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Machine Learning Based Maternal Risks and Fetus Health Monitoring System

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ABSTRACT: In risky pregnancy, various diseases such as heart, lung, kidney, high blood pressure, diabetes and liver that pregnant women have before may aggravate the expectant mother's condition during pregnancy. By analyzing medical parameters such as maternal age, heart rate, blood oxygen level, blood pressure, body temperature, and the values corresponding to these parameters, information on risk intensity can be estimated for some patients. It is possible to reduce such pregnancy-related complications by classifying risk factors early in symptoms. As we all know that a pregnancy lasts for 9 months and in this long period there may be various reasons which may cause disability or mortality in the newborn which is a very severe case and this needs to be avoided. One of the main tool to analyse the health of the fetal in the womb is by doing a CTG (Cardiotacagraphy) which generally is used to evaluate the heart beat and the uterine contractions hence the data generated is used by the doctor to analyse the health and give his wording. But there is a room for error hence the doctors are not reliable to analyse the data hence different machine and deep learning algorithms have been there which can analyse the data and predict the fetal health based on it. The goal is to identify the best classification model and contribute to early detection of complications for improved maternal and fetal well-being.

I. INTRODUCTION

Pregnancy complications may be caused by conditions women have before pregnancy or conditions women develop during pregnancy. The impact of pregnancy complications on maternal and neonatal outcomes is difficult to estimate because pregnancy complications are made up of a broad range of conditions with varying levels of severity. Every year, an estimate of 358,000 maternal mortalities is recorded worldwide, with about 99% cases occurring in poor developing countries. Early screening is expected to reduce maternal mortality rates. The purpose of this research, therefore, was to analyze the risk factors associated with risk level in the dataset, and to also identify fit/final models with the capacity to predict maternal complications. We will train a machine to learn a process from a dataset without programming, as the term "Machine learning" suggests.

Fetals are delivered from the women's womb and before that during the pregnancy the information about the fetus is tough to get. We can only get the information that there is a fetus and it would be delivered. So, as the information is not readily available the obstetricians who check the condition of the fetal rely on the indirect information. One of the most dependent information is about the fetal heart rate and there is a restriction of electronic fetal heart monitoring that this variation is hindering the records of the accurate communication and time management. There is an another component known as the cardiotocogram which contains distinct signals and is mainly used for recordings of the fetal heart rate which is the main way through which the obstetricians rely on the information. But the trend seen in these days by the doctors is that there is very high intra and inter observer fluctuation in FHR patterns. But there is a risk in which a falsely diagnosed fetal pain may lead to unnecessary interventions. Hence, the main motive of the research is to employ machine learning algorithms to classify the methods as there can be a room for error by the doctor but the prediction algorithm may perform really well in this case and also help in monitoring the results and give a proper analysis than the doctor could get by his own or someone's observation.

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II. LITERATURE REVIEW

In order to get required knowledge about various concepts related to the present system, existing literature was studied. Some of the important conclusions were made through those are listed below.

Md Assaduzzaman; Abdullah Al Mamun; Md Zahid Hasan: "Early Prediction of Maternal Health Risk Factors Using Machine Learning Techniques" [1] In rural areas, pregnant women face various difficulties and challenges, including a shortage of doctors, inadequate knowledge, a lack of public clinics, infrastructure issues, and transportation issues. The mother's pregnancy is the major cause of the infant's poor health, rather than any other factors that may have arisen after childbirth. Significant roles are played by maternal risk factors such as the mother's chronic condition, age, nutrition, and other medical assistance during pregnancy. Recent developments in Artificial intelligence methods, particularly machine learning models, have made it easier to make predictions in a variety of disciplines. We can identify the primary maternal risk factors that can lead to newborn child and maternal mortality using machine learning techniques. This paper proposes improved data preprocessing methods that involve feature engineering and data cleaning in order to effectively handle anomalies in the data values. To identify the maternal health risk factor, several machine learning algorithms were used, including Cat Boost, Random Forest, XGB, Decision Tree, and Gradient Boost. Using the preprocessed dataset, the suggested model was developed, trained, and tested. The Random Forest was the best machine-learning algorithm with an accuracy score of 90%.

Islam MN, Mustafina SN, Mahmud T, Khan NI: "Machine learning to predict pregnancy outcomesYear:2022" [2] A systematic review, synthesizing framework and future research agenda. BMC Pregnancy Childbirth .Machine Learning (ML) has been widely used in predicting the mode of childbirth and assessing the potential maternal risks during pregnancy. The primary aim of this review study is to explore current research and development perspectives that utilizes the ML techniques to predict the optimal mode of childbirth and to detect various complications during childbirth. A total of 26 articles (published between 2000 and 2020) from an initial set of 241 articles were selected and reviewed following a Systematic Literature Review (SLR) approach. As outcomes, this review study highlighted the objectives or focuses of the recent studies conducted on pregnancy outcomes using ML; explored the adopted ML algorithms along with their performances; and provided a synthesized view of features used, types of features, data sources and its characteristics. Besides, the review investigated and depicted how the objectives of the prior studies have changed with time being; and the association among the objectives of the studies, uses of algorithms, and the features.

Naveen Reddy Navuluri: "Fetal Health Prediction using Classification Techniques:"Year:2021[3]A fetal is basically an unborn offspring which is in the embryo stage until it comes to the world. During the pregnancy process, each three month period is known by a name called trimester. During this process the fetus grows and develops and along with it the regular checkups are very important. As we all know that a pregnancy lasts for 9 months and in this long period there may be various reasons which may cause disability or mortality in the newborn which is a very severe case and this needs to be avoided. One of the main tool to analyze the health of the fetal in the womb is by doing a CTG(Cardiotacagraphy) which generally is used to evaluate the heart beat and the uterine contractions hence the data generated is used by the doctor to analyze the health and give his wording. But there is a room for error hence the doctors are not reliable to analyze the data hence different machine and deep learning algorithms have been there which can analyze the data and predict the fetal health based on it. The main motive of the paper is to prove the prediction accuracy using the different classification models and compare which model performs better.

Zheng T, Ye W, Wang X, Li X, Zhang J, Little J:"A simple model to predict risk of gestational diabetes mellitus from 8 to 20 weeks of gestation in Chinese women. BMC Pregnancy Childbirth."Year:2019 Gestational diabetes mellitus (GDM) is associated with adverse perinatal outcomes. Screening for GDM and applying adequate interventions may reduce the risk of adverse outcomes. However, the diagnosis of GDM depends largely on tests performed in late second trimester. The aim of the present study was to bulid a simple model to predict GDM in early pregnancy in Chinese women using biochemical markers and machine learning algorithm.Data on a total of 4771 pregnant women in early gestation were used to fit the GDM risk-prediction model.

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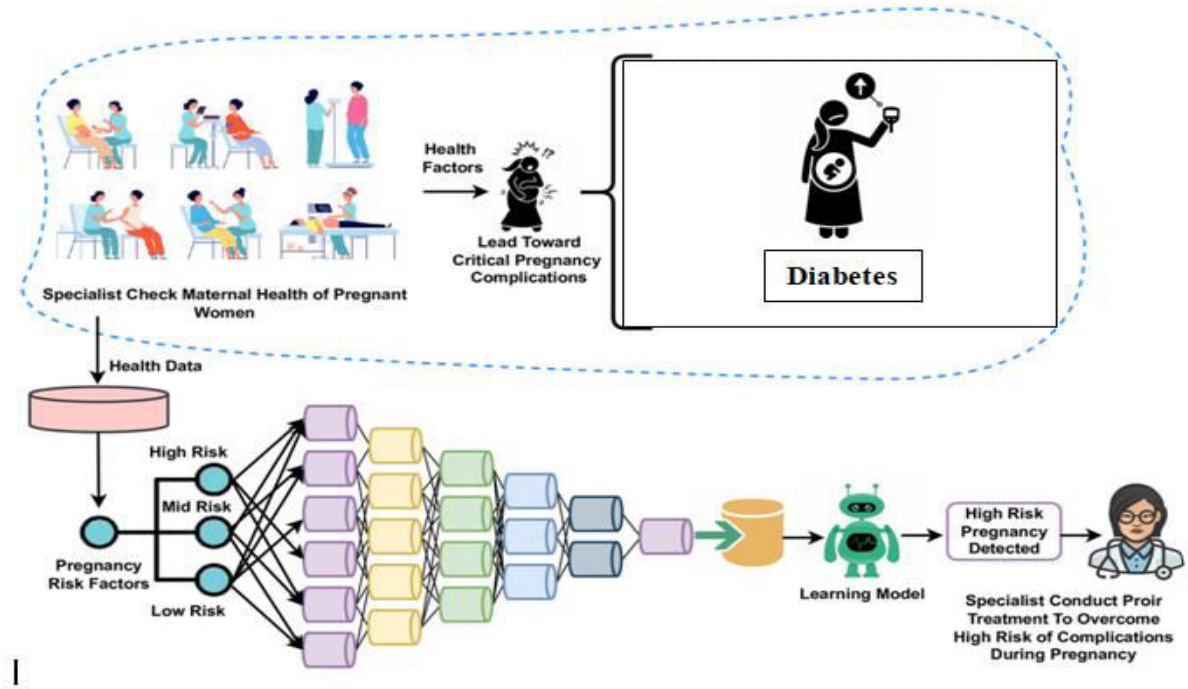
III. PROPOSED SYSTEM

The system employs advanced machine learning algorithms, including Naïve Bayes, K-Nearest Neighbor, Decision Tree, and Random Forest, to develop a robust predictive model for maternal and fetal health assessment. By analyzing key parameters extracted from cardiotocography (CTG) data, including fetal heart rate (FHR) and uterine contractions, these algorithms classify fetal conditions as normal, suspicious, or pathological. In maternal healthcare, categorizing risks into low, moderate, and high levels is crucial for effective management and intervention strategies and predicting diabetes in pregnant mothers. Leveraging the strengths of each algorithm, the system offers a comprehensive approach to early detection of fetal distress and risk assessment. The goal is early identification, enabling timely interventions for improved outcomes in maternal and fetus health. Users can input maternal and fetal health attributes through the graphical user interface, and the deployed model provides predictions regarding potential complications during pregnancy

IV. METHODOLOGY

The methodology is structured into three essential stages. The initial phase involves data preparation, where the Fetal Health and maternal dataset is utilized. Null values are systematically removed to enhance dataset quality, ensuring the accuracy of subsequent analyses and model training. Following data preparation, the feature engineering phase begins with a comprehensive dataset description, providing foundational insights. These feature engineering activities aim to provide a deeper understanding of the dataset and its characteristics to contribute to selecting relevant features for model training.In our proposed method, maternal risk and fetal classification can be detected more efficiently and less costly within a short time. The working of the system starts with collection of data and selecting important attributes. Then the required data is preprocessed into the standard format. In the first stage, preprocessed data are divided into two parts. Most of those are used in the training phase (80%), and the rest (20%) are used in the testing phase. The proposed system has trained our dataset using machine learning algorithms like Decision tree, Random Forest, Naive Bayes and KNN. Using Visual studio platform, we have trained and finally predicted the result of a patient. The accuracy of the system is obtained by testing the system using the testing data.



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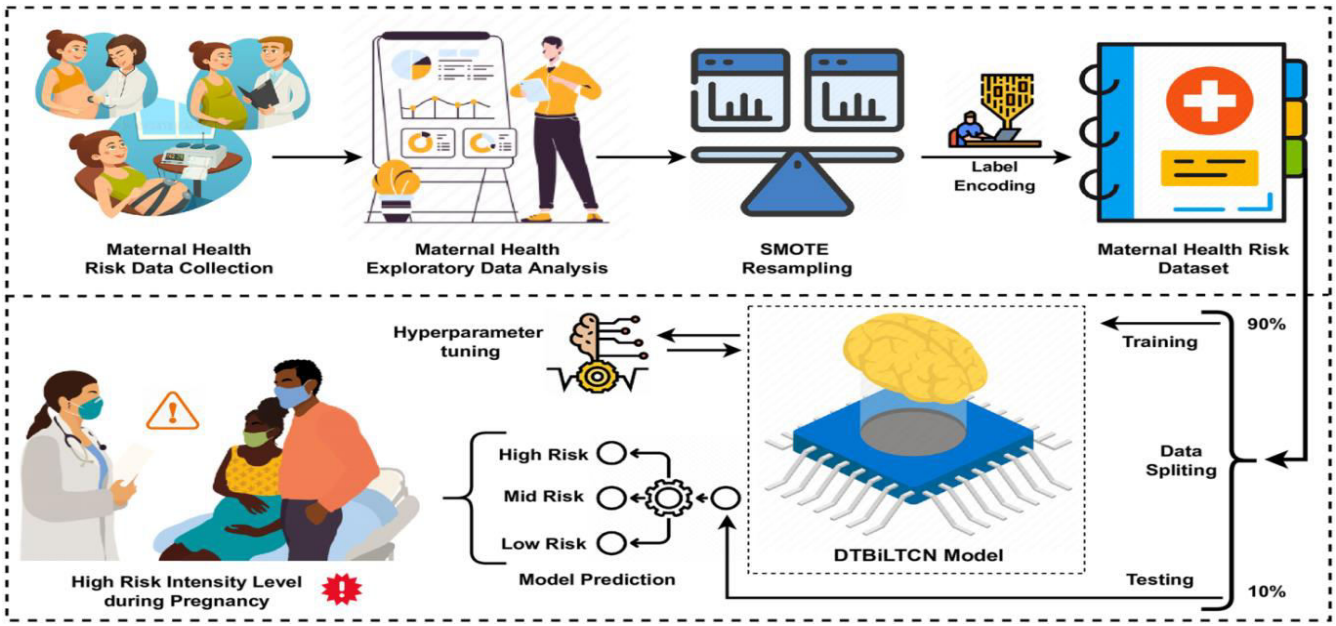

Fig 4.1 Methodology of Maternal Risks

This system is implemented using the following modules.

- Dataset Collection
- Data Preprocessing
- Feature selection
- Splitting Dataset

➢ **Dataset Collection**

Initially, we collect datasets from the Kaggle website for maternal risk prediction and fetal classification system. The dataset consists of 6 features and a total of 1014 patient records which are used for predicting maternal risk and the dataset consists of 22 features and a total of 2126 patient records which are used for fetal health classification. We utilize a dataset comprising individuals who have conducted analyses and tests for identifying maternal risks and classifying fetuses. In the dataset, patients are represented by rows, while factors or attributes (features) under examination are represented by columns, forming a matrix structure.

- Age: Age in years when a woman is pregnant.
- SystolicBP: Upper value of Blood Pressure in mmHg, another significant attribute during pregnancy.
- DiastolicBP: Lower value of Blood Pressure in mmHg, another significant attribute during pregnancy.
- BS: Blood glucose levels is in terms of a molar concentration.
- BodyTemp: Pregnant women's body temperature.
- HeartRate: A normal resting heart rate in beats per minute.
- Risk Level: Predicted Risk Intensity Level during pregnancy considering the previous attribute.

V. PRE-PROCESSING OF DATA

Data pre-processing plays a vital role in the development of a machine learning model. Initially, the data may be in an untidy or incompatible format, leading to potentially erroneous outcomes. During the data pre-processing phase, we convert the data into the necessary format.Ensuring the dataset's reliability and accuracy, this step becomes crucial in addressing factors like noise, duplicates, and missing values present in the data. Data pre-processing encompasses a range of activities that include collecting datasets, partitioning datasets, data cleaning, factorization, missing values imputation, etc. The purpose of data pre-processing is to enhance the accuracy of the model by refining the data before it is used for analysis or modeling.

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- **Data Cleaning:**NA values in the dataset is the major setback for us as it will reduce the accuracy of the prediction profoundly so, we will remove the fields which does not have values. We will substitute it with the mean value of the column. This way, we will remove all the values in the data set.

- **Data Integration:** Data Integration is a data preprocessing technique that combines data from multiple heterogeneous data sources into a coherent data store and provides a unified view of the data. While implementing data integration, it should work on data redundancy, inconsistency, duplicity, etc.

- **Data transformation:** Data transformation is an essential data preprocessing technique that must be performed on the data before data mining to provide patterns that are easier to understand. Data transformation changes the format, structure, or values of the data and converts them into clean, usable data.

- **Data Reduction:** Data reduction is a process that reduces the volume of original data and represents it in a much smaller volume. Data reduction techniques are used to obtain a reduced representation of the dataset that is much smaller in volume by maintaining the integrity of the original data.

➢ **Feature Selection**

In a data set where we have a large set of features. Feature selection includes the selection of appropriate attributes for the prediction system. To detect the links between attributes, we only choose those attributes that are highly dependent each other in order to apply Machine Learning algorithms and achieve better accuracy.

Below are some benefits of using feature selection in machine learning:

- It helps in avoiding the curse of dimensionality.
- It reduces the training time.
- It reduces overfitting hence enhance the generalization.

There are mainly two types of Feature Selection techniques, which are:

- Supervised Feature Selection technique: Supervised Feature selection techniques consider the target variable and can be used for the labelled dataset.
- Unsupervised Feature Selection technique: Unsupervised Feature selection techniques ignore the target variable and can be used for the unlabelled dataset.

➢ **Splitting Dataset**

After the collection of the dataset, we split the dataset into training data and testing data. The accurate classification result of the dataset depends on the training and testing phase.

VI. RESULT

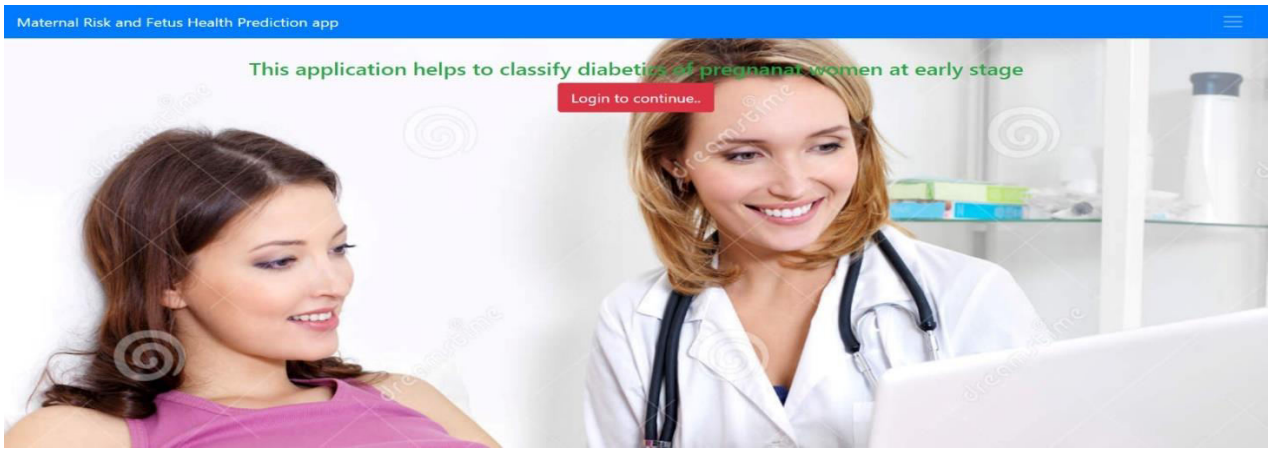

FIG 6.1 LOGIN PAGE

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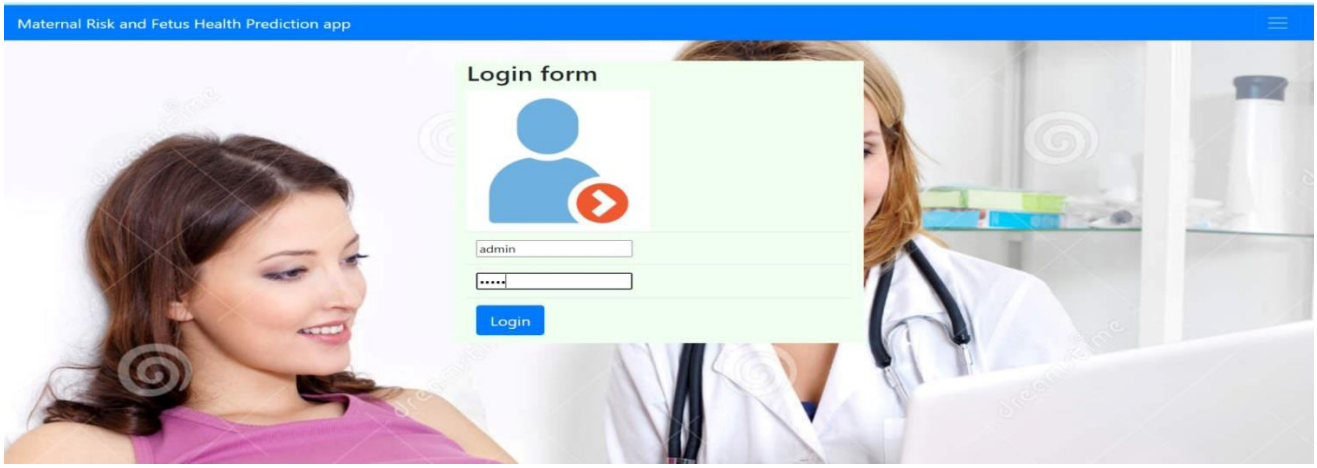

FIG 6.2 LOGIN FORM

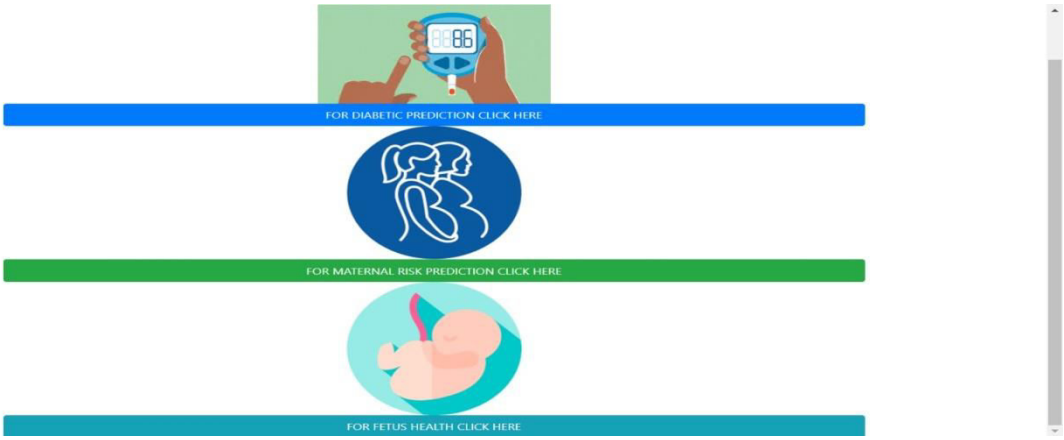

FIG: HOME PAGE

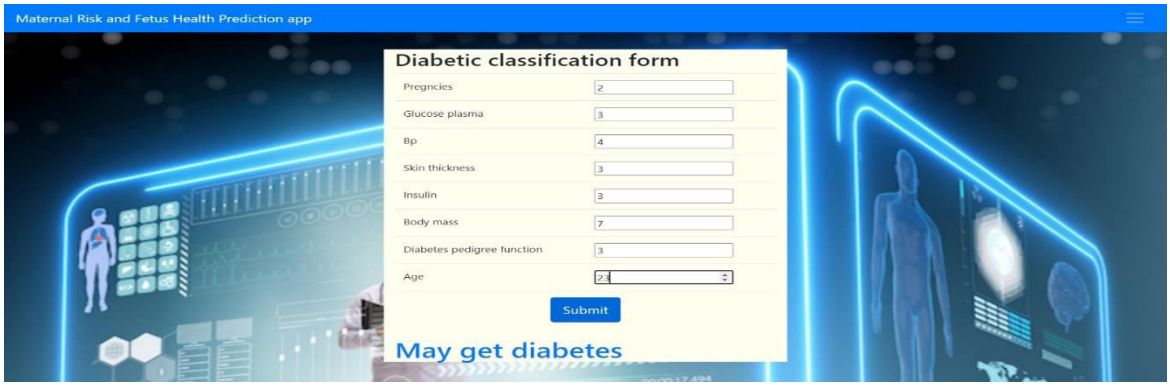

FIG 6.3 DIABETIC CLASSIFICATION FORM

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FIG 6.4 MATERNAL RISK PREDICTION FORM

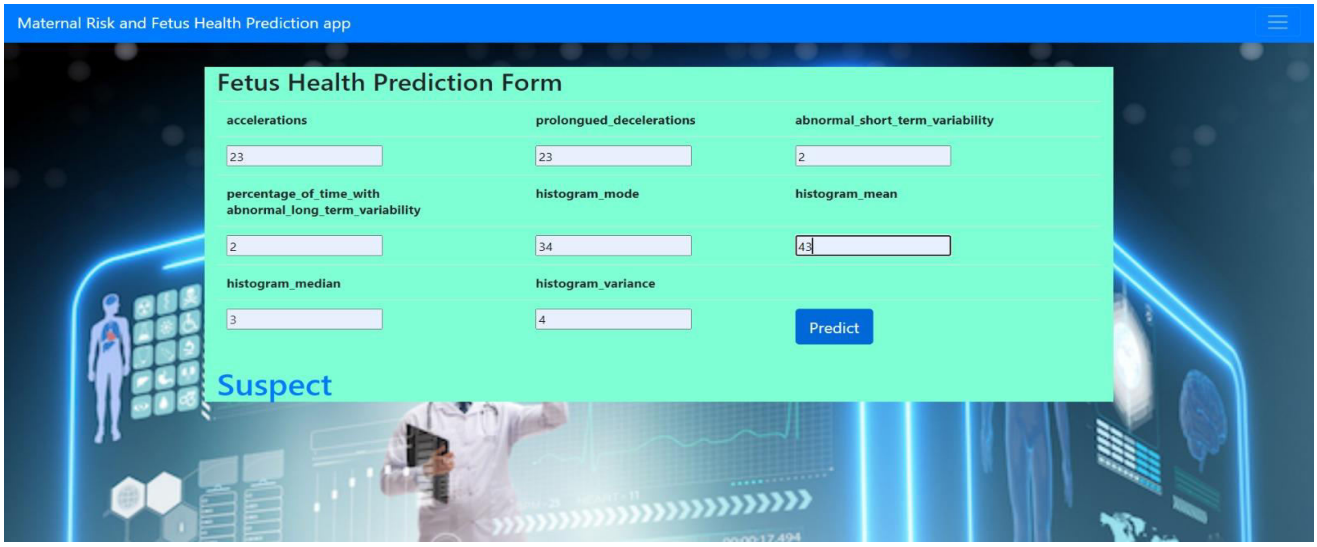

FIG 6.5 FETUS HEALTH PREDICTION FORM

VII. CONCLUSION

Machine learning techniques are of immense importance in disease diagnosis, offering substantial benefits. They enable the early prediction of maternal risk and assessment of fetal classification, thereby facilitating the implementation of appropriate treatment procedures for patients. In this project, various classification methods employed in medical diagnosis are investigated, with a specific emphasis on their accuracy. It is intriguing to note that the decision tree classifier achieves the highest accuracy among the models KNN, Random Forest, Naive Bayes, and Decision Tree. To increase the accuracy of these models and address their shortcomings, additional research anddevelopment are required. In conclusion, predicting maternal health risks using ML models has the ability to significantly enhance maternal health outcomes and lower mortality rates.

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