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Juno: A Complete Pregnancy Tracker for Advancing Maternal Healthcare and Risk Prediction

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Abstract: Pregnancy is one of the most fascinating and chal-lenging experiences the human body can go through, and it is different for every person, influenced by a wide range of physical, emotional, lifestyle, and social factors. Early detection and prediction of potential complications are essential to im-proving outcomes for both mother and baby. This project uses various machine learning methods on pre-pregnancy data such as physical health, stress levels, and lifestyle choices to predict the risk of pregnancy-related issues. Further, to support the journey, we developed the Juno application—a digital companion that helps expectant mothers document and manage their pregnancy journey from beginning to postpartum. Users can track physical changes, moods, symptoms, supplement intake, medical appoint-ments, and receive useful reminders and suggestions. The app also provides insights into fetal development and aims to offer support throughout childbirth and after delivery. Juno makes it easier to stay organized, reflect on changes, and recognize when to seek help, contributing to better health outcomes. Our goal is to combine technology with care to offer a simple yet effective tool that supports women through one of the most life-changing Experiences.

Keywords: *Pregnancy Monitoring, Maternal Health, Ma-Chine Learning in Healthcare, Risk Prediction, Mobile Health Application.*

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I. INTRODUCTION

Pregnancy is a life-changing journey filled with physi-cal changes, emotional moments, and important milestones.Thanks to modern technology, expectant parents can now move beyond traditional paper journals and photo albums to more interactive and organized digital tools. Juno is an all-in-one pregnancy companion that combines health tracking, baby development updates, and memory keeping in a simple, easy-to-use app. It helps parents stay informed and confident throughout each stage of pregnancy and postpartum.

The rise of smartphones and internet access has revolution-ized maternal healthcare, making essential information and monitoring tools more accessible. Equipped with sensors like cameras and accelerometers, smartphones allow for advanced activity and health tracking. Mobile health apps now offer automated tracking of vital signs, symptoms, and fetal de-velopment, empowering parents to take an active role in their health and well-being. These tools bridge gaps in prenatal care, making support and education more widely available.

This project proposes a comprehensive app that monitors key maternal indicators like gestational age, weight, symp- toms, and emotional states, while also offering weekly updates and stage-based advice. Juno integrates personalized insights and reminders, helping users document their journey and stay on top of health needs. The app supports both pregnancy and postpartum phases, improving care quality through constant engagement and record-keeping. By combining technology and healthcare, Juno aims to improve outcomes for both mother and baby.

II. MOTIVATION AND PROBLEM STATEMENT

Pregnancy is a transformative time that demands consistent attention to both physical and emotional health, yet many expecting mothers still encounter barriers in accessing timely and reliable care. Limited prenatal visits, lack of ongoing support, and delays in identifying health concerns can con-tribute to avoidable complications. These challenges call for smarter, more responsive healthcare solutions that can adapt to individual needs and provide continuous support beyond the clinic setting.

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As smartphones become increasingly integrated into daily life, they offer a powerful platform for expanding the reach of maternal healthcare. This project explores the development of a mobile application that supports comprehensive preg-nancy management, including features like fetal development updates, nutrition and supplement tracking, symptom logging, and postpartum care tools. By using machine learning, the app can identify trends, provide personalized insights, and offer early warnings for potential issues, enhancing the ability of mothers to stay engaged and proactive in their care.

Developing such an app involves technical and ethical chal-lenges, including ensuring the accuracy of collected data, man- aging input from diverse sources, and safeguarding sensitive user information. This research focuses on addressing these challenges to create a user-friendly, secure, and medically-informed platform. More than a digital tracker, the app is designed to be a trusted companion throughout the pregnancy and postpartum journey. The ultimate goal is to use technology not just for convenience, but to improve maternal health outcomes and empower women through every step of this life-changing experience.

III. REVIEW OF LITERATURE

- Yu Mu, Kai Feng, Ying Yang and Jingyuan Wang (2018) Applying deep learning for adverse pregnancy outcome detection with pre-pregnancy health data: Trained on 75K couples with 308 health features, it predicts 6 out-comes: normal, premature birth, low birth weight, birth defect, abortion, and stillbirth. The model achieves 0.892 Accuracy.
- Macrohon JJE, Villavicencio CN, Inbaraj XA, Jeng JH (2022) A Semi-Supervised Machine Learning Approach in Predicting High-Risk Pregnancies in the Philippines: This study developed a ML model for early risk tagging in maternal health using data from the Philippines. A modified Decision Tree with entropy criterion achieved 93.70%. accuracy.
- Mazaheri Habibi, M.R., Moghbeli, F., Langarizadeh, M.et al. (2024) Mobile health apps for pregnant women usability and quality rating scales: A systematic review: Analyzing 23 studies from the past 13 years, apps were categorized into entertainment, information, and health monitoring. Evaluated on accuracy and precision, the
- Amila app emerged as the best, with 66.66% effectiveness and 98% user satisfaction. Nissen M, Huang SY, J¨ager KM et al. (2024) Smartphone pregnancy apps: systematic analysis of features, scientific guidance, commercialization, and user perception: 36 apps dominated the market. All were commercial, but only 15 mentioned medical expert involvement. Auto-mated text analysis revealed that 10.3% of 2-star reviews cited commercialization, while just 0.6% of user reviews referenced scientific accuracy.
- Lamyae Sardi, Ali Idri, Leanne M. Redman, Has-san Alami, Rachid Bezad, Jos´e Luis Fern´andez-Alem´an (2020) Mobile health applications for postnatal care: Review and analysis of functionalities and technical features: This study conducted a Systematic Literature Review (SLR) to assess available iOS and Android postnatal apps using a 37-item evaluation questionnaire. Out of 48 retrieved apps, functional analysis revealed relatively low scores due to the complexity of postnatal care.
- Jo-anne Patricia Hughson, J Oliver Daly, Robyn Woodward-Kron, John Hajek, David Story. (2018) The Rise of Pregnancy Apps and the Implications for Culturally and Linguistically Diverse Women: Narrative Review: Reviewed 38 studies on pregnancy app usage from 2012–2017. Found that most women use apps for fetal development and pregnancy health information. Data storage, personalized features, and social sharing were valued. Lower uptake was seen in non-English-speaking and low-income groups, due to tech, language, and literacy barriers.
- Pouriayevali B, Ehteshami A, Kohan S, Saghaeiannejad-Isfahani S. (2022) Functionality of self-care for pregnancy mobile applications: A review study Reviewed 76 pregnancy self-care apps (from 4196 screened) on Google Play and Cafe Bazaar. Identified 3 main themes and 69 subthemes: (1) Training materials for both parents, (2) self-care functionalities like consultations, fetal tracking, reminders, and (3) user interface (UI) features. Highlighted the importance of Health solutions for pregnancy self-care and the need for transparent reporting and controlled trials to improve app development and evaluation.

IV. PROPOSED METHODOLOGY

The project was carried out in two distinct phases, each targeting a different but complementary aspect of maternal healthcare. In the first phase, the focus was on building predictive models using pre-pregnancy data to assess potential complications. Analyzing physical health indicators, lifestyle factors, and stress levels—the goal was to detect early warning signs and identify high-risk cases before complications could develop.

The second phase of the project aimed at supporting pregnant individuals throughout their journey. A user-friendly mobile tool was designed to help expecting mothers track daily and weekly changes in their health and pregnancy status. This includes features for logging symptoms, mood, supplement intake, physical changes, and medical appointments.

A. Risk Prediction

The dataset used for the first part of the project is the Mother's Significant Features specifically made available for researchers in the woman and child health domain. MSF dataset records are collected from the Mumbai metropolitan region in Maharashtra, India. The survey data is collated in a numeric form so basic modelling can be done easily. It involves taking the mother's health, social, stress and lifestyle attributes from before the pregnancy.

MSF comprises 450 records with a total of 130 attributes consisting of mother's features, father's features and health outcomes. This survey was taken by women just after childbirth. Available features are further divided into 5 categories namely physical, social, lifestyle, stress level, and health

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outcome. These features act as the independent variables for the models. All possible complications associated with child health, mother's health and pregnancy outcomes are covered in the health outcomes category. They act as the dependent variables and are predicted as the output of the models.

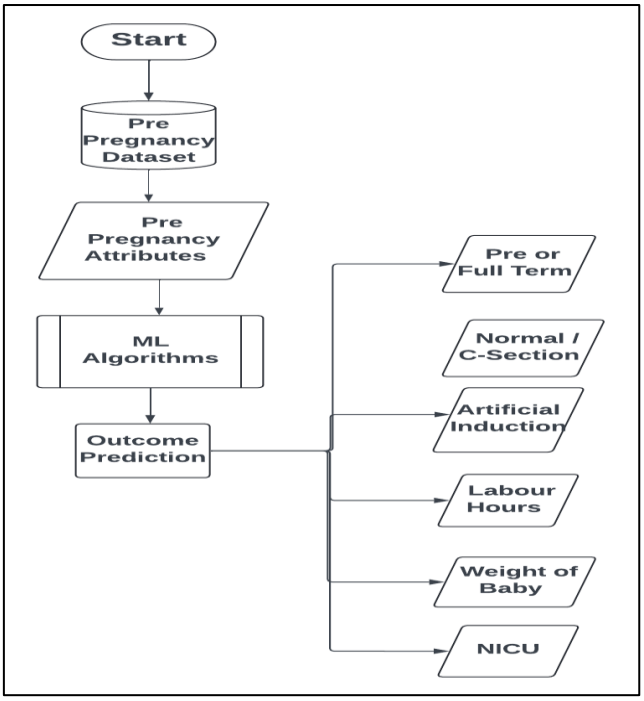

Fig 1: Modeling Flow

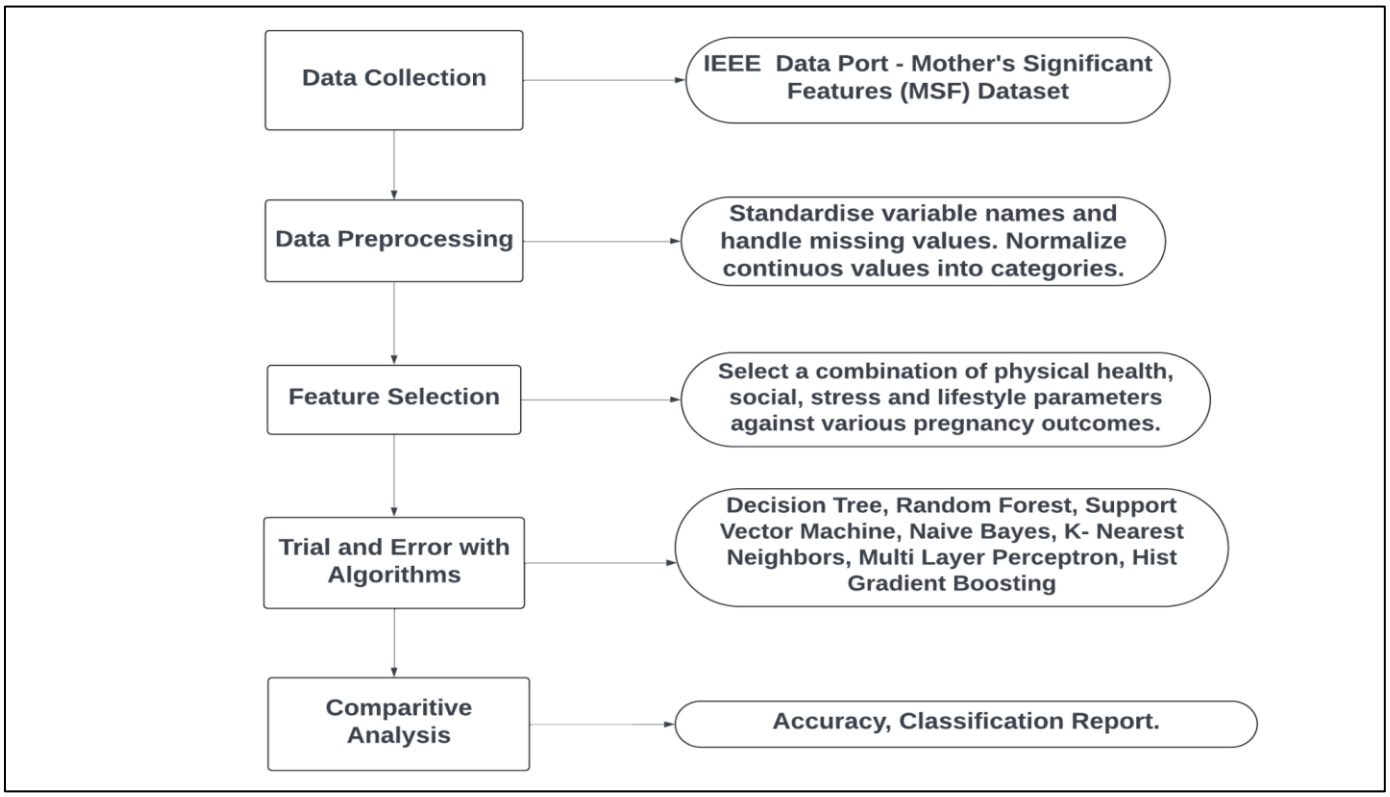

Fig 2: Flow of Code

B. Tracking Application

In the next part, we have created an application that supports the following features:

- Track daily physical health parameters.
- Track daily medication and supplements along with reminders.
- Log daily moods and maintain a diary along the journey.
- Log daily symptoms to track any concerning patterns.
- Track weekly fetal development.
- Set doctors appointments and get reminders for the same.

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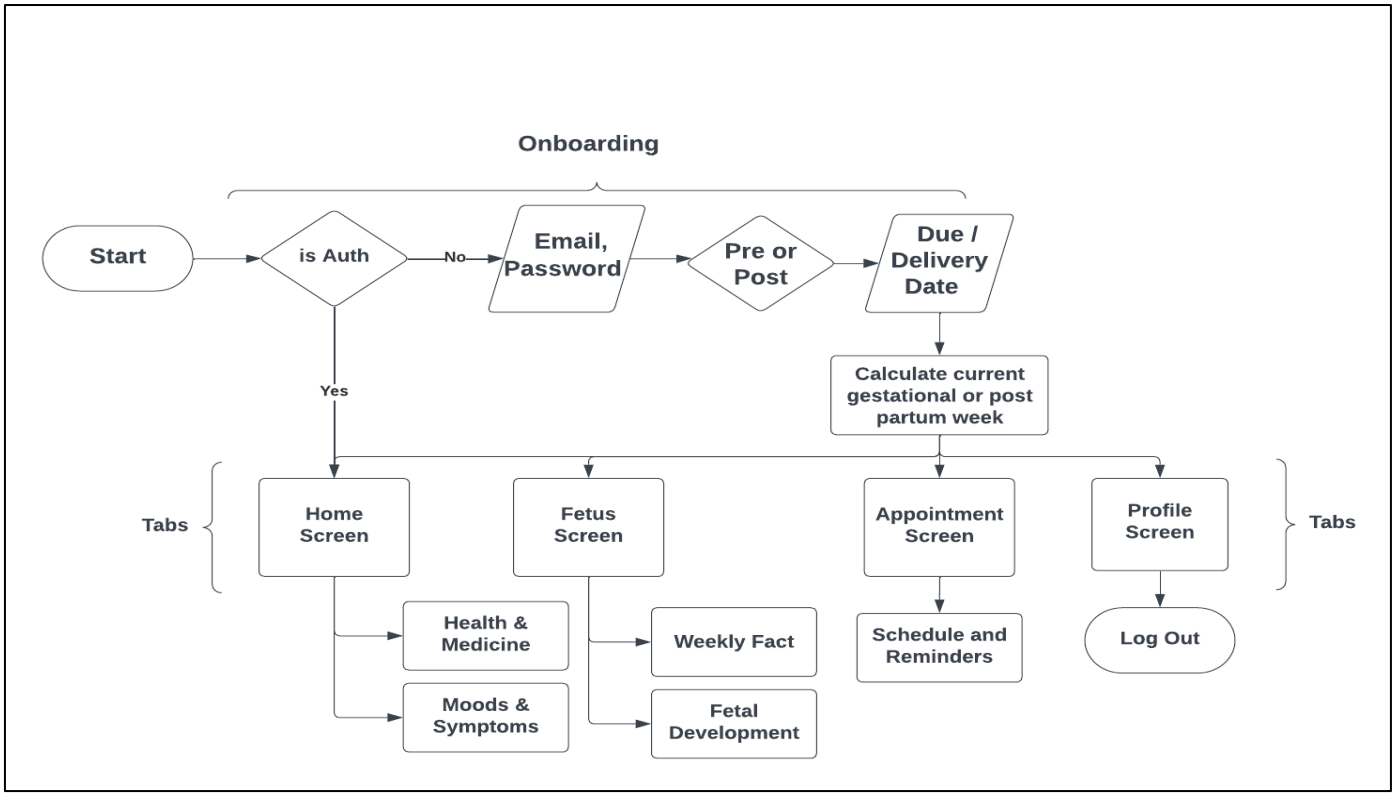

Fig 3: Application Workflow

V. METHODOLOGY

A. Algorithms

The following algorithms were used to test best performance accuracy across six outputs: preterm birth, c section, artificial induction, stay in NICU, hours spent in labour, and weight of the infant.

Decision Trees are widely used in classification tasks due to their interpretability and simplicity. They split data into branches based on feature values, creating a tree-like structure that is easy to visualize and understand. This makes them suitable for tasks where transparency is important, such as medical diagnosis or customer segmentation. However, they are prone to overfitting, especially with noisy or complex datasets. To address this, ensemble methods like Random Forest are employed. Random Forest builds multiple decision trees using random subsets of data and features, reducing overfitting and improving generalization. It is highly effec-tive for tasks like fraud detection, image classification, and bioinformatics, where robustness and accuracy are critical.

Gaussian Naive Bayes and Multinomial Naive Bayes areprobabilistic classifiers often used in text and data classifi-cation. Gaussian Naive Bayes is ideal for continuous, nor-mally distributed data, such as in medical diagnosis or sensor data analysis. Multinomial Naive Bayes, on the other hand, excels in NLP tasks like spam filtering, sentiment analysis, and document classification, where features represent word frequencies or counts. Hist Gradient Boosting, a variant of gradient boosting, improves efficiency by binning continuous features, making it suitable for large-scale classification tasks like click-through rate prediction or customer churn analysis.

Multi-Layer Perceptrons (MLPs), a type of neural network, are used for complex classification tasks like image and speech recognition, where capturing nonlinear relationships is essen-tial. K-Nearest Neighbors (KNN) is a simple, non-parametric algorithm used for classification tasks like recommendation systems and pattern recognition, leveraging the similarity between data points. Support Vector Machines (SVMs) are versatile and powerful, often applied in text classification, image recognition, and bioinformatics, thanks to their abil-ity to handle high-dimensional data and perform well with clear margin separation. Each algorithm has unique strengths, making them suitable for specific classification challenges.

B. Application Tech Stack

- Front End: The app's frontend is built using React Native with Expo, enabling fast, cross-platform development for both Android and iOS. Traditionally, Android apps use Java or Kotlin, and iOS apps use Swift or Objective-C, requiring separate codebases. Cross-platform frameworks like Flutter (written in Dart) and React Native (in JavaScript) solve this by allowing one codebase for both platforms. While Dart is limited to Flutter development, JavaScript has broader use across web and server development, making it more versatile.

We chose React Native as it is written using JavaScript, offers flexibility, community support, and easier integration. Expo simplifies development with tools for testing and accessing device features without native code.

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- Back End: The app's backend is powered by Firebase, a Backend-as-a-Service (BaaS) platform provided by Google.

Instead of building and maintaining traditional server infras-tructure, Firebase offers ready-to-use services like authentica-tion, real-time databases, cloud storage, and push notifications.

This allows for faster development and easier scaling without managing a dedicated backend. Unlike custom backend setups using frameworks like Node.js, Django, or Spring, Firebase handles much of the complexity, making it ideal for mobile apps. Its seamless integration with React Native and real-time data syncing make it a reliable and efficient choice for this Project.

VI. IMPLEMENTATION

The implementation phase of this research focused on developing and testing various machine learning algorithms to predict critical childbirth outcomes, such as pre-term delivery, C-section likelihood, artificial induction, labor duration, baby weight, and NICU stay. Algorithms like Random Forest (RF), Decision Tree (DT), Histogram Gradient Boosting (HGB), Multinomial Naive Bayes (MNB), Gaussian Naive Bayes (GNB), Multi-Layer Perceptron (MLP), K-Nearest Neighbors (KN), and Support Vector Machine (SVM) were evaluated for their accuracy. The results, summarized in Table I, demonstrate their performance across different prediction tasks.

Further, the Juno application begins with a simple email and password login. Users then select whether they are currently pregnant or in the postpartum stage and enter their due date or birth date, allowing the app to automatically calculate their current week. As shown in Figures 4 and 5, the app is organized into four main sections: Home, Fetal Development, Appointment Management, and User Profile.

The Home screen acts as the daily dashboard where users can log symptoms, health updates, and notes. The Fetal Development section provides weekly insights into the baby's growth and allows milestone tracking. Appointment Manage-ment helps users schedule medical visits and set reminders.

The User Profile stores personal details, notification prefer-ences, and logout options. Together, these features create a structured and supportive tool for navigating pregnancy and postpartum.

Table 1: Accuracies

Algorithm	Pre Term	C Section	Artificial Induc-tion	Labour Hours	Weight of Baby	NICU Stay
RF	81.5%	58.5%	97.0%	67.4%	68.1%	80.0%
DT	68.9%	61.5%	91.1%	59.2%	54.9%	68.1%
HGB	77.0%	51.1%	97.0%	70.3%	55.5%	80.0%
MNB	65.2%	51.9%	73.3%	46.6%	18.5%	49.6%
GNB	24.4%	54.9%	80.0%	35.5%	11.9%	29.6%
MLP	82.7%	47.4%	97.0%	46.0%	66.6%	74.9%
KN	82.2%	55.5%	97.0%	57.7%	62.2%	80.7%
SVM	75.5%	57.7%	89.6%	48.1%	54.0%	70.3%

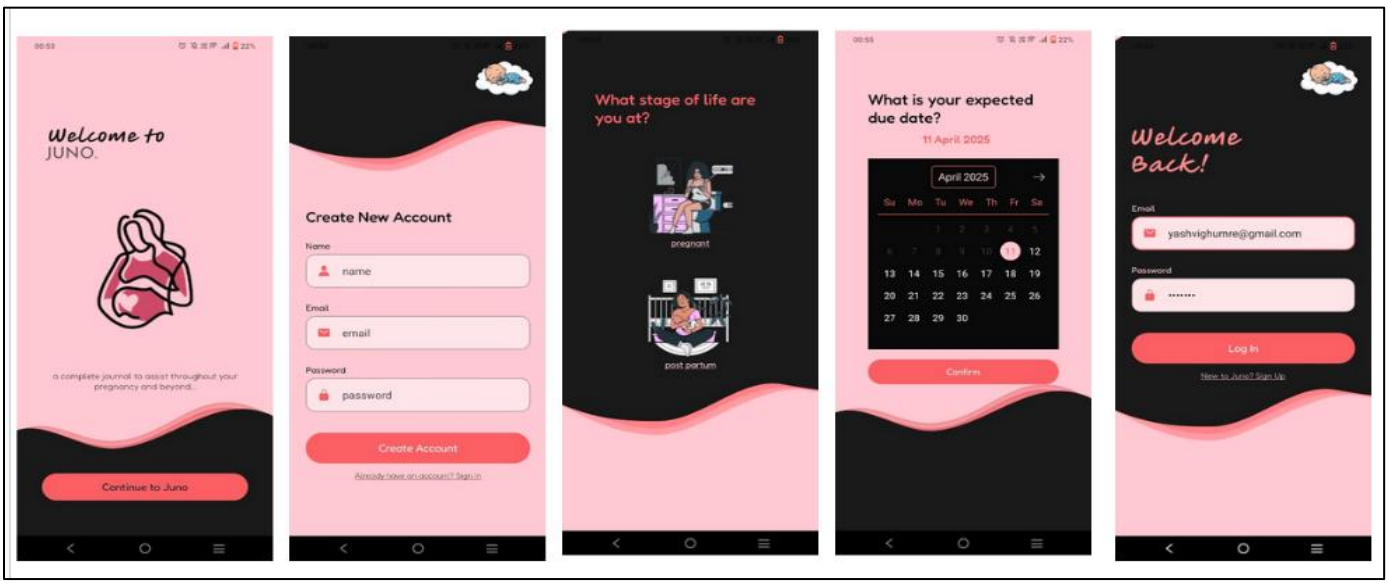

Fig 4: Onboarding

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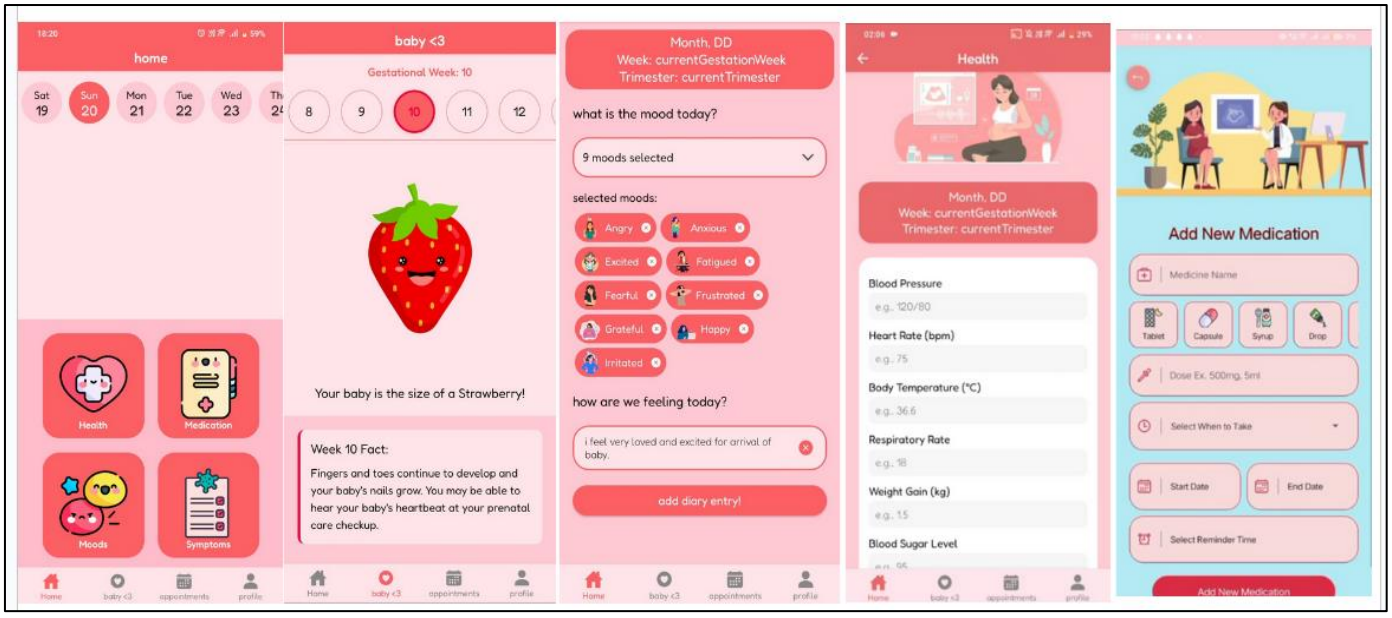

Fig 5: User Interface

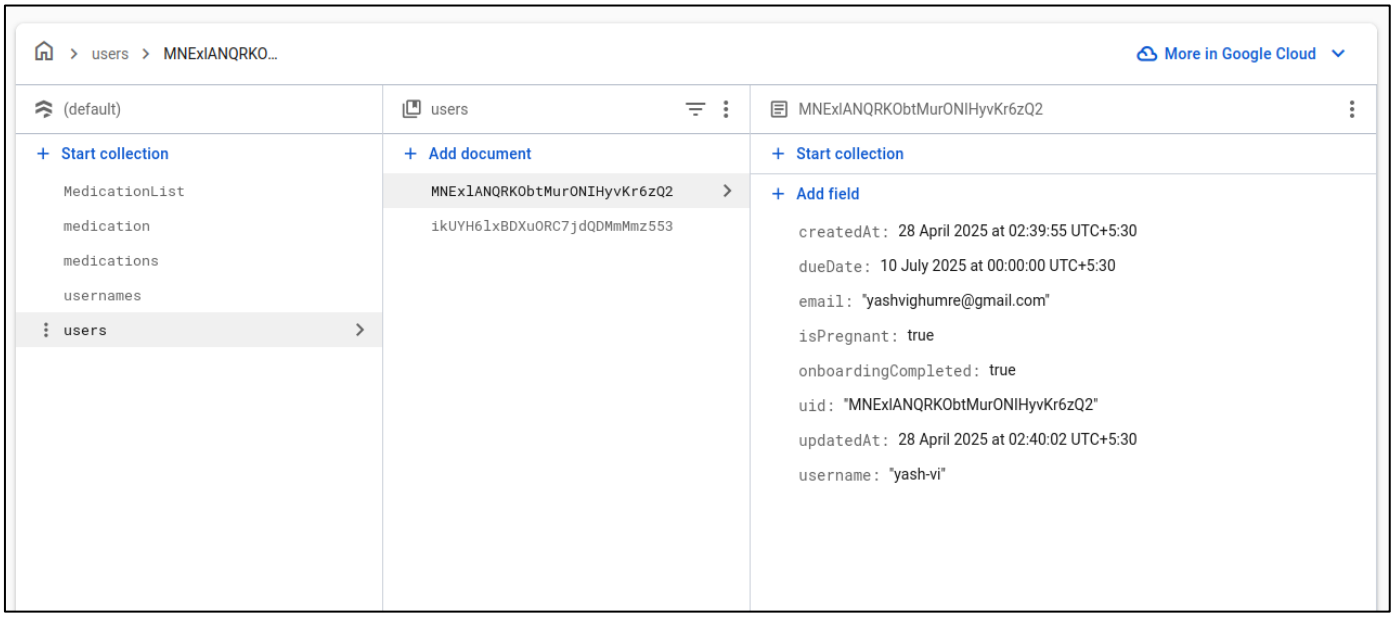

Fig 6: Backend

VII. CONCLUSION & FUTURE WORK

In conclusion, this project focuses on two key areas, firstly applying machine learning to analyze pre pregnancy data for early risk diagnosis and intervention, and secondly, an appli-cation for tracking daily health and lifestyle features during pregnancy and postpartum. Both the systems are designed to empower expecting parents to monitor health, stay informed and plan ahead for potential outcomes.

Moving forward, commitment to continual improvement and passion for best supporting expecting mothers drives us to explore new avenues for enhancing the effectiveness and utility of our application. We plan to bring the two parts of the project together to further personalize the in-app recommendations.

Additionally, we plan on exploring the possibility of incor-porating role management, to develop different interfaces for both the parents, and include personalised recommendations resources for the father to best support the mother.

Looking to the future, another exciting possibility is con-necting the application with gynaecologist's patient manage-ment systems, allowing patients to share their data and symp-toms seamlessly with their doctors. This integration could take smart healthcare to the next level, making maternal healthcare and risk prediction more proactive, personalized and effective.

Ultimately, this project has the potential to make pregnancy and postpartum care safer, smarter and more supportive for parents everywhere.

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We also extend our gratitude to our classmates and se-niors who provided valuable feedback and encouragement throughout the process. Finally, we would like to express our appreciation to our families for their unwavering support and understanding during the long hours and late nights spent working on this project. Thank you all for your contributions, support, and encouragement.

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