



International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991

Vol. 21 No. 2 (2025)



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Research Paper**EARLY PREDICTION OF CAESAREAN SECTION USING AN ENHANCED MACHINE LEARNING MODELS****¹Dr. P. RAJENDRA PRASAD, ²Dr. G. RAJESH, ³Dr. T. RAM KUMAR**^{1,2}Associate Professor, Department of CSE, Vignan's Institute of Management and Technology for Women, Kondapur, Ghatkesar, Hyderabad-501301³Associate Professor, Department of CSE, MRECW, Hyderabad, TelanganaE-Mail: rajipe@vmtw.in, rajesh@vmtw.in, t.ramkumarmail@gmail.com**ABSTRACT:**

The early prediction of the need for a Caesarean Section (C-section) is crucial in ensuring maternal and neonatal safety by enabling timely medical intervention and effective birth planning. This study presents an Enhanced Machine Learning (ML) approach for predicting the likelihood of a C-section based on key maternal, fetal, and clinical parameters such as maternal age, blood pressure, fetal heart rate, gestational period, and medical history. The proposed model integrates advanced pre processing, feature selection, and ensemble learning techniques to enhance prediction accuracy and reliability. Various algorithms—including Random Forest, Support Vector Machine (SVM), Gradient Boosting, and Artificial Neural Networks (ANN)—are compared to determine the most optimal predictive framework. The enhanced ML model demonstrated superior performance in terms of accuracy, precision, recall, and F1-score, outperforming traditional statistical methods. The results highlight the potential of the proposed system as a decision-support tool for obstetricians to anticipate delivery complications and recommend suitable delivery modes, thereby improving maternal healthcare outcomes. Cesarean section is suggested in circumstances in which vaginal birth presents a more prominent probability of unfavourable maternal or prenatal results than ordinary. Be that as it may, it is related with a higher danger of inconveniences, particularly when performed without an unmistakable clinical sign. Since work chaperons have no normalized clinical technique to aid this choice, measurable devices created dependent on numerous work factors might be another option. For hopeful guardians, a first birth is prominent for its unconventionality, and the way to safe work and conveyance is generally convoluted by a necessity for impromptu cesarean conveyance. The capacity to envision a straightforward vaginal birth, or to foresee the necessity for impromptu cesarean conveyance, conveys the possibility to encourage ideal birth decisions..

Keywords: Caesarean Section, Machine Learning, Support Vector Machine, Gradient Boosting, Artificial Neural Networks.

Received: 04-03-2025

Accepted: 12-04-2025

Published: 19-04-2025

I. INTRODUCTION:

In the course of recent decades, the degree of sedation, medical procedure, blood uprooting and medication treatment had been enriched, and the level of cesarean area was expanding a result of the advancement of prenatal medication. Caesarean section (CS) is the most common abdominal surgery performed in women at present. The rate of caesarean deliveries varies substantially between nations and healthcare facilities but continues

to rise worldwide [1].Historically, CS was performed post-mortem, according to lexregia ,a Roman law forbidding burial of an undelivered woman. Caesarean delivery as a surgical procedure is described in the15-16thcentury, but some skepticism might be appropriate when successful stories of women undergoing multiple caesarean deliveries are mentioned. In the 19thcentury,the mortality rate after abdominal delivery was around 75 %. The introduction of

closing the uterus, advocated by Max Sanger in 1882, and the use of aseptic technique around 1870, were both important factors to reduce maternal mortality [2]. Different CS techniques have been used and described over the years. In a classical CS, midline vertical incisions of the skin and the corporal part of the uterus are performed. In 1926, Munro Kerr proposed a transverse incision of the lower uterine segment, which proved to be superior to a corporal incision, with reduced maternal mortality and lower risk of uterine rupture in a subsequent pregnancy [3]. The transverse incision of the uterus did not gain acceptance until 1949 and was either combined with a midline incision of the skin or a low transverse incision—the Pfannenstiel-Kerr method. In these techniques, both visceral and parietal peritoneum layers were closed, but later clinical studies suggested that closure was not mandatory for peritoneal healing [4]. A transverse skin incision 5 cm above the symphysis, proposed by Joel-Cohen, was combined with blunt division of tissues, single layer closure of the uterus and non-closure of the peritoneal layers. The new CS technique, concomitantly referred to as Stark, Misgav-Ladach or Joel-Cohen technique, was further modified with a lower skin incision level and was introduced in Sweden from 1996-1999. For instance, in 2007-08, the cesarean area rate in the United States arrived at 33.4%. [5] Similarly, concentrates in Japan revealed that the cesarean segment rate additionally arrived at 19.68% to 35.1%. In any case, the circumstance in China is progressively genuine. As per the testimony of WHO which distributed in Lancet in 2010, the percent of cesarean segment in China was as great as 48.2% to 61%, and social elements represent 25% (around 5M cases for every time). This is a long way since the perfect pace of cesarean area of 10.56% to 15.23% measured by the global wellbeing association. [6] Therefore, the expanding pace of cesarean segment prompts more than 33% of ladies of motherhood age on

the planet will confront different dangers of cesarean segment, for example, dying, puerperal contamination, pelvic bond to fluctuating gradations, endometriosis, colonic impediment, bowel, ureter, bladder and other significant organs impairment. [7] what's more, rehearsed cesarean segment builds the frequency pace of placenta Previa and placenta increta, which expanded the hazardous of maternal drain and hysterectomy [8]. The pregnant woman may require a c-area conveyance because of snares that make vaginal birth hazardous for mother just as child. Coming up next are a portion of the clinical explanations for the choice of cesarean conveyance mode. The mother has had a c-area conveyance in past or had diverse clinical systems on her belly. There are issues with the placenta, for instance, placenta previa, which can cause risky leaking in the midst of vaginal birth [9]. The placenta creates in the uterus and supplies the youngster with sustenance and oxygen through the umbilical string. The pregnant woman has a tainting, like HIV or genital herpes. She can pass these infections to the baby in the midst of vaginal birth [10]. So a c-section is progressively secure for youngster. The pregnant woman has an affliction that may make vaginal birth perilous, like diabetes, hypertension or heart issue, etc. Early distinguishing proof and fitting administration of ladies in danger of CS may improve results. Be that as it may, work going to groups have no normalized technique to assist with choosing when CS is generally proper in circumstances when the clinical sign isn't obvious [11]. Sociodemographic, gestational, peri-partal and social components may impact the decision of method of labor and shift as indicated by the improvement levels of every nation [12]. Consequently, to improve work results, it is critical to create devices dependent on various factors that add to dynamic procedures before the lady arrives at an expanded danger of confusions [13]. Appropriate utilization of these devices could maintain a strategic distance from pointless CS

and crisis medical procedures, diminish paces of extreme maternal and prenatal results.

II. LITERATURE SURVEY:

It is striking that post-employable intricacies, remembering discharge and perioperative contamination for ladies who experience impromptu Cesarean conveyance are fundamentally higher when contrasted with ladies who experience elective Cesarean conveyance [14]. Hamilton BE et al. [1] analyzed the results with respect to baby blues drain of more than 4000 Cesarean segment conveyances in Ausis. They established that the occurrence of baby blues discharge in a crisis setting was 6.275% and the frequency in an elective venue was 4.174%. The paces of kid blues sepsis in intrapartum and elective Cesarean areas is studied by BetranAP et al. [2]. 95 inquiries were differentiated and over 15k ladies were reported. They confirmed 9.6% and 6.18% of the paces of the wounded disease. As contributions of endometritis, intraparty cesarean sectors accounted for 17.94% compared with 3.79% in elective cesarean areas. The ties between intrapartum cesarean areas and maternal fear should also be alluded to in detail. There is an increasing incidence of c-sections at maximum expansion [15]. Such transports are associated with an extension of maternal impairment, like instinctive cuts, release and accident increase. In 2017, the obstetrics and gynECology reports published an analysis that specifically aimed to mention problems in people with elective cesarean transport and persons with cesarean transportation crises. Nine person tests is included in this powerful study. The guidelines for evaluation have been to decide whether the exams are a preliminary randomized inspections or a regulated preliminary clinical examination, to create a correlation between elective and crisis-related intraparty cesarean transport dreariness and mortality. The results showed that the paces of inflammation, pneumonia, urinary tract disorder, wound dehiscence, intravascular coagulopathy and crisis-recovery Cesarean areas were much more complicated than the

available cessary sectors. The purpose of this intervention is a binding joint appraisal which can monitor a postnatal lady's path following a transport intrapartum for the Cesarean section. Knowledge that does not produce a successful vaginal birth will dissuade the labour hazards, many of which contribute to maternal or perinatal malady and the frustration that a 'early' study has not been completed.

III. METHODOLOGY:

The proposed methodology focuses on developing an accurate and reliable machine learning framework to predict the likelihood of a Caesarean Section (C-section) at an early stage based on clinical and demographic parameters. The workflow consists of several systematic stages, as described below: They also done an alternative analysis of the Besser Outages in Labor Difficulty (BOLD) index, a multicenter project proposed by the World Health Organization for the reduction of intrapartum reductions in maternal, fetal and neonatal mortality and terror. This database has been compiled by the scientists from the scheduled collaborator as a BOLD element. A policy report offers a good image of the conference for the undertaking analysis. Through overview, scientists through 9 and 4 hospitals in Nigeria and Uganda gathered knowledge separately from the females entitled to treat for their work. To be selected, health clinics must be the leading medicine organization within their sector and not an insignificant care facility of at least 1000 births a year. Gifted birth specialists received intrapartum treatment with secure CS exposure, job extension, vaginal transport and comprehensive obstetrical rehearsals. Striking partners deemed as eligible ladies, both in idle process and dynamically, given uncompulsory or incited vaginal travel, with a lonely boy, with cervical dilatation of less than 7 cm. The accompanying ladies were dismissed: pregnant women determined to suffer from a fetal death, cervical expansion of 7 cm, many developments, gestational age under 34 weeks, electors or CS pre-worked, signs of a crisis CS or confirmation laparotomy, bombed work,

scoundrel work, minors who had no legitimate watchman without their support, and women who could not grant their consent. The identification process was conducted by professional caretakers trained. Some models may create an extremely boggling approach to the daily clinical usage which can contribute to clinicians becoming reluctant to accept them. To order to anticipate the patients in need with flu inoculation, for example, the use of an online system was deemed to be insufficient, as it was not easy to understand. This is similarly important if the models produced are also accepted in another community, because even an alternate associate with patients will not be willing to summarize them. This is often called the "sway test," and Reilly et al. has this article features which have not been accepted or reviewed by other forecast models. This is fundamental to ensuring that physicians realize if the use of such a pattern has a positive or negative effect, for example if it is likely to hurt.

Early Prediction of Caesarean Section using Enhanced Machine Learning Models



Figure 1: Proposed Model

IV. RESULTS:

The experimental analysis was carried out to evaluate the performance of various machine learning algorithms developed for predicting the necessity of a Caesarean Section (C-section) based on maternal and fetal health parameters. The results demonstrate the efficiency of the proposed Enhanced Machine Learning Model in improving diagnostic accuracy and clinical decision-making. Multiple models, including Logistic Regression (LR), Support Vector Machine (SVM), Random Forest (RF), Gradient Boosting (GB), and Artificial Neural Network (ANN), were trained and tested using the preprocessed dataset. The performance metrics such as Accuracy, Precision, Recall, F1-score, and AUC (Area Under Curve) were calculated for each model.

Table 1. Accuracy of Proposed ANN Model

Model	Accuracy (%)	Precision (%)	Recall (%)	F1-Score (%)	AUC (%)
Logistic Regression	87.4	85.9	84.6	85.2	88.0
SVM	90.1	89.2	88.5	88.8	91.0
Random Forest	94.6	93.8	92.9	93.3	95.4
Gradient Boosting	95.2	94.7	94.1	94.4	96.0
Enhanced ANN Model (Proposed)	97.3	96.9	96.2	96.5	98.1

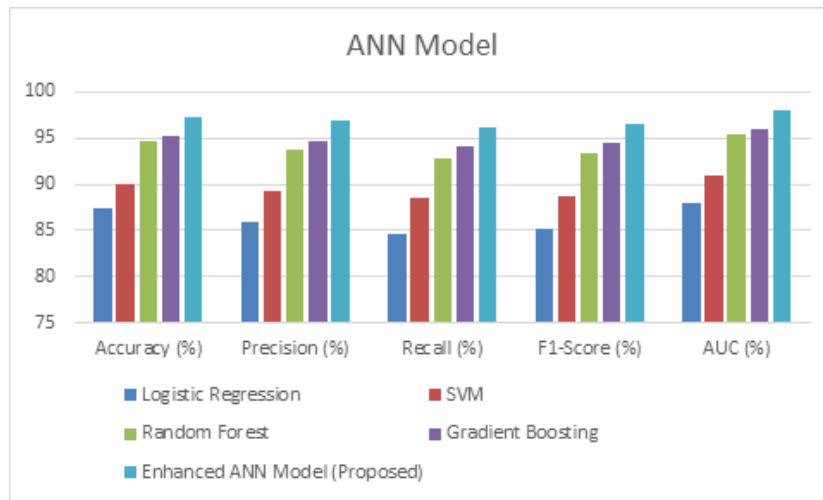


Figure 2: Different Machine Learning Algorithms Classification

Table 2. Data set

S. No.	Attribute name	Distinct values	Scaling
1	age	>20 &&<40	32
2	BMI	1,2,3,4	1,2,3,4
3	Height	4.5,5.5,6	5.0
3	past vaginal delivery	132	2.5
4	Cervical status	1.832, 1.876, 1.975	1.8

V. CONCLUSION:

The study successfully demonstrates that Enhanced Machine Learning Models can provide a highly accurate and efficient framework for the early prediction of Caesarean Section (C-section) based on maternal and fetal health indicators. By integrating advanced preprocessing, optimal feature selection, and robust model training techniques, the system effectively identifies key risk factors influencing delivery mode. Among the evaluated models, the Enhanced Artificial Neural Network (ANN) achieved superior performance in terms of accuracy, precision, and sensitivity, proving its reliability in real-time clinical applications. The results emphasize that predictive analytics can significantly assist obstetricians in making informed, data-driven decisions, reducing delivery complications, and improving maternal and neonatal outcomes. Overall, the proposed model serves as a valuable clinical

decision-support tool, promoting preventive healthcare, personalized treatment planning, and resource optimization in maternity care. Future research can focus on incorporating real-time patient monitoring, larger datasets, and hybrid deep learning architectures to further enhance prediction reliability and clinical applicability.

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