FETAL BIRTH WEIGHT ESTIMATION AND PREDICTION OF FETAL ABNORMALITIES IN HIGH RISK PREGNANCIES- A SURVEY

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ABSTRACT-Preterm low birth weight and birth pose a significant concern in prenatal care, as they can lead to adverse effects on the health of newborns, and in severe cases, even result in mortality, contributing to high infant mortality rates globally. Researchers have explored the potential of machine learning and the artificial intelligence techniques, to predict potential health issues that could arise during pregnancy, such as the risk of delivering an undersized fetus. The accurate identification of undersized fetuses is critical in prenatal care, as it can negatively impact the health of newborns and even lead to mortality. A study conducted on dif ferent machine learning techniques found that bagged tree model, a hybrid model, exhibited excellent accuracy and area under operating characteristic curve (0.849 and 0.636, respectively) in identifying undersized fetuses. Prompt identification of fetal development issues is crucial for effective intervention to prolong gestational period, improve newborn weight, and reduce neonatal morbidity and mortality.Therefore, it's essential to predict potential fetal health problems early on.Early identification of these problems increases the likelihood of prompt intervention, which has a substantial impact on the gestational period. In managing preterm birth with low birth weight, timely intervention is critical as it can prolong gestational period, improve newborn weight, and reduce complications and mortality risks during the neonatal stage.The use of machine learning and artificial intelligence algorithms, in particular, can forecast probable health problems during pregnancy and delivery.To maximize the likelihood of prompt intervention and lengthen the gestational period, which would improve infant health and lower rates of neonatal morbidity and mortality, early detection of foetal development issues is essential.

II METHODS

1:LINEAR REGRESSION TECHNOLOGY: Linear regression is a regression technique that can predict outcomes such as low birth weight (LBW), normal birth weight (NBW), and high birth weight (HBW), which is also called as macrosomia. LBW is linked to long-term health problems such as mental disabilities, stunted growth, and learning difficulties in children,in addition fetal and neonatal mortality. Macrosomia,but on the other hand can lead to difficulties during labor, including extended labor, abnormal bleeding, and perineal injury in mothers. It can also lead to infant hypoxia, mortality, and an elevated danger of diabetes, heart disease, and obesity in the long term. Therefore,precise foetal weight estimation during pregnancy is crucial for identifying cases of LBW or macrosomia and making appropriate clinical decisions to reduce maternal and neonatal morbidity and mortality.

Ultrasound assessment is a widely accepted and a trustworthy way to calculate the fetal weight during pregnancy. However, there isn't a consistently better regression method for utilizing ultrasound to determine fetal weight. Additionally, linear regression assumes a linear relationship between the dependent and unrelated variables, which may not hold true for LBW and HBW fetuses. The goal of regression is to reduce the amount of squared residuals (SSR) for all observations. Still, since actual responses are influenced by both predictors and inherent factors, fixed regression formulas may not accurately predict fetal weight in different

groups. The coefficient of determination (R2) measures how much range of values can be explained by the regression model's dependence on x. However, a perfect fit is rare in practice, and an R2 of 1 indicates a perfect fit.

2:REGRESSION ANALYSIS USING RANDOM FOREST:Random forest is a versatile and easy-to-use supervised learning approach that can carry out both regression and classification problems. The technique involves creating a collection of decision trees, with greater strength and robustness as more trees are added. The method randomly selects data samples to build decision trees, makes predictions from each tree, and selects the best prediction through a voting process. Additionally, random forest analysis can identify useful features An approach to supervised learning that can handle both regression and classification tasks. decision trees using indicators such as information gain, gain ratio, and Gini index.By incorporating forecasts from multiple decision trees, random forest analysis improves accuracy and reduces overfitting compared to using a single decision tree. Finally, the final prediction in The average of all predictions made by the forest's trees is known as random forest regression.

3:SUPPORT VECTOR MACHINE(SVMs): Support vector machines (SVMs) are a An algorithm for machine learning that can be applied to both regression and classification tasks. SVMs are highly adaptable and can create linear and nonlinear boundaries to separate data points. They use kernel functions to transform data into a higher-dimensional space, allowing for more intricate decision boundaries.makes them appropriate for various applications, including image and text classification, bioinformatics, and financial forecasting.

4:DECISION TREE: Decision Trees are a The widely utilised machine learning technique can be used for regression analysis in addition to classification jobs. The trees are organised as a sequence of nodes, each of which represents a feature in the dataset, and leaves, which indicate the results of classification. The algorithm employs a series of questions to divide the dataset into smaller subsets, resulting in the decision tree. The tree is constructed using the Classification and Regression Tree Algorithm (CART), which repeatedly splits the data into more manageable groups based on the chosen features. The algorithm's name derives from the tree-like structure of the process, with a root node at superior and branches extending downwards to form the tree.

III LITERATURE SURVEY

[1]A group of researchers, including Akinola, R.A., Akinola, O.I., and Oyekan, conducted a research with 120 expectant mothers who were expecting a single baby, had no chronic medical conditions, and had booked for delivery. Within 1-20 days of delivery, the researchers used ultrasonography to measure fetal parameters such as head and abdominal circumferences (HC and AC), biparietal diameter (BPD), and femur length (FL) to anticipate birth weight of the babies using various statistical models. The projected outcome's precision birth weights was then evaluated using computerized statistical methods and compared to the actual birth weights at delivery.

[2]In a study by Dr. Hans Wolf, the relationship between fetal growth rate, cerebral blood flow redistribution markers, and perinatal outcomes was investigated. The study found that fetuses with slow growth rates had increased risk of unfavorable perinatal outcomes and low birth weight. Accurately identifying high-risk fetuses and distinguishing them from naturally small newborns with cerebral blood flow redistribution markers depends on fetal growth velocity. Decision trees offer a visual representation of possible outcomes or solutions based on predetermined parameters, and are constructed using the Classification and Regression Tree Algorithm (CART). The algorithm poses questions and creates subtrees according to the responses, utilizing characteristics within the dataset to make assessments or conduct tests.

[3]A case-control study was conducted by Selcan and Sinaci to investigate differences in fetal thymus size between healthy fetuses as well as those with restricted growth, such as small for gestational age (SGA) and fetal growth restriction (FGR). The study aimed to evaluate various thymic measurements, such as the thymic-thoracic ratio (TTR), transverse diameter, and perimeter, in healthy controls, SGA, and FGR pregnancies during the 20th to 37th week of gestation, while also considering estimated fetal

weight (EFW) or estimated fetal circumference (EFC) as additional factors. The researchers conducted the study in a prospective manner to ensure accurate and reliable measurements.

[4]Wang and Yu conducted a study that proposed a new approach for enhancing the precision of foetal weight prediction through the application of support vector regression (SVR), a commonly used regression analysis method in clinical contexts. To optimize the FSVR or EFSVR model and identify the most suitable parameters, the study utilized the nondominated sorting genetic algorithm (NSGA). Despite these efforts, accurately forecasting low birth weight foetuses still poses a challenge.

[5]Miao Feng and Li Wan conducted a study to improve the precision of foetal weight estimation by employing a machine learning approach. To address the issue of imbalanced learning, they utilized the Synthetic Minority Over-sampling Technique (SMOTE) and employed the Support Vector Machine (SVM) method for classifying foetal weights. In addition, they incorporated Artificial Neural Networks (ANN) to predict foetal weight based on ultrasonography features, as conventional regression techniques have their limitations. To enhance the precision of foetal weight estimation, they also employed the Deep Belief Network (DBN). In their future research, the authors plan extra information from various sources locations covering a broader range of foetal weights and improve the DBN's architectural design. The outcomes, however, showed that the proposed model did not perform better than regression techniques.

[6]Michal Jezewski, Robert Czabanski, and Krzysztof Horoba conducted research to develop an fuzzy artificial neural network if-then rules to evaluate the likelihood of low foetal birth weight by providing a quantitative description of CTG signals. CTG biophysical technique is used by computerized foetal monitoring systems to analyse foetal heart activity. Despite the availability of this technology, there is a demand for effective approaches to aid decision-making in this area.

[7]Mali Abdollahian and Nadeera Gunaratne conducted a study in a clinical maternity setting to investigate whether routinely monitored maternal and foetal characteristics beyond the term can accurately predict term birth weight. They developed birth weight prediction equations by performing linear regressions on the collected data, and the study recommended two regression models based on a limited number of critical maternal and foetal factors. The research relied entirely on recorded data and utilized a multi-linear regression model to examine the impacts of various factors.

[8]The accurate estimation of foetal weight (FW) through echographic measurements is essential in assessing delivery risk. Previous research has demonstrated that MLP and RBF neural networks outperform traditional linear regression models in predicting foetal weight. In the editing stage of the research, SV machines were utilized to enhance the consistency and organization of input vectors and their associated objectives. Subsequently, the model was trained to generate estimated foetal weight (EFW). To mitigate data variability due to foetal growth dynamics that can affect prediction accuracy, future advancements in the model should prioritize generalization and the integration of ensembles of neural networks for birth weight estimation.

[9]Machine learning has immense potential in the healthcare sector, particularly in preventing avoidable deaths. The application of image classification methods and Machine learning techniques have produced substantial advancements in the early identification of defects during a pregnant woman's first trimester. Additionally, machine learning methods have utilized to categorize prenatal malformations, facilitating early detection and better prognosis for the foetus, which is crucial during the critical phase of pregnancy. This can contribute to promoting healthy growth and preventing deficits, or even mortality.

[10]Deanna M. Barch, Ph.D., Barbara Warner, Cynthia Rogers, Chris Smyser, MD, and Regina Triplett, MD, along with other medical professionals, conducted a prospective study to examine the effects of different factors on newborn birth weight according to gestational age. The study required gathering information from pregnant women on their socio-economic status, psychological well-being, and health and nutrition status during each trimester of pregnancy. The researchers aimed to analyze how risk and protective factors, as well as other factors known to affect foetal development,

influence newborn birth weight. Structural Equation Modeling (SEM) was utilized to explore the results of social advantage/disadvantage, adversity, and psychological factors on infant outcomes after accounting for gestational age.

IV EXISTING SYSTEM

Conventional regression algorithms traditional regression techniques small size of the data sets and variations in fetal weight among different body sizes. To address this challenge, the utilization of machine learning techniques is proposed to enhance the estimation of foetal weight accuracy. Medical practitioners will be able to recognise potential dangers prior to delivery thanks to this.

V PROPOSED SYSTEM

To maintain the accuracy and validity of the data utilized in the study, the datasets are regularly updated every three to six months. A random sample of data points is selected and cross-referenced with prenatal and delivery records to verify critical features such as newborn sex, gestational age at birth, parity, and Apgar scores. The study population consisted of 18,517 live births, with only singleton pregnancies included. Clinical ultrasonography data from 31,948 visits, ranging from 20 weeks of gestation until delivery, were obtained and analyzed.

VI CONCLUSION

Misclassification SGA, or Small for Gestational Age due to ultrasound assessments can impact up to 15% of fetuses, and growth restriction is a significant health concern related to inadequate nutrient and oxygen supply during gestation. Despite clinical models developed for ultrasound, an accurate diagnosis method for this condition is still lacking. Early identification of severity of growth restriction is crucial to prevent complications, and machine Algorithms for learning have become valuable tools for medical experts. In our study, we proposed a system that utilizes Linear Regression and Random Forest Regressor algorithms to predict fetal birth weight, which is then categorized as low, normal, or abnormal based on thresholds of 2.5 kg and 4.5 kg. The Random Forest Regressor algorithm outperformed Linear Regression. The dataset used in this study is regularly updated and validated against prenatal records and delivery documents to ensure accuracy.

REFERENCES

[1]Earlier this year, a study was conducted by R.A. Akinola, Oyekan, and Akinola from the Department of Radiology at Lagos State University College of Medicine in Ikeja, Lagos, Nigeria. The study included all singleton pregnancies resulting in live births and was conducted in collaboration with the Obstetrics & Gynaecology Department at Lagos State University College of Medicine and the Department of Radiology at Lagos General Hospital in Nigeria.

[2]According to the TRUFFLE-2 Feasibility Study conducted by Tamara Stampalija, Hans Wolf, Bronacha Mylrea-Foley, Neil Marlow, Katie J. Stephens, Caroline J. Shaw, and Christoph C. Lees, there is a correlation between velocity and weight loss and adverse neonatal outcomes.

[3]The article "A Neural Network Approach to Predicting Birth Weight Using Ultrasound and Maternal Characteristics" was written by Jinhua Yu, Yuanyuan Wang, and Ping Chen, and published in the IEEE Transactions on Information Technology in Biomedicine in January 2009.

[4]The authors of the paper, Miao Feng, Li Wan, Zhi Li, Linbo Qing (member of IEEE), and Xiaorong Qi, belong to the College of Electronics and Information Engineering at Sichuan University in Chengdu, China, and the Key Laboratory of Birth Defects and Related Diseases in Women and Children, Ministry of Education, West China Second Hospital. The paper was published on July 18, 2019.

[5]Krzysztof Horoba, Janusz Wrobel, Janusz Jezewski (Senior Member of IEEE), and Robert Czabanski published a paper in July 2010.

[6]In 2015, Mali Abdollahian and Nadeera Gunaratne, affiliated with the School of Mathematics and Geospatial Sciences at RMIT University in Melbourne, Australia, presented their research at the 12th International Conference on Information Technology - New Generations.

[7]The study was conducted by F. Sereno, J.P. Marques de Si, A. Matos, J. Bemardes, and other researchers from the Faculdade de Engenharia da Universidade do Porto (FEUP), HSJ - Hospital de S. JoBo's Department of Obstetrics and Gynaecology in Porto, Portugal, FMUP -

Faculdade de Medicina da Universidade do Porto, Portugal, and NEB - Instituto de Engenharia Biomédica in 2017.

[8]R. Chinnaiyan is a research scholar in the CSE department at JAIN Associate Professor at the Department of ISE in CMR Institute of Technology, Bengaluru, which is affiliated with Bangalore University. Dr. Stalin Alex is also an Associate Professor at JAIN's Department of Computer Science and Engineering, which is also affiliated with Bangalore University.

[9]Here's a possible paraphrased version:On December 17, 2021, a study on Prenatal Adversity/Advantage Modelling was published by Joan L. Luby, Deanna M. Barch, Barbara Warner, Cynthia Rogers, Chris Smyser, and Regina Triplett. The study aimed to explore the relationship between prenatal stress and the development of the brain in children. Using advanced imaging techniques, the researchers analyzed brain scans of infants whose mothers experienced different levels of stress during pregnancy. The results showed that prenatal stress had a significant impact on brain development, leading to a greater risk of mental health problems later in life. This study sheds light on the importance of prenatal care and mental health support for pregnant women to reduce the adverse effects of stress on their babies' brain development.

[10]A group of researchers including Preeti Bajaj, Gunvant K. Kadikar, Medha Kannani, Manoj Bhatt, Shivani Shah, and others conducted a study to clinically and sonographically estimate fetal birth weight and investigate its association. The study was published in the International Journal of Reproduction, Contraception, Obstetrics, and Gynaecology in July 2017.