Fetal Distress Prediction Based on Cardiotocographic (CTG) Data

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1. Motivation

The number of fetal (unborn baby in the mother's womb) and maternal deaths every year worldwide is staggering. Undetected fetal abnormalities can progressively worsen, leading to permanent damage to the fetus and even death. However, early intervention can potentially be life-saving for both the mother as well as the child. Cardiotocography(CTG) is a technique used to determine a fetus's healthy being by monitoring its heart rate and the mother's uterine contractions. However, visual inspection of such data might not be very reliable and hence requires additional ways of assessing and evaluating fetal well-being. *Advanced machine learning algorithms should help us analyse the CTG data and predict the fetal state.*

Our main aim is to develop a model that can identify high risk fetuses accurately comparable to highly trained medical professionals. We hope that this would play a significant role in reducing fetal mortality and congenital disabilities globally.

2. Related Work

1. This study employs ten distinct machine learning techniques to predict the pathological state of a fetus using a CTG dataset. It avoids biases of skewed data using SMOTE balancing technique. **[1]**
2. This paper performs feature selection to obtain correlated features and examines the performance of R and Python-based tools to develop a machine learning model for fetal distress classification. **[2]**
3. This paper uses Principal Component Analysis(PCA) for optimal Feature Selection and performs a binary classification of the fetal state using the ensemble learning-based AdaBoost algorithm. **[3]**

3. Timeline

Week	Tasks
1	Pre-processing data, Data visualization
2	Feature Analysis and Selection, Plotting Maps, Dimensionality Reduction, Logistic Regression
3	Naive Bayes, Decision Trees
4	Random Forests, K - Nearest Neighbours
5	Analysis of Model Performance, Hyperparameter Tuning
6	Bagging and Boosting
7	Support Vector Machine, Multi Layer Perceptron
8-9	Analysis of Model Performance, Hyperparameter Tuning, Advanced Models, Drawing Final Conclusions
10	Report Writing and Presentation Making

4. Individual Tasks

Tasks	Team Member/s
Pre-processing and Data Visualization	Rasagya, Harshita
Feature Selection and Analysis, Plotting Maps	Suyashi, Ayush
Regression and Naive Bayes	Harshita, Rasagya
Random Forest, Support Vector Machine	Ayush, Harshita
K-Nearest Neighbours, Multi Layer Perceptron	Suyashi, Ayush
Descision Tree, Boosting	Rasagya, Suyashi
Hyperparameter Tuning	Everyone
Analyis of Model Performance, Drawing Final Conclusions	Everyone
Report Writing, Presentation Making	Everyone

5. Final Outcome

Pregnancy-related complications and deaths impacting mothers and their babies remain a significant global challenge, especially in developing and low-income countries.

Our project aims to predict fetal distress accurately using a multi-class learning classification model. We plan to visualise and analyse the data in-depth, perform feature analysis and extraction, and test different supervised machine learning algorithms to develop a model that accurately diagnoses fetal well being. We would compare and contrast our models using evaluation metrics commonly utilised in testing healthcare-associated machine learning models like Accuracy, Precision, Sensitivity, Specificity and F1 measure. Our final goal is to develop a robust and reliable model that doctors can use practically for accurate fetal assessment.

We intend to share any novel findings with hospitals wherein such models can be tested and employed by obstetricians in the real world to evaluate the fetal state and provide timely medical intervention to the mother and the baby, if required.

References

[1] Z. Hoodbhoy, Md. Noman, A. Shafique, Ali Nasim, D. Chowdhury, B. Hasan, *Use of Machine Learning Algorithms for Prediction of Fetal Risk using Cardiotocographic Data*, 2019

[2] S.C.R Nandipati, C. XinYing, *Classification and Feature Selection Approaches for Cardiotocography by Machine Learning Techniques*, 2020

[3] Y. Zhang, Z. Zhao, *Fetal State Assessment Based on Cardiotocography Parameters Using PCA and AdaBoost*, 2017