



ISSN: 2454-9940



**INTERNATIONAL JOURNAL OF APPLIED
SCIENCE ENGINEERING AND MANAGEMENT**

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www.ijasem.org

EXPLORING MACHINE LEARNING ALGORITHMS TO FIND THE BEST FEATURES FOR PREDICTING MODES OF CHILDBIRTH

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ABSTRACT— One of the most important factors in guaranteeing the safety of both mother and child is the delivery method. Although the doctor in charge usually has the final say in determining the delivery method, selecting the incorrect delivery method can result in a variety of immediate and long-term health problems for both the mother and the unborn child. Identifying potential features for identifying the mode of childbirth and investigating machine learning algorithms by taking into account the best features for predicting the mode of childbirth (vaginal birth, cesarean birth, emergency cesarean, vacuum extraction, or forceps delivery) were the two goals of this study. In order to determine the most significant machine learning algorithm for prediction based on 6157 birth records and a minimum set of features, an empirical study comprising a literature review, interviews, and a structured survey was carried out. Additionally, five distinct machine learning algorithms were investigated. The study identified 32 characteristics that may be used to predict delivery methods and divided them into several groups according to their significance. Stacking classification (SC) produced the highest f1-score (97.9%), while random forest (RF) performed nearly as well (f1-score = 97.3%). Taking into account all (n = 32) methods, they were followed by k-nearest neighbors (KNN; f1-score = 95.8%), decision tree (DT; f1-score = 93.2%), and support vector machine (SVM; f1-score = 88.6%).

Index Terms— Machine learning, prediction, vaginal childbirth, cesarean childbirth, data mining, childbirth, modes of delivery.

I. INTRODUCTION

One or more infants are delivered either naturally or via cesarean section at the end of the pregnancy. Overall, the most common mode of childbirth is natural delivery, while others are cesarean section, emergency cesarean section, vacuum extraction, and forceps delivery [1]. Each of these birth styles has advantages and disadvantages, and the mother's traits could not align with the delivery method selected. Risks associated with selecting the incorrect delivery method include fetal termination, severe bleeding, infant respiratory issues, and more [2]. Even though natural delivery is the most popular method, it might provide challenges for moms who are symptomatic, such as those over 35, with conditions like diabetes or preeclampsia, or who are carrying more than one fetus [3]–[6]. When a normal delivery could endanger the mother or baby, a cesarean section, sometimes referred to as a c-section or cesarean delivery, is frequently required [7]. Even while a cesarean section might not be the greatest option for a normal delivery, it can be a life-saving treatment for both mother and baby if, for instance, the baby is in an unusual position in the womb or labor is not proceeding as it should. In addition to these worries, the number of cesarean sections performed worldwide is rising quickly. The World Health Organization (WHO) reports that between 2000 and 2015, the percentage of newborns born via cesarean section than doubled, rising from 12% to 21% of all births [8]. About one-third to one-half of maternal deaths occurred after cesarean delivery,

with the overall maternal mortality rate ranging from 6 to 22 deaths per 100,000 live births [9]–[11]. In developing and disadvantaged nations, the situation is worse. For instance, in Bangladesh, the rate of preventable cesarean sections rose by 51% between 2016 and 2018 [12], and 77% of all cesarean sections performed in 2018 were medically unnecessary. The maternal mortality rate in the United States was 17 deaths per 100,000 live births in 2017; in Bangladesh, it was 173 deaths per 100,000 live births, greater than the rates in the majority of affluent nations [13]. Additionally, the National Low Birth Weight Survey Bangladesh, 2015, conducted by the Institute of Public Health Nutrition, found that the cesarean section rate was 35.5%, higher above the WHO's recommended range of 10–15% [14], [15]. Maternal mortality and morbidity rise to around twice the rate of cesarean birth as compared to a normal delivery. Mothers who have cesarean sections may experience a number of health problems, including blood loss, organ damage, infection, problems with subsequent pregnancies, and similar conditions [16]. Emergency cesarean sections, also known as surgical cesarean sections, are performed when the mother's and/or the baby's health is in immediate danger [17], [18]. Despite its similarities to classic cesarean section, emergency cesarean section carries a higher risk of surgical damage and infection [19]. The responsible medical practitioner typically choose the delivery method. Reducing difficulties during labor could be achieved by using a maternal healthcare application to help physicians forecast a delivery method that fits the mother's features. Predicting pregnancy outcomes and delivery methods has not been extensively studied, and even fewer clinical decision-support systems have been created in line with this research. Pereira and colleagues [20] carried out a study to create data mining classification models to predict delivery types using obstetric risk factors in real-time. After conducting a study using ultrasound technology, Usman and colleagues [21] created the "Intrapartum" Android application, which enables medical practitioners to calculate the possibility. The responsible medical practitioner typically choose the delivery method. Reducing difficulties during labor could be achieved by using a maternal healthcare application to help physicians forecast a delivery method that fits the mother's features. Predicting pregnancy outcomes and delivery methods has not been extensively studied, and even fewer clinical decision-support systems have been created in line with this research. Pereira and colleagues [20] carried out a study to create data mining classification models to predict delivery types using obstetric risk factors in real-time. After conducting a study using ultrasound technology, Usman and colleagues [21] created the "Intrapartum" Android application, which enables medical practitioners to calculate the possibility. To examine the characteristics that are essential for forecasting delivery methods, more study and inquiry are needed and to find auxiliary characteristics that help improve the precision of these forecasts. Similarly, since it is rarely practicable or possible to analyze every feature of a pregnancy throughout childbirth, research should identify which algorithms or methodologies can offer higher accuracy when taking into account a particular group of features.

II. LITERATURE SURVEY

A) Prediction of Cesarean Childbirth using Ensemble Machine Learning Methods N. Khan, T. Mahmud, M. Islam, Published in International Conference on Information Integration and Web-based Applications & Services (30 November 2020)- Cesarean section around the world is increasing at an alarming rate. Cesarean section, on one hand, may introduce different short-term and long-term complications for mother; on another hand it may be a life-saving procedure for both mother and child, depending on childbirth complications. The purpose of this research is to predict whether or not the cesarean section is necessary with the help of data mining and

consequently, increasing the safety of the mother and newborn during and after childbirth by avoiding unnecessary cesarean section. To attain the objective three different ensemble prediction models based on- XGBoost, AdaBoost and Catboost were developed. As an outcome XGBoost showed the highest accuracy-88.91% while AdaBoost showed 88.69% accuracy and Catboost showed 87.66% accuracy. This research also revealed that amniotic liquid, medical indication, fetal intrapartum ph, number of previous cesareans, pre-induction are the most influential features for predicting the target outcome accurately.

B) Machine learning to predict pregnancy outcomes: a systematic review, synthesizing framework and future research agenda by M. Islam, Sumaiya Nuha Mustafina, T. Mahmud, N. Khan, Published in BMC Pregnancy and Childbirth (22 April 2022) - 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. The study also delineated future research opportunities to facilitate the existing initiatives for reducing maternal complacent and mortality rates, such as: utilizing unsupervised and deep learning algorithms for prediction, revealing the unknown reasons of maternal complications, developing usable and useful ML-based clinical decision support systems to be used by the expecting mothers and health professionals, enhancing dataset and its accessibility, and exploring the potentiality of surgical robotic tools. Finally, the findings of this review study contributed to the development of a conceptual framework for advancing the ML-based maternal healthcare system. All together, this review will provide a state-of-the-art paradigm of ML-based maternal healthcare that will aid in clinical decision-making, anticipating pregnancy problems and delivery mode, and medical diagnosis and treatment.

C) Exploring the Machine Learning Algorithms to Find the Best Features for Predicting the Breast Cancer and Its Recurrence by Anika Islam Aishwarja, Nusrat Jahan Eva, Shakira Mushtary, Zarin Tasnim, N. Khan, M. Islam, Published in ICO (2020) – Every year around one million women are diagnosed with breast cancer. Conventionally it seems like a disease of the developed countries, but the fatality rate in low and middle-income countries is preminent. Early detection of breast cancers turns out to be beneficial for clinical and survival outcomes. Machine Learning Algorithms have been effective in detecting breast cancer. In the first step, four distinct machine learning algorithms (SVM, KNN, Naive Bayes, Random forest) were implemented to show how their performance varies on different datasets having different set of attributes or features by keeping the same number of data instances, for predicting breast cancer and it's recurrence. In the second step, analyzed different sets of attributes that are related to the performance of different machine learning classification algorithms to select cost-effective attributes. As outcomes, the most desirable performance was observed by KNN in breast cancer prediction and SVM in recurrence of breast cancer. Again, Random Forest predicts better for recurrence of

breast cancer and KNN for breast cancer prediction, while the less number of attributes were considered in both the cases.

IMPLEMENTATION

Modules

Service Provider

In this module, the Service Provider has to login by using valid user name and password. After login successful he can do some operations such as Login, Browse Data Sets and Train & Test, View Trained and Tested Accuracy in Bar Chart, View Trained and Tested Accuracy Results, View All Antifraud Model for Internet Loan Prediction, Find Internet Loan Prediction Type Ratio, View Primary Stage Diabetic Prediction Ratio Results, Download Predicted Data Sets, View All Remote Users.

View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user's details such as, user name, email, address and admin authorizes the users.

Remote User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like REGISTER AND LOGIN, PREDICT PRIMARY STAGE DIABETIC STATUS, VIEW YOUR PROFILE.

CONCLUSION

The best sets of factors to take into account when making such selections have not yet been investigated, despite the fact that selecting the most appropriate delivery methods is essential for the safety of both women and babies. As a result, this study conducted a thorough empirical investigation, categorized all potential features into distinct groups, and then used a machine learning feature selection technique. Afterwards, the optimal method for predicting the best childbirth model with the fewest features was identified by analyzing the outcomes of applying five machine-learning algorithms to combinations of these categories (classes). The effectiveness of the strategy used in this investigation was demonstrated by the performance for several feature classes.

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