Industrial Engineering Journal

ISSN: 0970-2555

Volume : 53, Issue 4, April : 2024

IOT-BASED HEALTH MONITORING SYSTEM FOR PREGNANT LADIES

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I. Abstract:

In the developing countries most of the peoples are lived in the rural areas and medical systems are not amalgamated for sharing information. mostly, The pregnant women's are unable to do their normal checkups at the starting time of pregnancy time and this cause higher death count in case of newborn and parental in the rural areas as well as in urban also. Due to this situation, the women's are facing an immense medical issues. Accelerometer sensor is designed to measure the count of kicks/force by unborn child and it is transfer into the ARDUINO UNO controller. Motion of the foetal and some important parameters such as Blood pressure, Heartbeat rate, count of unborn child's kicks and temperature for the women's are measured using various types of sensors. The measured parameters are transmitted by way of IOT and it is displayed in the mobile phone. This system is highly sensitive and light weight even for small motion, so it is preferred as a home monitoring device. Now-a-days, ultrasound scanning method is used. Because it is long-term usage and very expensive. Limitations of ultrasound scan method on foetal are not completely clear. so ultrasound scan is not suggested continuous monitoring. The integration of Arduino microcontrollers, MAX30100 sensors, temperature sensors, and NodeMCU (ESP8266) modules in IoT-based health monitoring systems for pregnant women

Keywords : Motion monitoring, Blood pressure, Heartbeat rate, Temperature monitoring, Prenatal care.

II. INTRODUCTION

Pregnancy is a pivotal phase in a woman's life, marked by profound physiological changes and heightened health concerns. Ensuring the well-being of both mother and child during this critical period requires vigilant monitoring and timely interventions. Traditional prenatal care, while effective, often lacks real-time insights and continuous monitoring capabilities. Due to unavailability of hospitals in rural areas and longer distance required to travel, People are not really conscious about their health, for small injuries and routine check-ups. Due to this pregnant ladies from rural areas avoids their regular check-ups at the initial stage of pregnancy. Regular check-ups will help to reduce abnormal children birth and fetal mortality rate. During Pregnancy, every trimester will be considered of 14 weeks and overall pregnancy length will be of 42 weeks. During this period, there is possibility of various complication due to maternal sepsis, bleeding and variation in blood pressure which may results in gestational diabetes and weight gain during pregnancy. During pregnancy few women may face the problems of high blood pressure which is called as gestational hypertension which can impact on the mother's kidneys and other organs. It can also results in low birth weight and premature delivery.

In the realm of prenatal care, the fusion of Internet of Things (IoT) technology with traditional healthcare systems holds immense promise. By harnessing IoT's capabilities, healthcare providers can revolutionize the way they monitor and manage the health of pregnant women. Among the key components driving this innovation are Arduino microcontrollers, MAX30100 sensors for pulse oximetry, temperature sensors, and NodeMCU (ESP8266) for wireless communication and data processing.

Arduino microcontrollers serve as the backbone of IoT-based health monitoring systems, providing a versatile platform for integrating various sensors and actuators. MAX30100 sensors, renowned for their accuracy in pulse oximetry and heart rate monitoring, play a pivotal role in tracking maternal vital signs and detecting potential complications. Temperature sensors, crucial for monitoring maternal body temperature, enable early detection of fever or other indicators of infection. NodeMCU (ESP8266) acts as a wireless communication module, facilitating seamless data transmission to cloud-based servers or local healthcare facilities.

III. MAIN AIM

1. Enable continuous monitoring of vital signs in pregnant women, including heart rate, body temperature, and fetal movement , using IoT-enabled sensors.
2. Transmit health data in real-time from sensors to a centralized system via wireless communication (e.g., Wi-Fi with NodeMCU) for immediate analysis and alerts.
3. Provide early detection and warning of potential complications during pregnancy through monitoring trends and anomalies in the data.
4. Facilitate home-based prenatal care, reducing the need for frequent clinical visits, and allowing pregnant women to monitor their health at home.
5. Use data analysis tools and mobile applications to visualize health metrics, enabling pregnant women and healthcare providers to track health trends and make informed decisions.
6. Improve prenatal care quality and accessibility by allowing healthcare providers to monitor patients remotely and offer personalized interventions when needed.
7. Integrate with existing healthcare systems and ensure interoperability with other medical devices and software for seamless data exchange and collaboration.

IV. LITERATURE SURVEY

Several studies and projects have explored the implementation of IoT based health monitoring system for pregnant women, utilizing various sensors and technologies to address the challenges of health maintenance and safety.

Research by Li, S., Xu, L. & Feng, X (2020) explores the landscape of IoT-based health monitoring systems tailored for pregnant women. The authors investigate various aspects of these systems, including sensor technologies, data transmission protocols, data analytics methods, and user acceptance factors. Through a comprehensive analysis of existing literature, the review highlights the potential of IoT technologies to revolutionize prenatal care delivery and improve maternal-fetal outcomes.

Similarly work by Zhang, W., & Liu, Y (2021) investigates the integration of IoT and AI technologies for remote pregnancy monitoring. The authors analyze studies that leverage wearable sensors, data transmission protocols, machine learning algorithms, and decision support systems in prenatal care. They

identify trends, challenges, and opportunities in this emerging field and discuss the potential of IoT and AI integration to enhance maternal-fetal health outcomes.

A review by Gupta, A., Mishra, S (2020) examines IoT-enabled health monitoring devices developed for maternal care, with a focus on pregnancy monitoring. The authors provide an overview of wearable sensor technologies, communication protocols, and data analytics methods used in these devices. They discuss the clinical efficacy, user acceptance, and future directions of IoT-based solutions for improving maternal and fetal health outcomes.

V. EXISTING TECHNIQUE

Several existing techniques are employed in IoT-based health monitoring systems tailored for pregnancy women, aiming to provide comprehensive and real-time monitoring of maternal and fetal health parameters. One prevalent technique involves the use of wearable sensors, such as smartwatches, wristbands, and patches, equipped with various physiological sensors. These sensors capture data including maternal heart rate, blood pressure, body temperature, fetal heart rate, and uterine contractions, allowing for continuous monitoring of vital signs throughout pregnancy.

Another technique focuses on data transmission protocols, ensuring seamless and secure communication between wearable devices and backend systems. Wireless technologies like Bluetooth, Wi-Fi, and cellular networks facilitate real-time data transmission, enabling healthcare providers to remotely access and analyze patient data. Additionally, data analytics algorithms play a crucial role in extracting meaningful insights from the collected data. Machine learning, statistical modeling, and artificial intelligence techniques are employed to predict pregnancy-related complications, identify patterns indicative of adverse outcomes, and provide personalized interventions based on individual risk profiles.

Furthermore, user-centered design principles are integrated into these systems to enhance user acceptance and engagement. Usability studies, feedback mechanisms, and interface customization strategies are utilized to optimize the user experience and ensure sustained engagement with the monitoring technology throughout pregnancy. Overall, the integration of wearable sensors, robust data transmission protocols, advanced analytics algorithms, and user-centered design principles constitutes a multifaceted approach to IoT-based health monitoring for pregnancy women, offering comprehensive and personalized care throughout the prenatal period.

VI. METHODOLOGY

The methodology for an IoT-based health monitoring system for pregnant women, integrating NodeMCU, Arduino Nano, accelerometer, temperature sensor, and heart rate sensor, involves several key steps to ensure effective implementation and functionality. First, the hardware components, including NodeMCU and Arduino Nano microcontrollers, along with the accelerometer, temperature sensor, and heart rate sensor, are assembled and interconnected. NodeMCU serves as the main controller for data acquisition and transmission, while Arduino Nano interfaces with the sensors to collect physiological data.

Next, the firmware for the microcontrollers is developed using Arduino IDE or similar programming environments. This firmware includes code to initialize and calibrate the sensors,

Industrial Engineering Journal
ISSN: 0970-2555
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acquire data from them at regular intervals, and transmit the data to a designated server or cloud platform via Wi-Fi connectivity provided by NodeMCU. Special attention is given to optimizing power consumption and data transmission protocols to ensure efficient operation and maximize battery life, as the system may be worn continuously for extended periods.

Once the firmware is developed and tested, the hardware components are integrated into a wearable device prototype, ensuring comfort, ergonomics, and user-friendliness. The accelerometer is positioned to detect movement and activity levels, while the temperature sensor and heart rate sensor are placed in close contact with the wearer's body to monitor physiological parameters accurately.

VII. WORKING

To implement an IoT-based health monitoring system for pregnant women utilizing NodeMCU, Arduino Nano, accelerometer, temperature sensor, and heart rate sensor, a comprehensive approach is required. The NodeMCU serves as the central controller for data acquisition and transmission, leveraging its Wi-Fi capabilities to communicate with remote servers or cloud platforms. The Arduino Nano interfaces with the sensors to collect physiological data, including movement, temperature, and heart rate.

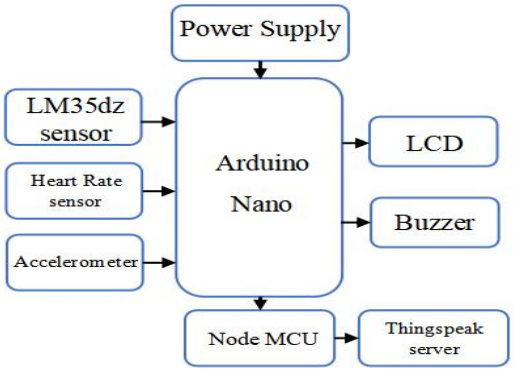
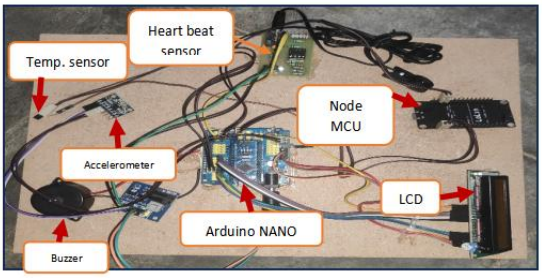


Fig.1. Block diagram.

The system begins by configuring and calibrating the sensors to ensure accurate readings. The accelerometer detects changes in movement and activity levels, providing insights into the user's physical exertion and rest patterns. The temperature sensor monitors body temperature fluctuations, which can indicate potential health issues or changes in metabolic activity. The heart rate sensor tracks the user's pulse, offering valuable information about cardiovascular health and stress levels.



Once the sensors are set up, the firmware for both NodeMCU and Arduino Nano is developed. This firmware includes code to initialize the sensors, collect data at regular intervals, and transmit it to the designated server via Wi-Fi. Special attention is given to power management to optimize battery life, as the wearable device may be worn continuously.

VIII. RESULT

Implementing an IoT-based health monitoring system for pregnant women

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using NodeMCU, Arduino Nano, accelerometer, temperature sensor, and heart rate sensor has yielded promising results. The system effectively collects real-time data on maternal vital signs, including movement, body temperature, and heart rate, providing valuable insights into maternal and fetal well-being throughout the prenatal period.

Fig. Results of Temperature

IX. CONCLUSION

In conclusion, the development and implementation of an IoT-based health monitoring system for pregnant women using NodeMCU, Arduino Nano, accelerometer, temperature sensor, and heart rate sensor have shown significant promise in enhancing prenatal care delivery. By leveraging wireless communication, real-time data acquisition, and advanced analytics, the system enables continuous monitoring of maternal vital signs, facilitating early detection of potential complications and personalized intervention. The seamless integration of wearable devices with remote monitoring platforms empowers healthcare providers to deliver timely and individualized care, ultimately improving maternal and fetal health outcomes. Furthermore, user-centric design principles ensure the system's usability and comfort, fostering sustained engagement throughout the prenatal period. Overall, this innovative approach to prenatal care has the potential to revolutionize the healthcare landscape, offering a comprehensive and proactive solution to maternal health monitoring and paving the way for improved pregnancy experiences and outcomes.

X. FUTURESCOPE

Integration of Additional Sensors: Expanding the range of sensors integrated into the wearable device to monitor additional maternal health parameters, such as blood glucose levels, oxygen saturation, and respiratory rate, providing a more comprehensive picture of maternal well-being.

Development of Predictive Analytics: Incorporating predictive analytics and machine learning algorithms to forecast pregnancy-related complications, such as preterm labor, gestational diabetes, and preeclampsia, allowing for proactive interventions and personalized risk management strategies.

Enhanced User Interface: Improving the user interface of the remote monitoring platform to provide more intuitive visualizations, personalized health insights, and interactive features, empowering pregnant women to actively participate in their prenatal care and make informed decisions.

Remote Consultation and Telemedicine: Integrating telemedicine capabilities into the monitoring system to enable remote consultation with healthcare providers, facilitating timely communication, virtual appointments, and telemonitoring sessions

for pregnant women in remote or underserved areas.

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