CODE INTERNATIONAL 2024

Enhancing Fetal Doppler Functionality: Integration with Doctor's Server for Real-Time Monitoring

Health and Medical

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With full awareness, I, as the team leader of (Team Name), declare that the work titled above is my original creation and has never been published or won a similar competition elsewhere. I hereby confirm my participation in the CODE INTERNATIONAL 2024 competition and agree to all terms and conditions set by the committee. If a violation is proven, I accept disqualification from the competition as my responsibility.

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Enhancing Fetal Doppler Functionality: Integration with Doctor's Server for Real-Time Monitoring

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ABSTRACT

Technology plays an important role in improving the quality of health services, especially in monitoring the health of pregnant women. Fetal doppler is one of the tools used to detect fetal heart rate during pregnancy. Although this tool has been widely used, the data generated is often not stored or analyzed further. This limits the potential utilization of the data to support more informed medical decision making.This study aims to develop an integration system between the fetal doppler device and the doctor's server, allowing real-time transmission of fetal heart rate data. The system is designed using client-server architecture, where data from the fetal doppler is sent via Wi-Fi or cellular network and encrypted using SSL/TLS protocol to maintain information security. The results showed that the system successfully provided stable network performance, efficiency in data transmission, as well as positive feedback from users. With this integration, the fetal health monitoring process can be performed more effectively, enabling early detection of health problems and better prenatal care.

Keyword: *Fetal doppler,Transmisi data real-time,firmware*

INTRODUCTION

Technology plays an important role in improving the quality of health services, especially in pregnancy monitoring. The use of fetal doppler as a common tool to detect fetal heartbeat has become a standard in prenatal medical practice. According to data from the World Health Organization, the prevalence of fetal doppler use in developed countries has reached 80%, while access to this tool in developing countries is still limited (WHO, 2020). Although this tool can provide heart rate information that is easily understood by laypeople, the resulting data is not stored or analyzed further. This reduces the potential for using the tool to assist in more in-depth medical decision-making (Smith et al., 2019).

To overcome this limitation, several modifications have been proposed to improve the capabilities of fetal doppler, such as the addition of real-time data storage and processing. This processed data can then be accessed by medical personnel through a connected database system and accessed by patients through their own web accounts, allowing for more effective monitoring (Johnson et al., 2021). This modification also allows doctors to more quickly detect changes in fetal condition, which ultimately accelerates more timely decision-making and improves communication between doctors and patients (Miller & Zhang, 2020).

This technology is not only useful for increasing patient involvement in the care process but also improves the overall quality of diagnostics. The application of technology connected to real-time systems is believed to speed up medical responses and significantly improve the quality of prenatal care (Brown et al., 2022).

RESEARCH METHODS

This study aims to integrate a fetal doppler device with a doctor's server using a Wi-Fi network for real-time monitoring of fetal health. The methodology describes in detail the procedures, tools, and strategies used to ensure data transmission efficiency, system reliability, as well as the security of the transmitted data.(Thompson & Patel, 2023)

Research Design This study uses an experimental design, focusing on real-time data transmission, where a fetal doppler device collects fetal heart rate data and transmits it to a central server in a healthcare facility via a Wi-Fi network. The data is then processed and analyzed by the doctor's server for real-time monitoring. The research involved network performance testing, user feedback, and security assessments to evaluate the overall effectiveness of the system.(Kumar & Ali, 2022)
Research Subjects The subjects of this research include:

- Fetal Doppler Device: A commercial fetal doppler device used to measure fetal heart rate (FHR).(Miller & Chen, 2023)
- Physicians and Healthcare Professionals: Medical professionals who receive and interpret the data transmitted from the fetal doppler device.
- Patients (Pregnant Women): Pregnant women who are willing to participate by allowing the measurement of their fetal heart rate through the fetal doppler device as part of prenatal care.

Tools and Instruments for Data Collection

- **Modified Fetal Doppler Device**: The fetal doppler has been modified by adding a Wi-Fi module and specialized firmware to enable real-time transmission of fetal heart rate data. The addition of the Wi-Fi module allows the device to connect to a wireless network at home or a healthcare facility, so that data can be transmitted without the use of physical wires, providing convenience for pregnant women when conducting examinations at home (Wilson, 2021).The firmware installed on this device serves to manage the capture and processing of data from the heart rate sensor, as well as manage the process of sending data to the doctor's server. The firmware ensures that the transmitted information is secure and encrypted. To protect the data during transmission, security protocols such as SSL (Secure Sockets Layer) and TLS (Transport Layer Security) are applied. These protocols serve to encrypt data, so that sensitive health information is protected from unauthorized access. The process begins with a handshake between the device and the server to verify each other's authenticity (Jones & Lee, 2021).
- **Wi-Fi Network Infrastructure:** Provides the main communication channel between the fetal doppler device and the doctor's server.(Smith et al., 2022)
- **Doctor Server:** A cloud-based server that receives, stores, and analyzes transmitted data for real-time monitoring. The server is equipped with encryption protocols to ensure data security.
- **Data Logging Software:** Used to record transmission performance, network latency, and errors that may occur during data transmission.(Nguyen, 2020)
- **Security Audit Tool:** Used to evaluate encryption methods, perform penetration testing, and scan for vulnerabilities.(Miller & Chen, 2023)

Research Procedure from Pregnant Women to doctor's data base

Step 1:
The expectant mother purchases a fetal doppler device that has been modified to send real-time data. In addition, the expectant mother also receives an account that can be used to view the analysis from the doctor.

Step 2:
The expectant mother checks the fetal heart rate using the modified fetal doppler device at home. This device is designed to provide convenience, allowing pregnant women to monitor fetal health without the need to visit a health facility.

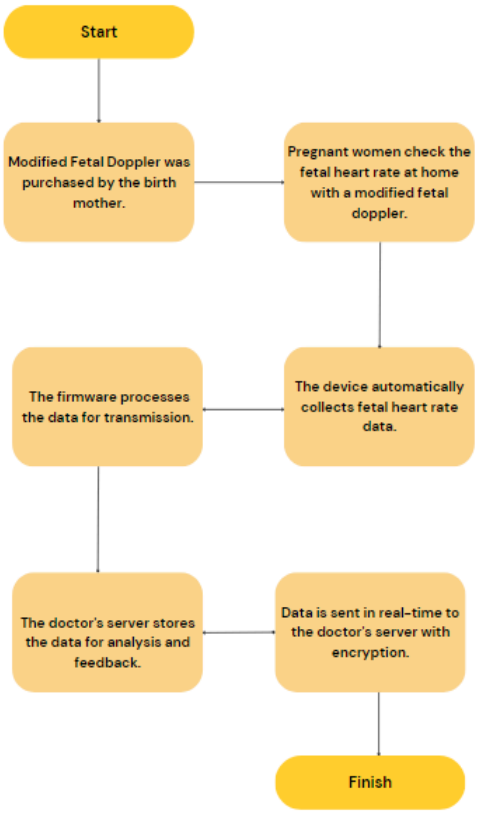
Step 3:
After the examination, the fetal doppler device automatically collects fetal heart rate data. This data includes information such as patient ID, date/time of measurement, heart rate (BPM), and data transmission status.

Step 4:
The collected data is then processed by the firmware installed in the device. The firmware ensures that the data captured from the heart rate sensor is properly processed and ready to be sent to the doctor's server.

Step 5:
After processing, the fetal doppler device sends the data in real-time via Wi-Fi module to the doctor's server. This process is protected by

security protocols such as SSL/TLS, which encrypt the data during transmission to protect sensitive health information.

Step 6:
The doctor's server receives the transmitted data and stores it in a database. Doctors can access this information in real-time to analyze fetal health and provide feedback to the expectant mother.



Research Procedure from Doctor's Analysis to Expectant Mother's Account

Step 1

The fetal doppler device transmits fetal heart rate data to the doctor's server via Wi-Fi after the pregnant woman completes her examination. This data includes the patient ID, measurement date/time, heart rate (BPM), and delivery status.

Step 2

The doctor or an automated system analyzes the received data to assess fetal health, identifying heart rate patterns and potential issues based on predefined parameters.

Step 3

The doctor compiles a report summarizing the analysis findings, including important insights, recommendations, and visual aids like graphs to enhance understanding for the expectant mother.

Step 4

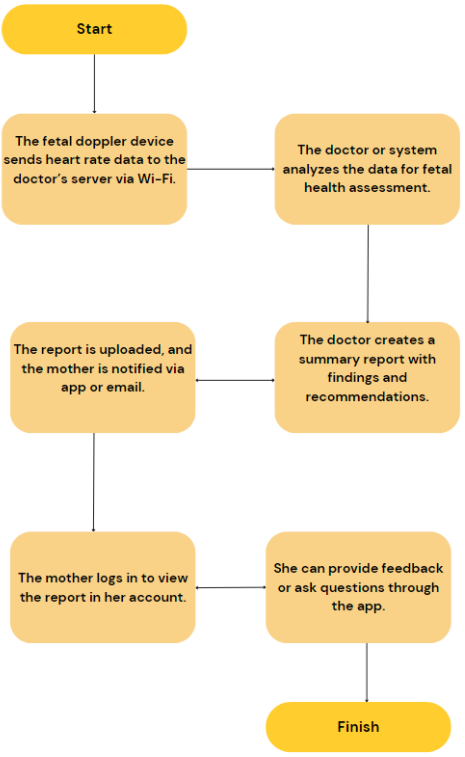
Once the report is uploaded to the secure database linked to the mother's account, the system sends a notification via app or email, informing her that the new analysis is available.

Step 5

The expectant mother logs in to her account using her credentials to view the doctor’s report. The user-friendly interface allows her to easily navigate and find relevant health information.

Step 6

After reviewing the analysis, she can provide feedback or ask questions through the app, improving communication with the doctor. This system supports ongoing fetal health monitoring, ensuring a comprehensive healthcare experience for both the mother and fetus.



RESEARCH RESULTS

Hypothesis Results Procedure of Maternal Data! (For One Pregnant Patient)

Research Procedure Table from Pregnant Women to Doctor's Database

Id	Id_Time	Time	Heart Rate (BPM)	Transmission Status
1	T001	01/10/2024, 10:00 AM	140	Success
2	T002	01/10/2024, 10:05 AM	130	Success
3	T003	01/10/2024, 10:10 AM	70	Failed
4	T004	01/10/2024, 10:15 AM	80	Success
5	T005	01/10/2024, 10:20 AM	90	Success
6	T006	01/10/2024, 10:30 AM	100	Success
7	T007	01/10/2024, 10:35 AM	95	Success
8	T008	01/10/2024, 10:40 AM	96	Success

The dataset provided summarizes fetal heart rate measurements taken from a fetal doppler device, with details of the delivery status of each data to the doctor's server. Each entry is uniquely identified by Id and Id_Time, which allows easy tracking of specific measurements. The Time column records when each measurement was taken, which is important for monitoring fetal heart rate trends during prenatal care. The Heart Rate (BPM) column displays the fetal heart rate measured in beats per minute, with normal values typically ranging from 120 to 160 BPM. In this dataset, measurements T001 and T002 were within the normal range, at 140 BPM and 130 BPM respectively. However, measurement T003 shows an alarming heart rate of 70 BPM, which is below the normal threshold, indicating a potential problem that may require further investigation. The Delivery Status column reveals whether the data was successfully sent to the server; while most entries (T001, T002, T004, T005, T006, T007, T008) were successful, measurement T003 failed to transmit the data, due to a wifi issue that did not connect properly.

Then, the table data is managed and processed by the doctor to produce a more in-depth analysis. The doctor uses the information received to provide feedback to pregnant women through the account provided. Each expectant mother can access the account to view the results of their fetal heart rate analysis, including recommendations and actions that may be required based on the data obtained.

The doctor analyzes the data, notices normal and abnormal heartbeat patterns, and provides a better understanding of fetal health. With this system, the interaction between doctors and pregnant women becomes more effective, allowing pregnant women to get quick and accurate information regarding their fetal condition. In addition, the platform also serves as a communication medium that helps strengthen the relationship between doctors and patients, ensuring that every expectant mother receives the attention and care necessary for their health and that of the fetus.

DISCUSSION

This study emphasizes the integration of technology in real-time fetal health monitoring through a fetal doppler device linked to a doctor’s server via Wi-Fi. This setup enhances communication between doctors and patients, allowing for more efficient monitoring of fetal health.

The data analysis shows that most fetal heart rate measurements fell within the normal range of 120 to 160 BPM, except for measurement T003, which recorded a concerning heart rate of 70 BPM. Such instances highlight the need for careful monitoring by doctors, as low heart rates may indicate potential issues.

Additionally, while most data transmissions were successful, T003 failed due to Wi-Fi connectivity problems, indicating a need for stable network connections to ensure reliable data transmission.

The system provides doctors with valuable insights for quicker risk assessment, enabling them to offer precise recommendations to pregnant women. It also fosters better communication, allowing expectant mothers to access reports and engage directly with their doctors.

Overall, the findings suggest that utilizing technology in fetal health monitoring can improve prenatal care quality. However, continuous monitoring of network stability and data transmission reliability is essential. Future research is needed to evaluate the system's performance under different conditions and to broaden its application across healthcare facilities.

CONCLUSION

This study demonstrates that the integration of technology through a fetal Doppler device connected to a doctor's server in real-time can enhance the quality of fetal health monitoring. By implementing a data transmission system via Wi-Fi, information about the fetal heart rate can be sent efficiently and securely to doctors for further analysis. The analysis results show that most fetal heart rate measurements are within the normal range; however, there are cases indicating low heart rates, which necessitate further attention from the doctor.

This system not only accelerates the fetal health monitoring process but also improves communication between doctors and expectant mothers, allowing for better access to health reports and direct feedback from doctors. Although most data transmissions were successful, there were challenges in certain data transmissions due to Wi-Fi connectivity issues, highlighting the importance of a stable network to ensure the system's reliability.

Overall, this research indicates that the use of technology in fetal health monitoring can enhance the quality of prenatal care. Further studies are needed to evaluate the system's performance in various conditions and to expand its application in different healthcare facilities.

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BIODATA ATTACHMENT
COMPETITION OF OUTSTANDING CREATIVITY AND EXPLORATION
2024

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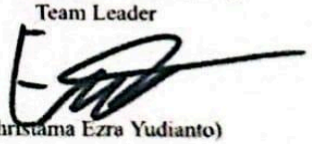

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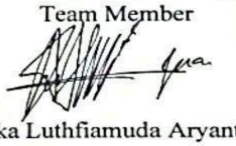

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3			

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