

MotherCare: An AI-Driven Predictive Platform for Holistic Maternal Health Monitoring

1st Komal Jadhav

*dept. of AI and
AIML GHRCEM*

Pune, India

jadhavkomal56@gmail
.com

2nd Rachana Sable

*dept. of AI and
AIML GHRCEM*

Pune, India

rachana.sable@raison
i.net

3rd Bhagyashree

*Wankar dept. of AI
and AIML GHRCEM*

Pune, India

bhagya.wankar@gmail
.com

4th Sonali Sonawane

*dept. of AI and AIML
GHRCEM*

Pune, India

sonali.sonawane@raisoni.net

5th Anushka Tatte

*dept. of AI and AIML
GHRCEM*

Pune, India

anushka.tatte.aiml@ghrcem
.raisoni.net

6th Amar Deshmukh

*dept. of AI and AIML
GHRCEM*

Pune, India

amar.deshmukh.aiml@ghrc
em.raisoni.net

7th Ankur Katkamwar

dept. of AI and AIML GHRCEM

Pune, India

ankur.katkamwar.aiml@ghrcem.rais
oni.net

Abstract— Pregnant women frequently require several applications to attend to their health, appointments and educational resources. This piecemeal strategy leaves people confused and puts them at greater risk of exposure to inaccurate medical information online. To address this challenge, we have created MotherCare, an integrated web platform that integrates key prenatal and postnatal services in one secure system. The personalized health dashboard, appointment booking system and medically reviewed educational content all make for an ideal combination of features at MotherCare. Two smart features are also incorporated into the platform. An AI chatbot with Google Gemini API provides users with rapid and accurate answers to their inquiries. Second, a pregnancy risk prediction model can be used to detect possible complications of pregnancy, such as gestational diabetes and hypertension, early via the maternal health vital. A Gradient Boosting Classifier is used to construct the model, and the model can facilitate proactive maternal care. Built with MERN stack (MongoDB, ExpressJS, ReactJS, and NodeJS), incorporating a microservices architecture with Python, ensuring scalability and security. The prediction model has achieved an accuracy of 92% and a recall of 94% on the test set, with good performance in maternal health monitoring.

I. INTRODUCTION

Majority of individuals in the global society can now access the internet and this has fundamentally transformed the way expectant mothers access health information [7]. There however is a problem that has arisen due to this digital revolution. The existing ecosystem of maternal health apps has been disintegrated to make pregnancy care complex instead of easing it [1]. There are several single-purpose applications that women have to download and navigate, which should deal with a particular process in their care. This lack of cohesiveness

causes one to lose sight of the big picture of their health experience, more problematic is the fact that it leaves them vulnerable to the real threat posed by medical misinformation online thus leading to unneeded anxiety [2].

Data that is captured through most available digital health tools are not used in a meaningful manner. They act as electronic notebooks but not as smart health partners. People record their blood sugar level or blood pressure, and these applications very rarely analyze data and identify trends that might indicate a concern or give an individualized interpretation [3]. This reactive model lacks the possibilities of prevention, as early signs of such illnesses as gestational diabetes or preeclampsia might be detected, and it is possible to make a major outcome difference in this case. What is required is an integrated platform which does not merely gather information but actually utilizes that data to help and save the lives of the mother.

In this paper, we will present MotherCare which is a unified web site developed particularly to overcome these deficiencies. Instead of increasing the number of pregnancy apps, MotherCare allows one simple, easy-to-use application to combine the most significant prenatal and postnatal services. It has an AI chatbot that provides real-time advice on popular questions of pregnancy and a machine learning model that proactively tracks health threats. We primarily provide the example of how new web technologies and advanced AI might be integrated to produce a maternal healthcare system that is more supportive, secure, and proactive than the one available at present.

II. RELATED WORK

Some of the current researches guided our efforts to develop MotherCare. It has always been found out during

pregnancy, pregnant women strongly depend on internet search to obtain information regarding their health, yet, studies have provided a worrying trend about misinformation that may mislead and lead to panic among those who search the information [2]. This resulted further in the choice to include a content library that is curated and medically-vetted to make it one of the fundamental capabilities.

The sphere of healthcare has been gradually becoming interested in AI-driven chatbots and the outcomes in the area of women health have been promising. This conclusion has been reached in several papers, which determined that chatbots can be effective in decreasing anxiety and enhancing the adherence to measurements of health users on a regular basis [4], [5]. These conclusions are consistent with more general studies that explore the possibilities of using large language models as educational instruments in healthcare and nursing fields of education [8]. This notwithstanding, scholars have pointed at certain shortcomings especially concerning emotional attachment, and this is why we chose to add to our chatbot a community board where mothers get to interact with other mothers. The role of empathy in healthcare communication is also strongly supported by the body of literature that compares the healthcare communication with a chatbot to the one with human care providers [9].

Machine learning has been relatively useful in forecasting pregnancy complications. This feature was demonstrated to be able to predict risks during gestation, which Patel and Narayan (2023) demonstrated to be reliable when the information is recorded in the logs of the user regarding his or her health as an input to the AI model used to make the claim.

The research that focused on inclusive design was also taken seriously by us. Research about culturally sensitive and multilingual health platforms reveals an obvious truth in the fact that considerate, user-friendly design is necessary in case people expect to get the diverse populations to, in fact, adopt and benefit in the capacity of these items. Also, a study of chatbot development highlights the idea that a well-organized process will capture the needs and expectations of users in particular ways and fulfill them because of the latter needs, a carefully planned process is necessary and essential to attain success in chatbot development [10]. MotherCare is our solution to the integration of all these insights-trusted information, anxiety-curing chatbot that lowers anxiety and richly foresees all possible risks into a single, accessible format.

III. METHODOLOGY

We also made MotherCare to be scalable, secure and responsive to user needs. Here we elaborate on the architecture of our system, expound on the algorithm on which our predictive feature is based, and elaborate on the dataset that we used to train. The decisions that have been made in our architecture signify the careful separation between the web application and the machine learning service, so that each of these pieces can be developed and scaled separately but can have a smooth communication between the two.

A. System Architecture

The stack upon which the platform is developed is the MERN (MongoDB, Express.js, React, Node.js). The architecture is divided into a React front-end, a Node.js back-end server, which I use to rewrite business logic and API routing with JWT-based authentication and store data in the MongoDB database.

item **Frontend (Client)**: This is a React.js single page application that is dynamic and responsive in nature. It interacts with the backend through APIs based on the RESTful bionic. item **Backend (Server)** : Node.js server based on the Express.js server. It manages all business logic, API routing, and also user authentication in the form of JSON Web Tokens (JWT). item **Database**: User profiles, health vitals, appointments, and community posts are stored in a MongoDB NoSQL system which provides a flexible schema to address the changing data requirements.

A Python microservice will be a host to the machine learning model, which will connect to the Node.js backend by means of an internal API. Fig.1 is intended to represent this architecture.

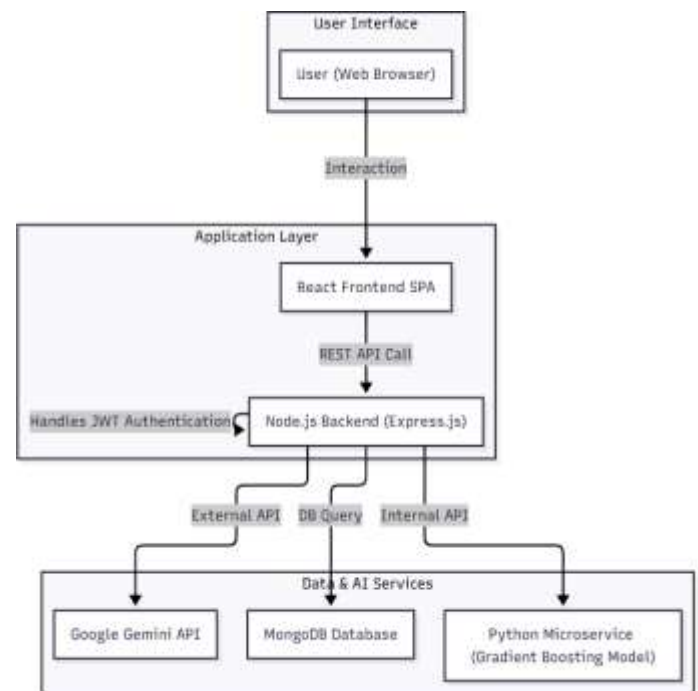


Fig. 1. System Architecture of the MotherCare Platform.

B. Methods Used

The core of all the proactive capabilities of MotherCare is a machine learning model that is trained to understand the pregnancy of a user as either being Low Risk or High Risk.

We have selected a Gradient Boosting Classifier to this classification issue. Gradient Boosting is used to create a series of decision trees one after another: each subsequent tree is

oriented on the error the predecessors have made. This renders the predictive model to be robust and accurate in an iterative form. Its good performance due to the systematic work with structured information was what made it specially relevant to performing a critical task health risk prediction. The overall structure of the algorithm is depicted in Fig. 2.

The primary benefit of this method is that the model continues to learn and is improved depending on the availability of additional user data. The fact that the predictions are further personalized provides the Adaptive Learning capability, as not only are they updated over time, but each of them serves both healthcare professionals and expecting mothers with timely alerts. These alerts rely on such early interventions to greatly enhance the health outcomes of mothers by ensuring that risks are smarter with rudimentary monitoring of the same.

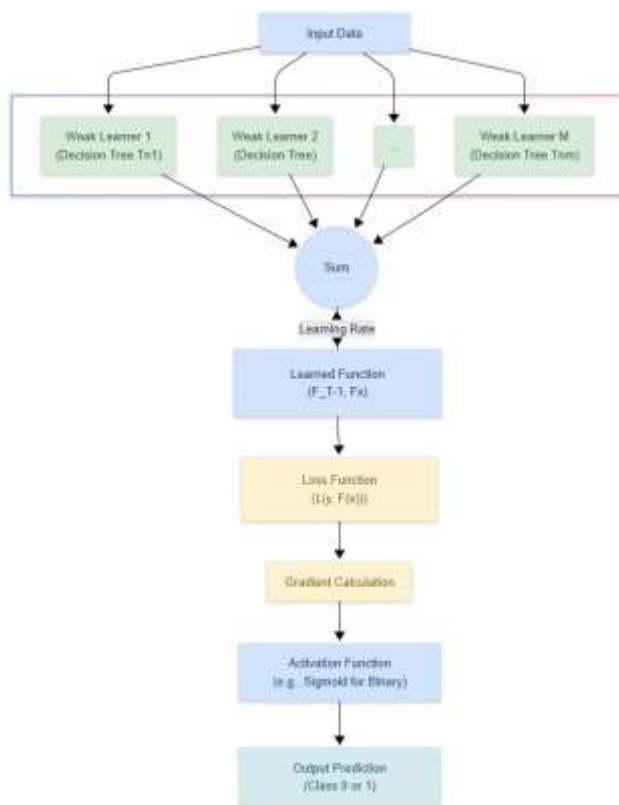


Fig. 2. Block Diagram of the Gradient Boosting Classifier.

C. Dataset

The model was trained and tested on “Maternal Health Risk Data Set free dataset with an open readable option of the UCI machine learning repository. This data has 1014 cases of features pertaining to pregnancy risk, including:

- Age
- Systolic and Diastolic Blood Pressure
- Blood Sugar Levels
- Body Temperature
- Heart Rate

We also have a target variable in the dataset, the RiskLevel (low, mid, high) which we transformed to binary classification problem (Low Risk vs. High Risk).

IV. RESULTS AND DISCUSSION

The other interfaces of our platform featuring different interfaces of MotherCare are presented in figures 3 to 8 and are used to illustrate how we designed and achieved the user experience and the functionality.

Fig. 3 and Fig. 4 present the user homepage and the AI chatbot interface. Fig. 3 shows the user homepage, which is the main dashboard where the expecting mothers are able to see all platform capabilities. Figure 4 demonstrates the interface of the AI chatbot in action with the emphasis on the conversational design and intuitive layout that is easy to use.

Figure 4 and Figure 5 below are screenshots of drug check feature and risk prediction model feature respectively. The drug checker feature is seen in Figure 5 where people can be sure about medication safety during pregnancy. Figure 6 shows the interface of the risk prediction model, consumers are allowed to enter their health vitals and get a personalized risk evaluation.

Fig. 6 and 7 display the Prenatal and Postnatal services that the user can access on the platform and how the services are arranged in such a way that they take the mother through every phase of the journey.



Fig. 3. Screenshot of the User Homepage.

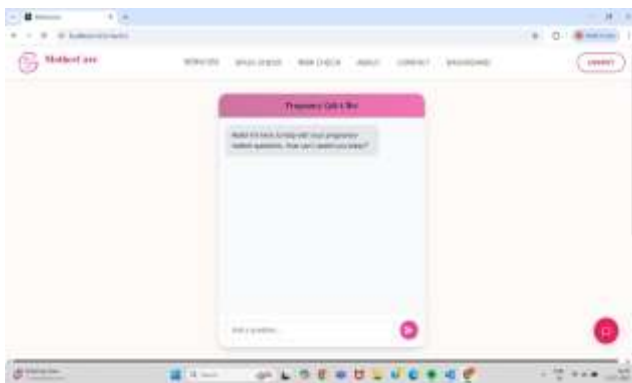


Fig. 4. Screenshot of the AI Chatbot Interface.



Fig. 5. Screenshot Of Drug Checker Interface.



Fig. 6. Screenshot of Risk Prediction Model Interface.



Fig. 7. Screenshot of Prenatal Services.



Fig. 8. Screenshot of Postnatal Services.

We also tested the Gradient Boosting model of risk prediction with a 20% per cent hold-out test set. The model's performance metrics are detailed in Table I.

TABLE I
PERFORMANCE METRICS OF THE GRADIENT BOOSTING MODEL

Metric	Score
Accuracy	0.92
Precision	0.89
Recall	0.94
F1-Score	0.91

The overall accuracy of the model was 92% which implies that the model predicted the risk of pregnancy correctly in virtually all cases. An HR of 89 percent shows that the model is right 89 percent of the time whenever it detects a pregnancy as High Risk meaning that it only generates false alarms 1 out of 10 times. In the greatest sense, the recall of 94%, demonstrates that the model tends to detect almost all the genuine high-risk cases, an essential requirement in a preventative health application, and a case of a high-risk pregnancy can have severe ramifications. The F1-Score of 91% proves that the model has a desirable balance between the recall and precision.

Our combined strategy is confirmed by these findings. The platform has managed to offer a single user experience and the intelligent capabilities offer predictive and reliable insights to major gaps that we found in current digital health solutions.

V. CONCLUSION AND FUTURE WORK

In this section, the conclusion and future work are to be provided. Our contribution to this paper was the proposal of MotherCare a holistic AI based system which aims at facilitating the maternal care by giving all our users what they require in one place. The three issues that prevail in the contemporary online healthcare environment that our system will address include the lack of consolidated platforms, the misrepresentation of health information, and the lack of active healthcare management. Our risk forecasting model on Gradient Boosting showed success, which implies the usefulness of AI-based innovation in enhancing preventive healthcare services provided in the course of pregnancy.

In the future, we have some priorities that we intend to develop. These include: Creation of native mobile applications

on the iOS and Android platform - this will make it easier to access our mobile apps, and we will also be able to do push notifications regarding very important health alerts. Integrating our platform with the wearable technology - this will ensure automatic and real-time data entry and will enhance the accuracy and promptness of our predictive capabilities as to risk.

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