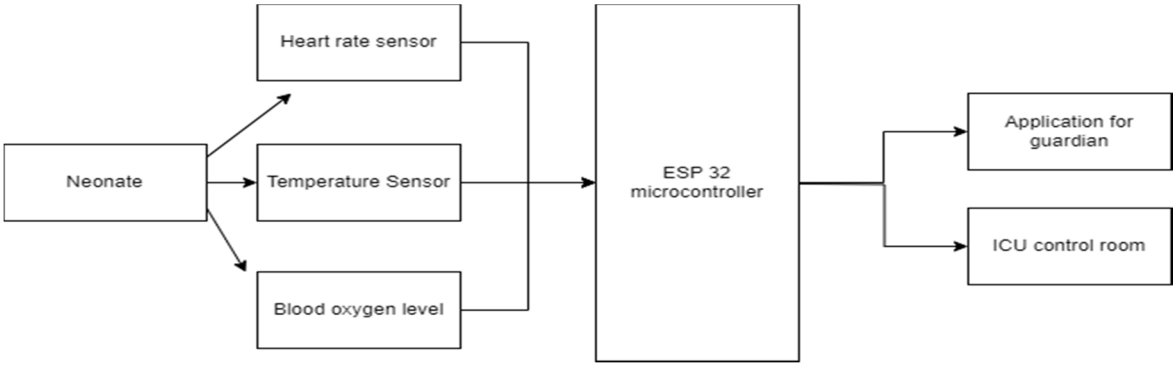


Fig 2.1: Block diagram of the proposed system

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III. HARDWARE EQUIPMENT

1) ESP32 Microcontroller:

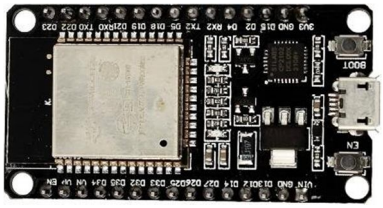


Fig 3.1 ESP32 Microcontroller.

An ESP32 microcontroller must be integrated with the inhaler for data processing and communication. Wireless connectivity (Wi-Fi) should be supported for cloud synchronization.

2) Temperature Monitoring DS18B20 Water Proof Temperature Probe Black (1m) Original Chip:



Fig 3.2 DS18B20 Temperature Sensor

Although temperature itself is not a direct measure of cardiac function, changes in temperature can serve as valuable indicators of various physiological processes and health conditions. In a comprehensive health assessment, monitoring multiple vital signs, including temperature, provides a more holistic view of an individual's well-being and helps healthcare professionals identify and address potential issues early. Fig represents DS18B20 Water Proof Temperature Probe – Black (1m) Original Chip.

3) MAX30100 Integrated Pulse Oximetry and a Heart Rate Sensor:



Fig 3.3 MAX30100 integrated pulse oximetry and a heart-rate sensor.

The pulse oximetry and heart-rate sensor were included in the MAX30100. Using two LEDs—a red and an infrared one to emit two different light wavelengths, this optical sensor measures the absorbance of pulsating blood using a photodetector. It is ideal to read the data with the tip of your finger when using this specific LED color combination. The target MCU receives the signal through the micro-BUS I2C interface after being processed by a low-noise analog signal processing unit. Additionally, excessive pressure may narrow capillary blood flow, which would reduce the data's dependability. It is also possible to program an INT pin.

IV. WORKING

A medical facility's neonatal emergency unit tends to the basic medical needs of critically sick infants, some of whom are preterm. For the baby's survival and the survival of fragile babies admitted to the neonatal intensive care unit (NICU), ongoing wellness checks are crucial. A stay in the newborn emergency unit might be a little overwhelming for parents who are eager to take their child home. They are unable to communicate with their child because of the wires and checking equipment.

The infant's blood oxygen saturation (SPO2), temperature, electrocardiogram (ECG), and respiration are vital markers that need to be monitored in the NICU.

1) Heart or cardiorespiratory: This screen shows an infant's breathing rate, heart rate and examples on a monitor. Wires from the monitors are appended to glue fixes on the skin of the child's chest, guts, and leg.
2) Blood pressure monitor: Pulse is estimated utilizing a little sleeve put around the child's upper arm or leg. Intermittently, a circulatory strain screen pumps up the sleeve and measures the level of pulse. A few infants require constant pulse observing. This should be possible utilizing a catheter (little tube) in one of the infant's supply routes.
3) Temperature: A temperature test is set on the infant's skin with a patch which is adhesive. A wire associates the temperature test to the overhead warmer to assist direct the warmth expected to keep the infant warm.
4) Pulse oximeter: The SPO2 machine measures the oxygen level in the child's blood with direct contact with the skin. A little light is attached to the infant's finger or toe, or in extremely minor children, hand or foot. A wire interfaces the light to the screen where it shows the measure of oxygen in the child's blood platelets.

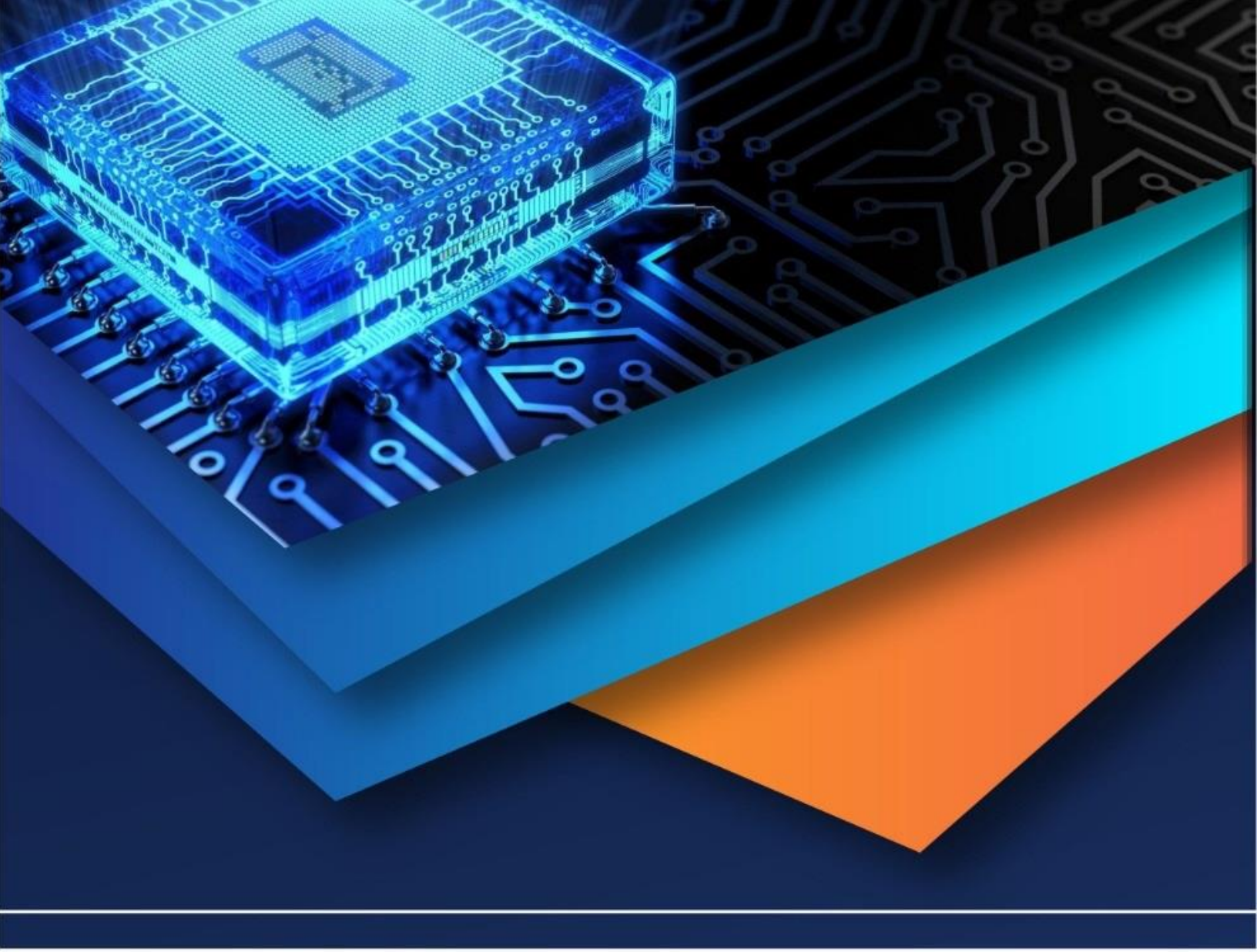
Setting up Firebase as a Realtime Database is a streamlined process that empowers developers to build dynamic and responsive applications with ease. Leveraging Firebase's intuitive interface, developers can seamlessly create a new project, set up the Realtime Database, and integrate it into their applications effortlessly. With Firebase, real-time data synchronization is made simple, allowing for instant updates across all connected devices without the need for complex server-side logic. Additionally, Firebase's robust security features ensure that sensitive data remains protected, granting developers a peace of mind as they focus on crafting exceptional user experiences. Whether it's for a small-scale project or a large-scale application, Firebase provides the tools necessary to harness the power of real-time data and elevate the capabilities of modern software development.

V. CONCLUSION

In conclusion, the development of the Neonatal Health project with a dedicated app represents a significant step forward in enhancing neonatal healthcare through innovative technological solutions. By integrating wireless monitoring systems with a user-friendly mobile application, this project aims to improve the accessibility and efficiency of neonatal monitoring within intensive care unit (ICU) settings. The ability to continuously monitor vital signs such as heart rate, temperature, and blood oxygen level in real-time provides healthcare providers and caregivers with valuable insights into the health status of neonates, enabling timely intervention and personalized care. Moreover, the seamless transmission of data between the neonate, ESP32 microcontroller, application for guardians, and the ICU control room enhances communication and collaboration among healthcare teams, ultimately leading to improved patient outcomes.

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