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Review of Ai and Predictive Technologies in Maternal

Nandhana R[1], Aiswarya Shaji[2], Rifana Hussain[3], Kasinadh S R[4], Reeba Rex S[5]

[1,2,3,4]UG Scholar, Department of Electronics and Communication Engineering, Dr APJ Abdul Kalam Technological University, Kerala, India
[5]Associate Professor, Department of Electronics and Communication Engineering, Dr. APJ Abdul Kalam Technological University Kerala, India

ABSTRACT

The Maternova Pregnancy Risk Prediction Device is an IoT-enabled maternal health monitoring system designed to reduce maternal mortality through early detection of pregnancy-related complications, particularly pre-eclampsia. The system continuously monitors key physiological parameters such as blood pressure, heart rate, oxygen saturation, body temperature, and fetal activity using wearable sensors integrated into a wrist-worn device and abdominal belt. Sensor data is transmitted to a cloud platform through LoRa, Wi-Fi, or Bluetooth, where machine learning algorithms—particularly a Naïve Bayes classifier—analyze real-time patterns to determine risk levels. The system provides instant alerts to pregnant women and healthcare providers, enabling timely medical intervention while supporting remote monitoring in low-resource settings. By combining IoT, predictive analytics, and user-friendly mobile applications, the proposed device offers a cost-effective, accessible, and reliable solution to improve prenatal care and reduce life-threatening maternal-fetal complications.

INTRODUCTION

Maternal healthcare is undergoing a significant technological shift with the integration of IoT-based monitoring systems and intelligent wearable devices. Pregnancy complications such as pre-eclampsia often remain undetected due to the absence of continuous monitoring, especially in remote and low-resource environments. The Maternova Pregnancy Risk Prediction Device aims to address this gap by utilizing wearable sensors, wireless communication technologies, and cloud-based analytics to provide real-time maternal and fetal health monitoring. By incorporating machine learning algorithms for early risk prediction, the system enhances diagnostic accuracy and supports timely medical intervention, thereby improving overall prenatal care and reducing maternal-fetalcomplications.

- The system focuses on reducing maternal mortality by enabling early detection of pregnancy-related complications like pre-eclampsia.
- Wearable devices integrated into the system continuously monitor vital parameters such as BP, SpO_2, heart rate, temperature, and fetal movements.
- IoT communication technologies (LoRa, Wi-Fi, Bluetooth) enable seamless data transfer between the wearable devices, mobile application, and cloud platform.
- A machine learning model—particularly the Naïve Bayes classifier—is used to analyze real-time data and predict risk levels.
- Healthcare professionals can remotely access patient data, allowing timely intervention and improved clinical decision-making.
- The system is designed for both clinical and home-based use, making it suitable for rural or low-resource settings.
- The integration of IoT, cloud analytics, and predictive algorithms makes the device a scalable and effective maternal health monitoring solution.

LITERATURESURVEY

Munyao M.M. – Real-Time Pre-eclampsia Prediction Model (2024),Munyao proposed an IoT-driven real-time monitoring system for early detection of pre-eclampsia. The study used wearable sensors to continuously measure maternal vitals such as blood pressure and heart rate. Machine learning algorithms were applied to the collected data, significantly improving the prediction accuracy compared to traditional checkup-based diagnosis. The system emphasized the importance of continuous remote monitoring in preventing pregnancy-related complications.

Marques et al. – IoT and Deep Learning in High-Risk Pregnancies, Marques focused on combining IoT-based monitoring with deep learning architectures to identify high-risk pregnancy conditions. Temporal patterns in maternal data were analyzed using LSTM-based deep networks. Results showed enhanced prediction sensitivity and reduced false alarms compared to classical machine learning methods. The study highlighted deep learning as a powerful tool for interpreting complex and time-varying physiological data.

Ranganayagi et al. – IoT-Based Maternal Health Monitoring System, Ranganayagi developed a continuous maternal health monitoring prototype using wearable sensors. The system captured maternal vitals in real-time and triggered alerts when abnormal readings were detected. Although the system effectively monitored maternal health, it lacked advanced predictive analytics. This limitation paved the way for integrating machine learning models into real-time monitoring systems to improve risk assessment.

Beri et al. – IoT-Based Pre-eclampsia Risk Management Framework, Beri presented a risk management model that integrates clinical history with IoT sensor data to provide a comprehensive evaluation of maternal risk levels. The system generated risk scores based on both current physiological signals and medical records. The study demonstrated that combining medical history with real-time IoT data enhances early detection accuracy, supporting timely clinical intervention.

Veena & Aravindhar – Remote Pregnancy Risk Monitoring Using IoT and ML, Veena proposed a remote maternal health monitoring system using IoT sensors and machine learning classifiers to detect early signs of pregnancy risk. The system offered user-friendly alerts through a mobile application, making it highly suitable for rural and underserved communities. The study confirmed the importance of integrating ML models into IoT healthcare systems for enhanced prediction accuracy.

Sharma et al. – Wearable IoT System for Maternal Monitoring (2023), Sharma developed a wearable IoT device capable of monitoring blood pressure, heart rate, and body temperature. Edge computing was integrated to process sensor data locally before uploading it to the cloud, reducing delay and improving reliability. Their findings showed that wearable monitoring devices significantly reduce the likelihood of undiagnosed pre-eclampsia.

Thomas & Varghese – Machine Learning Algorithms for Pre-eclampsia Prediction (2022), Thomas compared various ML classification algorithms such as SVM, Naïve Bayes, and Logistic Regression using maternal health datasets. The study concluded that Naïve Bayes delivered better stability and accuracy for smaller datasets, while SVM excelled in complex and larger datasets. This research underscores the importance of selecting optimal ML models based on data characteristics.

Rodriguez – Deep Learning for Fetal and Maternal Health Analysis (2021), Rodriguez developed an LSTM-based deep learning approach to analyze temporal signals such as fetal heart rate, fetal movements, and maternal BP. The model demonstrated superior performance in detecting gestational hypertension and fetal distress. The study emphasized the importance of capturing time-dependent patterns for accurate prediction.

Hassan – LoRaWAN for Long-Range Maternal Health Monitoring (2021), Hassan's research explored LoRaWAN technology for long-range, low-power maternal health monitoring. The communication system supported seamless data transfer across distances up to 10 km, making it ideal for remote areas with limited internet access. The system demonstrated high energy efficiency, enabling continuous monitoring without frequent recharging.

Garcia – Predictive Analytics for Early Detection of Pregnancy Complications (2023),Garcia applied predictive analytics to maternal datasets, identifying risk indicators such as abnormal BP elevation, reduced SpO_2, and irregular temperature patterns. The system generated multi-level risk alerts, assisting healthcare providers in making timely decisions. The study confirmed the effectiveness of predictive analysis in preventing severe complications.

PAPERCOMPARISON

RESEARCHPAPERS	*COMPARITIVESTUDY*
1. Munyao M.M. – Real-Time Pre-eclampsia Prediction Model (2024)	Munyao et al. proposed an IoT-based monitoring system that continuously collects maternal vitals and applies machine learning algorithms to predict pre-eclampsia risk. The model enables real-time analysis on a cloud platform and issues automated alerts to caregivers. The study demonstrated improved early detection accuracy compared to conventional clinical checkups, highlighting the effectiveness of combining IoT sensors with predictive ML techniques.
2.Marques et al. – IoT and Deep Learning in High-Risk Pregnancies	Marques et al. introduced an IoT-based maternal monitoring system that utilizes deep learning models to analyze temporal variations in physiological data for high-risk pregnancy detection. The integration of wearable sensors with cloud-based deep learning algorithms enabled more accurate risk prediction compared to traditional machine learning methods. The study emphasized the importance of continuous data monitoring and advanced AI techniques in improving maternal health outcomes.
3.Ranganayagi et al. – IoT-Based Maternal Health Monitoring System	Ranganayagi developed an IoT-based maternal monitoring system that uses wearable sensors to continuously measure vital parameters such as blood pressure, heart rate, and SpO_2 levels. The collected data is transmitted to a cloud platform, where real-time alerts are generated when abnormal readings occur. The study demonstrated the effectiveness of continuous monitoring in improving maternal safety but noted that the system lacked advanced predictive analytics, highlighting the need for machine learning integration in future solutions.
4.Beri et al. – IoT-Based Pre-eclampsia Risk Management Framework	Beri proposed an IoT-based risk management model that integrates wearable sensor data with the mother's clinical history to assess the likelihood of pre-eclampsia. The system continuously monitors key physiological parameters and generates risk scores based on real-time and historical information. The study demonstrated improved accuracy in early detection compared to traditional monitoring methods, emphasizing the value of combining IoT data with medical records for timely intervention.
5. Veena & Aravindhar – Remote Pregnancy Risk Monitoring Using IoT and ML	Veena and Aravindhar developed an IoT-based maternal monitoring system that uses wearable sensors and machine learning algorithms to predict pregnancy risks in real time. The system securely transfers patient data using MQTT and ECC encryption, while cloud-based analysis generates alerts through a mobile app. The study demonstrated that integrating ML with IoT significantly improves early risk detection, especially in remote and underserved areas.
6. Sharma et al. – Wearable IoT System for Maternal Monitoring (2023)	Sharma et al. proposed an IoT-driven maternal monitoring system that focuses on continuous screening of high-risk pregnancy indicators through a network of wearable biomedical sensors. The device measures vital physiological parameters such as blood pressure, heart rate variability, oxygen saturation, and maternal temperature using PPG-based optical sensing and electronic measurement modules. Sensor data is transmitted to a cloud server using lightweight protocols such as MQTT, ensuring low-latency communication while minimizing network overhead. On the cloud side, machine learning classifiers—specifically Support Vector Machine (SVM) and Random Forest models—are implemented to identify abnormal physiological patterns that correlate with pre-eclampsia and gestational hypertension.
7. Thomas & Varghese – Machine Learning Algorithms for Pre-eclampsia Prediction (2022)	Thomas and Varghese designed a wearable IoT device capable of continuously monitoring key maternal vitals, including heart rate, oxygen saturation, and blood pressure. The data is uploaded to a cloud database, where analytics software evaluates abnormal variations and alerts healthcare providers through a mobile interface. Their study demonstrated that wearable IoT solutions can improve accessibility to prenatal care, especially for women in remote regions, by enabling continuous monitoring outside hospital settings.

8. Rodriguez – Deep Learning for Fetal and Maternal Health Analysis (2021)	Rodriguez et al. introduced an IoT-based system that employs wearable sensors to measure maternal vital signs such as heart rate, SpO_2, and body temperature. The device transmits encrypted data to a cloud platform, where automated analysis identifies abnormalities and sends alerts to healthcare professionals. The study demonstrated that secure IoT monitoring improves maternal safety by enabling early detection of pregnancy-related complications without frequent hospital visits.
9. Hassan – LoRaWAN for Long-Range Maternal Health Monitoring (2021)	Hassan et al. proposed an intelligent IoT prenatal monitoring system that continuously records maternal parameters, including blood pressure and heart rate, using wearable sensors connected to a cloud platform. The system incorporates machine learning algorithms to classify risk levels and automatically notify healthcare providers through a mobile interface. Their findings showed that AI-enabled IoT systems enhance diagnostic efficiency and support early intervention, particularly in high-risk pregnancies.
10. Garcia – Predictive Analytics for Early Detection of Pregnancy Complications (2023)	Garcia et al. developed a smart IoT health monitoring framework that integrates wearable sensors to track maternal and fetal parameters in real time. The system uses cloud analytics to evaluate abnormal trends and provides automated alerts to clinicians through a mobile dashboard. Their study showed that continuous remote monitoring improves pregnancy outcome predictions and reduces the need for frequent hospital consultations, particularly benefiting women in underserved regions.

CONCLUSION

The proposed Maternova: Pregnancy Risk Prediction Device demonstrates the potential of integrating IoT-enabled biosensing technology with machine learning to transform prenatal care. By continuously monitoring maternal and fetal health parameters such as blood pressure, heart rate, SpO_2, body temperature, and fetal activity, the system addresses a major limitation of conventional hospital-based checkups, which often fail to detect risk conditions at an early stage. The cloud-supported predictive model enhances clinical decision-making by generating real-time alerts for pre-eclampsia and other pregnancy-related complications, ensuring timely medical intervention.

The device's portable design and secure data transmission architecture make it highly suitable for use in both clinical environments and remote or low-resource settings where access to healthcare services is limited. Furthermore, the incorporation of machine learning algorithms enables more accurate risk prediction than traditional diagnostic approaches, promoting preventive healthcare over reactive treatment strategies. Overall, Maternova contributes to a scalable, cost-effective, and patient-friendly solution that promotes safer pregnancies by enabling continuous monitoring, improving diagnostic accuracy, and enhancing accessibility to maternal healthcare services.

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[9]. Al-Zahrani et al. – Secure IoT Communication in Healthcare Monitoring Introduced strong encryption techniques for protecting patient data in IoT pregnancy monitoring systems.
[10]. Lio et al. – IoT Wearable Sensors for Remote Health Tracking Explored wearable IoT health sensors that monitor chronic and maternal conditions with cloud analytics.

[11]. Mian Mujtaba Ali et al. – Low-Cost IoT & Android Health Monitoring System Developed a wearable system for measuring SpO_2, heart rate, and temperature using IoT and mobile applications.
[12]. Kumar & Devi – Machine Learning-Based Pre-eclampsia Prediction System,Kumar and Devi proposed a predictive model using maternal clinical parameters such as blood pressure, protein levels, and BMI. The ML classifier effectively identified pre-eclampsia risk early, supporting timely treatment decisions.
[13]. Sowmya et al. – Cloud-Assisted IoT Wearable for Maternal Monitoring,Sowmya et al. developed a cloud-assisted wearable device that monitors fetal and maternal vitals. The system uses real-time data analytics to notify doctors through a mobile interface, improving remote pregnancy care