A Non Invasive Pre Eclampsia Detector Using Machine Learning

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ABSTRACT : Pregnancy is a special condition in which women go through various health complications throughout the period of gestation. It is not feasible to predict these complications in an absolute manner. Preeclampsia refers to a condition that occurs due to a sudden increase in Blood Pressure during 20 weeks of pregnancy. Preeclampsia may lead to the damage of some other organs of the body liver or kidneys or leads to the occurrence of brain stroke or seizures. In the existing system, pre eclampisa prediction is done by using the invasive technique by collecting the blood sample from the maternal. It is not possible to diagnose the disease accurately at the second trimester. But in this proposed system, it is predict the disease at the early stage of pregnancy. As it helps to avoid further complications. It is a non-invasive technique which utilizes blood pressure sensor,glucouse module to diagnose the pre eclampisa. The collected data from the sensor is monitored and processed by the micro controller using IoT. The readings can be visualized by mobile with the help of the decision tree algorithm the resultant condition of the pre eclampisa is diagnosed helps for further treatment using analyzed data. If the machine learning algorithm detects the pre eclampisa, alert message is sent through mobile communication. The major advantage of this proposed system is feasible, user friendly. The transmission of the data is fast so the early diagnose will be done without any maternal affect.

I. INTRODUCTION

Preeclampsia is a disorder which appears after 20 weeks of pregnancy. The main characteristics of preeclampsia are proteinuria and high blood pressure. The mean arterial pressure in the middle of the trimester demonstrated to be a good predictor of preeclampsia. Preeclampsia is a complication of pregnancy. With preeclampsia, you might have high blood pressure, high levels of protein in urine that indicate kidney damage (proteinuria), or other signs of organ damage.

Preeclampsia usually begins after 20 weeks of pregnancy in women whose blood pressure had previously been in the standard range. Left untreated, preeclampsia can lead to serious even fatal complications for both the mother and baby. Early delivery of the baby is often recommended. The timing of delivery depends on how severe the preeclampsia is and how many weeks pregnant you are. Before delivery, preeclampsia treatment includes careful monitoring and medications to lower blood pressure and manage complications. Preeclampsia may develop after delivery of a baby, a condition known as postpartum preeclampsia.

The problem described above seems relevant, and improving the preeclampsia diagnostics quality is one of the priority areas of obstetrics. Implementation of remote monitoring systems for pregnant women into clinical practice allows achieving this aim among other things. Based on this, the following purpose was chosen: the development an algorithm for preeclampsia detection and control using the results of pregnancy long-term remote monitoring. The hallmark symptom of preeclampsia is elevated blood pressure. A blood pressure reading consistently higher than 140/90 mm Hg is indicative of the condition. Additionally, preeclampsia often presents with proteinuria, an abnormal amount of protein in the urine, suggesting impaired kidney function. Other symptoms can include swelling, particularly in the hands and face, severe headaches, vision changes, and abdominal pain. The risk factors for preeclampsia include a first-time pregnancy, being over the age of 35 or under 20, a history of high blood pressure or kidney disease, obesity, carrying multiple fetus, and certain medical conditions such as diabetes and autoimmune disorders. Preeclampsia poses significant risks to both the mother and the baby.

. We provide a detailed overview of the system architecture, including the IoT system,components and the machine learning techniques. Additionally, we discuss the experimental results and demonstrate the feasibility and effectiveness of our approach through real-world testing.

II. LITERATURE REVIEW

Prior to developing our a non invasive pre – eclampisa predictor system, we conducted a comprehensive review of existing literature to understand the current state-of-the-art in pre eclampisa prediction systems, assistive technologies, and related research areas. This literature survey served as the foundation for our research, providing valuable insights into the challenges faced by individuals with mobility impairments and the various approaches used to address them.

[1] **Higher order spectral analysis of heart rate variability in pregnancy and postpartum** Veerabhadrappa, S. T et al. (2013) Normal pregnancy is associated with hemodynamic and cardiovascular changes. The physiological adaptation including an increase in heart rate, stroke volume and cardiac output and decrease in blood pressure and vascular resistance. The action of autonomic nervous system is thought to be important for the maternal adaptations, but its role is not fully understood . Autonomic function can be assessed by means of heart rate variability. It was reported that, both low and high frequency components of HRV were significantly lower in pregnant women as compared to non pregnant women. It was shown that the sympathetic activity remains unchanged in the first trimester of pregnancy. It was reported that the sympathetic activity increases during normal pregnancy and decreases in case of threatened preterm delivery and immediately before normal delivery.

[2] **Development of mHealth Applications for Pre-Eclampisa Triage** D. T. Dunsmuir et al., (2014) The hypertensive disorders of pregnancy, and in particular pre-eclampisa (commonly defined as the presence of new hypertension and proteinuria in pregnancy) and eclampisa (commonly defined as seizures during pregnancy not from a pre existing condition), remain one of the top two causes of global maternal mortality and morbidity. The majority of these deaths occur in low- and middle-income countries (LMICs) primarily due to delays in triage (early identification of who is at risk), prompt treatment, and transportation to facilities that can provide expert care. This application combines two separate previously successful innovations: 1) a predictive score, called the mini pre-eclampisa integrated estimate of risk (mini PIERS) score and 2) the Phone Oximeter, consisting of a smart phone application and pulse oximeter sensor.

[3] **Remote monitoring system for preeclampsia detection and control.** Yuliya A Zhivolupova,et al.,(2019) Despite the active development of mobile health devices and telemedicine systems no uniform approaches have been developed for processing, analyzing and presenting the recorded signals and data in a convenient form. A large amount of heterogeneous information collected during the monitoring does not allow medical personnel to effectively analyze the accumulated data and use it in clinical practice. The principles of constructing an intelligent algorithm for the preeclampsia detection is proposed in the article. The algorithm is designed for implementation in a wearable remote monitoring system. The objective of the system is to identify signs of the preeclampsia on its early stages in order to avoid the progress of complications and pathologies of pregnancy. The objective function implementation is ensured by the application of an intelligent algorithm of data analysis during the online monitoring.

[4] **Mobile application helps planning activities during pregnancy** Ilona Heldal,et al.,(2019)   Pregnancy significantly influences the life of a young family, bringing many changes. Prospective parents must change their lifestyles, adapt to new rules that transform their everyday activities, and allow planning activities considering these new rules. The demo introduces a mobile application, called ELISA, made for the new info communication purpose of supporting prospective parents that helps planning activities following the recognition of pregnancy. These groups of mobile applications we call m Parent apps. The information processing and sharing opportunities provided by the application may support the prospective parents by both intra- or inter-cognitive info communications between parents, doctors, and other pregnant or experienced parents.The demo describes a mobile application called ELISA made for the new info-communication purpose of supporting prospective parents, that helps planning activities following the recognition of pregnancy. The prototype of the application has been worked out to implement key features along with the planning of the critical tasks concerning the pregnancy.

[5] **Pregnancy health monitoring system based on bio signal analysis** Yashi Gupta ,et al., (2019) Women and fetus can be at serious health risks during pregnancy. According to a study conducted in 2016 [1], a total of 250 intrauterine fetal deaths were reported amongst 6942 deliveries conducted during the study period. Pregnancy is a special condition in which women go through various health complications throughout the period of gestation. It is not feasible to predict these complications in an absolute manner. Different complications have varying probabilities of occurrence depending upon the phase in pregnancy. Consequently, the only way to ensure a healthy pregnancy is periodic health checkups and continuous health monitoring. Existing literature suggests that conventional health monitoring systems are either too specific or too general, therefore too inflexible to be suited for pregnant women. This paper proposes an end to end solution for tracking the health parameters of users by performing photoplethysmogram (PPG) analysis. Heart Rate Variability (HRV) parameters are calculated and matched with the suggested normal range.

III. METHODOLOGY

2.1 INTRODUCTION

Pregnancy is a special condition in which women go through various health complications throughout the period of gestation. It is not feasible to predict these complications in an absolute manner. Preeclampsia refers to a condition that occurs due to a sudden increase in Blood Pressure during 20 weeks of pregnancy. Preeclampsia may lead to the damage of some other organs of the body liver or kidneys or leads to the occurrence of brain stroke or seizures. In the existing system, pre eclampisa prediction is done by using the invasive technique by collecting the blood sample from the maternal. It is not possible to diagnose the disease accurately at the second trimester. But in this proposed system, it is predict the disease at the early stage of pregnancy. As it helps to avoid further complications. It is a non-invasive technique which utilizes blood pressure sensor,glucouse module to diagnose the pre eclampisa. The collected data from the sensor is monitored and processed by the micro controller using IoT.

2.2 MACHINE LEARNING

Machine learning (ML) is a field of study in artificial intelligence concerned with the development and study of statistical algorithms that can learn from data and generalize to unseen data, and thus perform tasks without explicit instructions. Recently, generative artificial neural networks have been able to surpass many previous approaches in performance. Machine learning approaches have been applied to many fields including large language models, computer vision, speech recognition, email filtering, agriculture, and medicine, where it is too costly to develop algorithms to perform the needed tasks. ML is known in its application across business problems under the name predictive analytics. Although not all machine learning is statistically based, computational statistics is an important source of the field's methods.The mathematical foundations of ML are provided by mathematical optimization (mathematical programming) methods. Data mining is a related (parallel) field of study, focusing on exploratory data analysis through unsupervised learning.

2.3.LINEAR REGRESSION

Linear regression is a type of supervised machine learning algorithm that computes the linear relationship between a dependent variable and one or more independent features. When the number of the independent feature, is 1 then it is known as Univariate Linear regression, and in the case of more than one feature, it is known as multivariate linear regression.

The interpretability of linear regression is a notable strength. The model's equation provides clear coefficients that elucidate the impact of each independent variable on the dependent variable, facilitating a deeper understanding of the underlying dynamics. Its simplicity is a virtue, as linear regression is transparent, easy to implement, and serves as a foundational concept for more complex algorithms. Linear regression is not merely a predictive tool; it forms the basis for various advanced models. Techniques like regularization and support vector machines draw inspiration from linear regression, expanding its utility. Additionally, linear regression is a cornerstone in assumption testing, enabling researchers to validate key assumptions about the data.

Types of Linear Regression
Simple Linear Regression
Multiple Linear Regression
The goal of the algorithm is to find the best Fit Line equation that can predict the values based on the independent variables.

2.4 HEART RATE SENSOR:

Heart rate is a term used to describe the frequency of the cardiac cycle. It is considered one of the four vital signs. Usually it is calculated as the number of contractions (heart beats) of the heart in one minute and expressed as "beats per minute" (bpm). See "Heart" for information on embryofetal heart rates. The heart beats up to 120 times per minute in childhood. When resting, the adult human heart beats at about 70 bpm (males) and 75 bpm (females), but this rate varies among people.

However, the reference range is normally between 60 bpm (if less termed bradycardia) and 100 bpm (if greater, termed tachycardia). Resting heart rates can be significantly lower in athletes. The infant/neonatal rate of heartbeat is around 130-150 bpm, the toddler's about 100–130 bpm, the older child's about 90–110 bpm, and the adolescent's about 80–100 bpm.

2.5 TEMPERATURE SENSOR

A thermistor is a type of resistor whose resistance varies with temperature. The word is a portmanteau of thermal and resistor. Thermistors are widely used as inrush current limiters, temperature sensors, self-resetting over current protectors, and self-regulating heating elements. Thermistors differ from resistance temperature detectors (RTD) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while thermistors typically achieve a higher precision within a limited temperature range [usually −90 °C to 130 °C]. Assuming, as a first-order approximation, that the relationship between resistance and temperature is linear, then:

Where,
ΔR = change in resistance
ΔT = change in temperature
k = first-order temperature coefficient of resistance

2.6 BLOOD PRESSURE SENSOR:

A piezoelectric sensor is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical signal.A piezoelectric disk generates a voltage when deformed (change in shape is greatly exaggerated).Sensing material :Two main groups of materials are used for piezoelectric sensors: piezoelectric ceramics and single crystal materials. The ceramic materials (such as PZT ceramic) have a piezoelectric constant / sensitivity that is roughly two orders of magnitude higher than those of single crystal materials and can be produced by inexpensive sintering processes. The piezoeffect in piezoceramics is "trained", so unfortunately their high sensitivity degrades over time. The degradation is highly correlated with temperature. The less sensitive crystal materials (gallium phosphate, quartz, tourmaline) have a much higher – when carefully handled, almost infinite – long term stability.

2.7 GLUCOSE SENSOR:

A glucose sensor integrated into a pre-eclampsia detector serves as a crucial component in monitoring and managing this pregnancy-related condition. Pre-eclampsia is a hypertensive disorder characterized by high blood pressure and signs of damage to other organ systems, typically emerging after 20 weeks of gestation. Glucose sensors play a vital role in this context by continuously monitoring blood glucose levels, which can be indicative of the severity of pre-eclampsia and its associated risks.

IV. ACKNOWLEDGEMENT

V. CONCLUSION

In conclusion, the linear regression algorithm stands as a cornerstone in both statistics and machine learning, providing a robust framework for modeling relationships between variables. Through the estimation of coefficients using the method of least squares, linear regression offers a straightforward yet effective approach to fitting the best-

fitting line to observed data points. This line serves as a representation of the relationship between the dependent variable and one or more independent variables.Throughout various fields and industries, linear regression finds widespread application, ranging from finance and economics to healthcare and engineering.

Its versatility allows it to be used for predictive modeling, inference, and understanding the underlying relationships within datasets. Whether predicting stock prices, analyzing patient outcomes, or optimizing engineering processes, linear regression remains a valuable tool for extracting insights from data.The linear regression algorithm follows a systematic methodology, involving steps such as data collection, preprocessing, model training, and evaluation. By adhering to this methodology, practitioners can build reliable and interpretable models that provide actionable insights and facilitate informed decision-making.

In ability to provide meaningful insights into linear relationships within data. Despite its simplicity, linear regression continues to be relevant and widely used due to its interpretability, ease of implementation, and ability to handle both numerical and categorical data.summary, while linear regression serves as a foundational algorithm.As technology advances and new methodologies emerge, linear regression remains a timeless tool for data analysis, offering valuable insights into the complex interplay between variables in diverse domains.By using this technology our project had done.The preeclampsia is detected by using both hardware and software.

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