

Predictive System for Pregnancy Risk and Maternal Health

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Abstract- The Early detection of pregnancy and health of the fetus is important for health issues. Traditional approaches could need continuous monitoring and expertise in interpretation, making the process of early detection difficult. This paper presents a predictive system for fetal health and pregnancy risk assessment using machine learning. This system uses certain maternal and fetal health parameters in order to predict potential health conditions and risks involved.

The process used in this system consists of data collection, data pre-processing, feature analysis, machine learning model training, and prediction. This system works by using the health parameters given and predicting the fetal health condition and pregnancy risk using the patterns found in the dataset. Through the use of machine learning algorithms, this system attempts to offer faster and more accurate risk prediction. This is meant to help healthcare professionals detect cases requiring special attention.

Keywords: Fetal Health, Pregnancy Risk, Machine Learning, Predictive System, Fetal Monitoring, Risk Assessment.

I. INTRODUCTION

Pregnancy represents a vital time for the monitoring of the health of mother and fetus. Different health conditions can arise at this time, which may disturb pregnancy if they are not diagnosed in time. The health of the fetus can be affected by different factors, such as fetal heartbeat, uterine contractions, maternal blood pressure, levels of blood sugar, heart rate, and other readings.

This allows us to create computer systems that can help professionals in assessing pregnancy and fetal health early. This paper presents the Predictive System for Fetal Health and Pregnancy Risk based on the usage of machine learning techniques. The system uses essential indicators of maternal and fetal health to

analyze the input data and provide predictions about fetal health and pregnancy risk. The aim of this system is to make predictions easier and provide useful information for further clinical evaluation.

The main purpose of the system is to assist in early detections of possible health problems of fetuses and pregnancy risks.

II. LITERATURE REVIEW

A. RELATED WORK

Recent research has explored the use of machine learning and artificial intelligence to support maternal and fetal healthcare. These studies have investigated fetal health classification, pregnancy risk prediction, maternal health monitoring, and intelligent healthcare support systems [1], [3], [8], [9], [10].

Machine learning-based approaches have been investigated for assessing fetal health using clinical parameters, particularly cardiotocography (CTG) data. Classification models can learn from previously collected health records and categorize fetal conditions based on patterns present in the data [3], [4], [5], [6]. Recent studies have also examined the use of machine learning for predicting pregnancy outcomes and maternal health risks using clinical parameters [8], [9], [10], [11], [12].

Maternal health risk prediction is another important area of research. Previous studies have used factors such as age, blood pressure, blood sugar level, body temperature, heart rate, and other clinical parameters to identify different levels of pregnancy-related risk [1], [2], [10], [11]. These approaches demonstrate the potential of machine learning models to assist in identifying high-risk pregnancies at an early stage.

Artificial intelligence and machine learning have also been explored for broader maternal healthcare applications. Existing research has investigated pregnancy outcome prediction, maternal risk assessment, and pregnancy-related complications using machine learning techniques [8], [9], [10], [11], [12]. These approaches demonstrate the potential of intelligent systems to support healthcare professionals by providing prediction and decision-support information.

However, many existing studies focus on a specific prediction task, such as fetal health classification, pregnancy outcome prediction, or maternal risk assessment. This creates an opportunity to develop an integrated system that considers both fetal health and pregnancy risk within a single platform.

B. THEORETICAL FRAMEWORK

The proposed system is based on the application of machine learning to clinical and maternal health data. The theoretical foundation involves collecting relevant health parameters, preprocessing the data, selecting important features, training machine learning models, and evaluating their predictive performance [2], [3], [8].

For fetal health assessment, machine learning models can analyze clinical parameters and CTG-related features to classify fetal conditions into different categories [3], [4], [5], [6]. Similarly, pregnancy risk prediction can use maternal parameters such as age, blood pressure, blood sugar, body temperature, and heart rate to identify different levels of risk [1], [2], [10], [11].

Studies on pregnancy prediction and maternal health have shown that machine learning techniques can be applied to identify patterns in healthcare data and support risk assessment [8], [9], [10], [11], [12]. The effectiveness of these systems depends on factors such as dataset quality, preprocessing, feature selection, model selection, and evaluation methods.

The proposed framework therefore combines these concepts to provide an integrated predictive system for fetal health and pregnancy risk assessment.

C. RESEARCH GAPS

Existing studies demonstrate that machine learning can be useful for predicting fetal health conditions and identifying pregnancy-related risks [3], [4], [6], [8], [10], [11]. However, many existing approaches focus primarily on a specific prediction task, such as fetal health classification or maternal risk prediction, rather than integrating both aspects within a single system.

Another limitation is that different studies use different datasets, features, preprocessing techniques, and machine learning algorithms. This makes direct comparison between models difficult and highlights the importance of proper data preprocessing, feature selection, and model evaluation [6], [8], [9].

There is also a need for systems that provide prediction results in a simple and understandable form so that users can obtain meaningful information from the input health parameters. Integrating prediction models with a user-friendly interface can improve accessibility and provide decision-support information.

Therefore, the proposed system focuses on developing an integrated platform that combines fetal health assessment and pregnancy risk prediction using machine learning techniques. The system aims to process relevant health parameters, apply trained prediction models, and present the resulting assessment through an accessible interface.

III. PROPOSED SYSTEM

The system described, called “Predictive System for Fetal Health and Pregnancy Risk Using Machine Learning”, is an integrated platform aimed at assisting with the assessment of fetal health and pregnancy risks. By making use of health-related input parameters and machine learning techniques, it produces predictions which can help users to identify possible risk conditions at an early stage. The primary purpose of the system is to combine various pregnancy-supporting features so as not to require users to rely on separate applications or prediction methods.

The system is made up of a number of modules which work in unison to offer a fully user-focused platform. The main modules are fetal health prediction, pregnancy risk prediction, diet recommendations, exercise recommendations, an AI-based chat assistant, user authentication, prediction history, the dashboard, PDF report generation, and high-risk alerts. The system also includes a disclaimer stating that the predictions and recommendations it provides are for use only as supportive information and should not be regarded as a substitute for a professional medical diagnosis.

The fetal health prediction module looks at the fetal health parameters supplied by the user and uses a machine learning model that has been trained to predict the appropriate fetal health status. The pregnancy risk prediction module looks at factors related to the mother's health and assesses the possible level of pregnancy risk on the basis of the patterns acquired from the training data. These two prediction modules make up the main parts of the proposed system.

The system also has recommendation-based features which aim to give the user extra support. The diet recommendation component is able to offer appropriate dietary suggestions on the basis of the information known to the system, and the exercise recommendation component gives general suggestions relating to activity. These recommendations are meant to provide supportive information and should therefore be taken together with advice from qualified healthcare professionals.

The platform includes a chat assistant based on AI in order to enhance interaction with it. This enables users to pose questions about pregnancy in natural language and obtain general informational answers. The assistant is intended to make the system easier to use, though it is still up to healthcare professionals to make any medical decisions.

The system includes user authentication, enabling each user to securely access their account and related information. The prediction history module makes it possible to view past prediction records, which helps users keep track of the results obtained through the platform. A dashboard displays key information in a

structured way, and the PDF report generation module can be used to produce a report with the relevant prediction information.

The system is also able to issue high-risk alerts whenever its prediction shows that a condition requires attention. The purpose of such alerts is to prompt users to obtain the appropriate professional medical evaluation rather than trying to diagnose or treat the condition on their own.

The system as a whole brings together machine learning-based prediction methods with various features that are oriented towards healthcare support on one platform. By integrating these elements, it seeks to make information concerning pregnancy simpler to access, understand and keep under review, and also provides a basis for assessing fetal and maternal health with the aid of technology.

IV. METHODOLOGY

The methodology adopted in the proposed system is carried out through a sequence of steps related to the processing of the pregnancy health-related data and prediction. The entire process includes data collection, data preprocessing, feature preparation, model training, prediction, and result presentation. The same general procedure is applied to fetal health and pregnancy risk prediction while the only distinction is in input parameters and predictions.

A. Data Collection

At this stage, appropriate datasets are collected containing appropriate maternal and fetal health parameters. The data is used to train the model and the dataset used in the model contains the input features and their classes required for supervised learning. The fetal health dataset is the one for training and assessing the fetal health prediction model while pregnancy-related data is used for making predictions regarding the risk of pregnancy. The quality and relevancy of the collected data is of great importance as the models under the study can learn only what is represented in the available datasets.

B. Data Preprocessing

The Data preprocessing takes place next to the stage of data collection. Before the machine learning model

is trained, the data collected should be prepared for analysis. This stage includes checking the dataset for missing values, checking for inconsistencies, duplicates, and unimproved data format. Numerical features get transformed to the form needed for the machine learning models and categorical features get encoded if it is necessary.

C. Feature Preparation

The Relevant features are selected according to the needs of each prediction. In fetal health prediction, the input parameters include fetal monitor and such clinical parameters that were present in the data set used in the fetal health prediction. In pregnancy risk prediction, the input parameters are maternal.

D. Model Training

The After preprocessing and feature preparation, the datasets are divided into suitable subsets for model development and evaluation. Machine learning algorithms are trained using the available training data so that they can learn the relationship between the input parameters and the corresponding target classes. The model development process involves fitting the selected algorithms to the training data and evaluating their performance using appropriate evaluation measures.

E. Prediction Process

Once the models have been trained, new health-related inputs can be provided to the system. The input values are processed using the same general preprocessing approach used during model development. The processed values are then passed to the corresponding trained model. The fetal health model generates a fetal health prediction, while the pregnancy risk model produces an estimate of the associated risk category.

V. SYSTEM ARCHITECTURE

The system architecture represents the overall structure and interaction between the different components of the proposed predictive system. The architecture is designed to connect the user interface,

backend services, machine learning models, database, and supporting AI modules into a single platform. The frontend collects the input information and sends it to the backend for processing. The interface also provides access to prediction results, recommendations, prediction history, reports, and other available features. The backend layer acts as the main processing component of the system. It receives requests from the frontend, validates the input data, performs the required processing, and communicates with the appropriate machine learning model. The backend also manages authentication, prediction records, report generation, and communication with the supporting modules.

The data preprocessing component prepares the received health parameters before they are passed to the machine learning models. The same preprocessing approach used during model development is applied to user inputs so that the data is provided to the models in the expected format. The machine learning layer contains the trained prediction models.

The fetal health prediction model processes the relevant fetal health parameters and generates the corresponding prediction. The pregnancy risk prediction model uses maternal health-related parameters to estimate the possible risk category. The generated outputs are returned to the backend and displayed to the user through the frontend. The modules provide additional informational support based on the functionality implemented in the system. The dashboard organizes important information in a simple visual format, while the PDF report module allows relevant prediction information to be compiled into a report.

The overall architecture can therefore be represented as: User → Frontend Interface → Backend/API → Data Preprocessing → Machine Learning Model → Prediction Result → Dashboard/Alert/History/Report

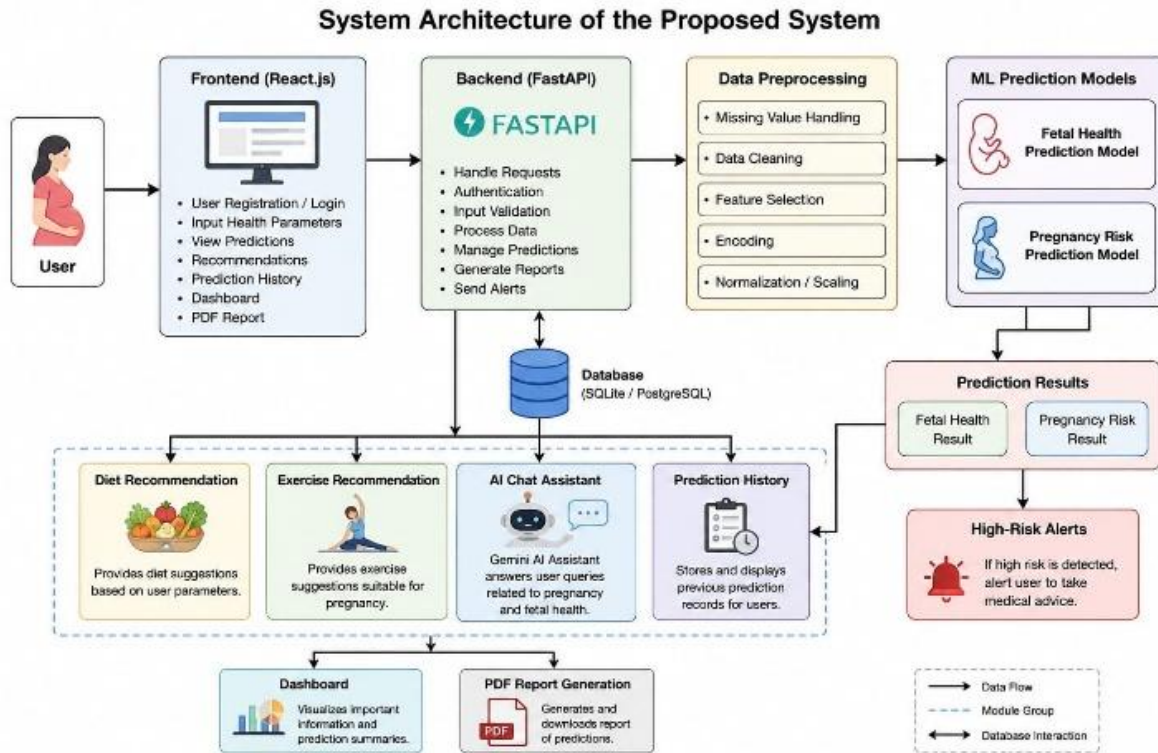


Figure 1: System Architecture of the Proposed System

VI. RESULTS AND DISCUSSION

A. Pregnancy Tracking and Wellness

The developed system provides a pregnancy tracking module that allows the user to enter the last menstrual period and obtain basic pregnancy-related information. The system displays the estimated due date, current pregnancy week, trimester, and overall pregnancy progress. In the demonstrated test case, the system displays an estimated due date of 10 December 2026, pregnancy week 24, and the second trimester. A progress indicator is also provided to give a simple visual representation of the pregnancy stage.

B. Fetal Health Assessment

The fetal health assessment module provides a structured interface for entering the required cardiotocography (CTG) measurements. The interface includes fields for the parameters required by the fetal health prediction model and provides a dedicated option to submit the measurements for prediction.

The design of the module provides an organized way for users to enter the required values without directly

interacting with the underlying machine learning model.

C. Maternal Health Risk Assessment

The maternal health risk module allows the user to enter relevant maternal measurements, including age, systolic blood pressure, diastolic blood pressure, blood sugar, body temperature, and heart rate. The entered values are submitted to the prediction system to estimate the corresponding maternal risk category.

In the demonstrated test case, the system predicted Mid Risk. The displayed prediction distribution was 73% Mid Risk, 16% Low Risk, and 12% High Risk.

D. Discussion

The implemented results demonstrate that the proposed system can bring different pregnancy-related functions together within a single web-based platform. The system provides pregnancy tracking, fetal health assessment, maternal risk prediction, and trimester-based wellness information through an organized user interface. The displayed outputs show that the system

can accept the required inputs and present the resulting information in an understandable form.

The maternal risk assessment demonstrates the presentation of a predicted risk category together with confidence values, while the pregnancy tracking module provides calculated pregnancy information and visual progress. These features make the system easier for users to interact with and understand.

The results presented in this section demonstrate the functionality of the developed application. They should not, however, be interpreted as proof of clinical accuracy. Further evaluation using appropriate datasets and machine learning performance measures such as accuracy, precision, recall, F1-score, and confusion matrix would be required to assess the predictive performance of the models.

VII. CONCLUSION

The proposed maternal-fetal health monitoring system brings several pregnancy-related support features together in a single web-based application. The system provides pregnancy tracking, maternal health risk assessment, fetal health assessment, and trimester-based wellness guidance. The pregnancy tracking module calculates the pregnancy week, estimated due date, trimester, and pregnancy progress from the entered last menstrual period. The fetal assessment module provides a structured interface for entering the required CTG measurements for fetal health prediction.

The implemented results show that the system can present health-related inputs and prediction outputs in a clear and organized manner.

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originality, integrity, and final content of the manuscript. ChatGPT was not listed as an author and does not bear responsibility for the research findings or conclusions.

IX. FUTURE SCOPE

In future, this project can be improved by using more healthcare data so that the prediction results can become more reliable. More maternal and fetal health details can also be added to the system. Real-time data from wearable devices could be used to monitor the mother and baby continuously. The diet and exercise recommendations can be made more personal according to the user's health condition and pregnancy stage. The AI chat assistant can also be improved to give better pregnancy-related support. The system can further be developed as a mobile application with better data security and cloud storage. More testing can also be done using different machine learning performance measures to check how well the models are working.

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