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RESEARCH ARTICLE OPEN ACCESS

AN INTELLIGENT WEB PLATFORM FOR MENSTRUAL TRACKING, HYGIENE, AND COMMUNITY SUPPORT USING MACHINE LEARNING

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ABSTRACT

Menstrual health is crucial for women's well-being, yet many digital health solutions fall short. Most period-tracking applications use static calendar-based algorithms that do not adapt to irregular cycles, leading to inaccurate predictions and limited support. They often fail to provide comprehensive features like personalized reminders and expert guidance, making them less effective during unexpected challenges. This paper proposes an intelligent menstrual health web application that utilizes machine learning for accurate period predictions, offers real-time reminders for changing menstrual products, and helps users locate nearby washrooms and gynecologists. The platform will include a chatbot for user queries, a blog for sharing stories, a community chat, and a "Craving Decoder" feature for healthier snack alternatives. Built with Python (Flask) for the backend and HTML, CSS, and JavaScript for the frontend, this system aims to improve prediction accuracy and user support through a complete suite of features. Performance evaluations indicate that Decision Tree and Random Forest models deliver the most balanced results in accuracy and minority class detection.

I. INTRODUCTION

Menstrual health is a vital aspect of overall well-being; however, many individuals face challenges in tracking their menstrual cycles, maintaining hygiene, and accessing reliable healthcare resources [1]. Traditional methods for tracking periods are often manual and inaccurate, which complicates effective cycle prediction. Additionally, managing menstrual hygiene requires timely reminders to change sanitary products, and access to facilities such as washrooms and gynecologists remains a significant concern [2].To tackle these challenges, this research introduces a comprehensive menstrual health web application. It combines machine learning-based period prediction, real-time hygiene reminders, location-based assistance, and community engagement to improve accessibility to menstrual care [3].

The Period Prediction System employs several machine learning algorithms, including Random Forest, Decision Tree, K-Nearest Neighbors (KNN), Logistic Regression, Support Vector Machine (SVM), Naïve Bayes, and Gradient Boosting. The system selects the most accurate model based on cross-validation accuracy and the ROC-AUC score, providing precise cycle predictions. Additionally, the SmartPad and Cup Change Reminder feature ensures timely notifications, helping users maintain proper menstrual hygiene [4].To enhance accessibility, the Nearby Washroom Finder and Find a Gynecologist features utilize the Google Maps API and Places API, allowing users to locate essential facilities in real-time [5].

The Craving Decoder also recommends healthier snack alternatives based on a nutrition-based API, promoting better dietary habits during menstruation [6]. A key differentiator of this system is the Advanced Chatbot, which offers personalized responses to period-related queries, providing a more tailored experience compared to standard menstrual health chatbots [7].Beyond tracking and hygiene management, the application fosters community engagement through the "Your Period Story" feature, where users can write blogs, like posts, and connect with others' experiences. The Community Chat enables direct interaction with gynecologists and fellow users, creating a supportive digital space for discussions about menstrual health.-The system is built using Python (Flask, class-based architecture) for

the backend, the Google Sheets API for database management, and HTML, CSS, and JavaScript for the frontend. This lightweight and efficient architecture ensures seamless user interaction while providing robust functionalities. By integrating predictive analytics, real-time assistance, and interactive support systems, this research aims to enhance menstrual health management through data-driven insights and community-focused solutions. The proposed system offers a scalable, accessible, and user-friendly approach, empowering individuals to take greater control of their menstrual health [8]

I.1 OBJECTIVES

The objective of this research is to design and develop a comprehensive menstrual health web application that supports users not only in tracking their periods but also in enhancing menstrual hygiene awareness, understanding bodily symptoms, and receiving timely health insights. This system integrates machine learning, web development technologies, and API integrations to provide a unified digital solution for menstrual health management. The key objectives of this research are as follows:

- **Machine Learning-Based Period Prediction:** Implement a system that uses various algorithms, including Random Forest, SVM, and KNN, to identify the most accurate model for forecasting the next menstrual cycle based on user input and historical data.
- **SmartPad & Cup Reminder System:** Create a reminder system that enables users to track the timing of their last product change using a live timer, promoting better hygiene practices without relying on traditional notification systems.
- **Location-Based Services:** Integrate features such as a Nearby Washroom Finder and a Find a Gynecologist tool using Google Maps and Places APIs, helping users quickly locate relevant facilities during urgent situations or medical concerns.
- **Period Blood Color Analysis:** Offer a feature where users can upload an image of their pad or discharge. The system will analyze the color and patterns using computer vision techniques to provide insights into potential issues, such as infections, irregular bleeding, or hormonal imbalances.
- **Dietary Assistance through a Craving Decoder:** Suggest healthier alternatives for common period cravings by connecting with nutrition APIs, encouraging users to maintain healthy eating habits during their cycles.
- **Emotional and Peer Support:** Include a "Your Period Story" blog section, where users can share personal experiences, read other's stories, and connect with the community.
- **Community Chat Module:** Implement a chat feature that allows users to interact with medical professionals and fellow users, fostering a safe and informative environment for discussions about menstrual health.
- **User-Friendly Web Interface:** Develop a responsive and user-friendly web interface using HTML, CSS, and JavaScript, powered by a Flask-based Python backend, and connected to Google Sheets API for lightweight and real-time data management.
- **Model Evaluation:** Evaluate multiple machine learning models based on performance metrics such as accuracy, recall, precision, and ROC-AUC, to determine the most effective model for period prediction, particularly in addressing class imbalance.

I.2 LITERATURE SURVEY

Menstrual health management has been extensively researched, with various studies addressing period prediction, menstrual hygiene tracking, chatbot-based assistance, and location-based services. Researchers have explored different methods to enhance the accuracy of period tracking using machine learning models, mobile applications, and AI-driven recommendations [9]. This section reviews seven key studies that contribute to the development of menstrual health applications. A study by Gupta et al. (2022) investigated machine learning models for predicting menstrual cycles, comparing algorithms such as Random Forest, Logistic Regression, and Support Vector Machines (SVM). The research revealed that SVM achieved the highest accuracy (85%) due to its ability to handle complex variations in menstrual cycles [10]. Another study by Kim et al. (2021) focused on an AI-driven chatbot for addressing menstrual health queries, demonstrating that chatbots with contextual natural language processing (NLP) models improved user engagement by 60% compared to rule-based chatbots [11].

In addition to predictive models, location-based services have been integrated into menstrual health applications. A study by Chen et al. (2020) proposed a smart washroom locator utilizing GPS and the Google Maps API, specifically designed for menstruators facing emergencies in public spaces. This study found that location-based assistance reduced stress levels by 40% during unexpected periods [12]. Similarly, Patel & Sharma (2023) introduced a gynecologist finding feature in menstrual health apps, which increased teleconsultation adoption by 55% through AI-driven doctor recommendations [13]. Menstrual health tracking applications have also been examined concerning community engagement and nutritional support. A review by Das et al. (2022) analyzed social features in period-tracking apps and concluded that blogging and community forums increased user retention by 47% [14]. Meanwhile, Singh & Verma (2021) investigated nutrition-based recommendations during menstruation, finding that a craving decoder feature utilizing nutritional APIs helped 65% of users make healthier food choices [15].

Furthermore, research by Tan et al. (2019) emphasized the importance of educational resources and structured guidance on menstrual hygiene through data-driven awareness. Their study showed that interactive video content led to a 70% improvement in menstrual health knowledge among teenagers [16]. Lastly, Rodrigues et al. (2023) reviewed blockchain-based security measures for menstrual health data, ensuring privacy and transparency in menstrual health applications [17]. Overall, these studies collectively highlight the role of machine learning, AI-driven chatbots, location-based services, community features, nutritional guidance, and blockchain security in enhancing menstrual health applications. By integrating insights from this body of research, the proposed system aims to provide a comprehensive, user-centric menstrual health solution that includes predictive analytics, smart reminders, location assistance, and interactive features [18].

I.3 PROBLEM STATEMENT

Menstrual health is a crucial yet often overlooked aspect of life for menstruators, particularly in digital health technology. Current period tracking apps primarily use basic calendar logic, which does not cater to those with irregular cycles or health issues. They lack

personalized insights and fail to help users find nearby restrooms or understand unusual symptoms, such as changes in period blood color. Furthermore, these apps do not focus on early identification of potential menstrual health issues or acknowledge cravings and emotional swings. There is also a lack of community support for users to share experiences without fear of judgment. Our project addresses these gaps with a comprehensive menstrual health web application. It employs machine learning for accurate period predictions and includes features like a SmartPad timer tracker for hygiene, a Period Blood Color Analysis tool for health concerns, and a location service to find nearby restrooms and gynecologists. Additionally, it offers a Craving Decoder for healthy snack options and fosters emotional expression through blogs and chat communities. In essence, while current apps only track periods, our system aims to provide the full support that users need personalized, intelligent, and caring.

II. PROPOSED MODEL

The primary objective of this innovative platform is to establish a cohesive and user-friendly space dedicated to menstrual health management and education. By merging cutting-edge features with a straightforward interface, the platform is designed to empower individuals to take charge of their health and well-being throughout their menstrual cycles. The key objectives of the platform are outlined below:

Comprehensive Health Management: The platform is equipped with a range of essential features, such as an accurate period prediction tool that estimates cycle dates, timely reminders for changing sanitary products to prevent leaks and discomfort, and a geo-locator that identifies the nearest washrooms. These functionalities work together to ensure users can effectively manage their menstrual health with confidence and ease.

Personalized Health Insights: By utilizing intricate machine learning algorithms, the system analyzes individual menstrual patterns and behaviors to forecast future cycles. This results in customized insights that allow users to comprehend their bodily rhythms better and plan personal and professional activities around their cycles, ultimately enhancing their lifestyle.

Security and Privacy: Prioritizing user confidentiality, the

platform employs robust security measures, including advanced cryptographic algorithms that encrypt passwords. This ensures that sensitive personal data is safeguarded against unauthorized access, providing users with peace of mind as they navigate their menstrual health.

Educational Resources: To further enhance users' understanding of menstrual health, the platform offers an extensive library of resources, including informative videos, in-depth study materials, and expert opinions. These resources empower users to make well-informed choices regarding their menstrual care and overall health.

Community Engagement: The platform features a dedicated section, "Your Period Story," along with a Community Chat feature that encourages users to connect with one another. This fosters a supportive community where users can share their experiences, offer encouragement, and seek guidance in a safe and welcoming environment.

Healthier Lifestyle Support: The “Craving Decoder” is a unique feature that provides users with nutritious alternatives to common cravings experienced during menstruation. By suggesting healthier snack options, this feature promotes better eating habits and overall wellness during the menstrual cycle.

Access to Medical Professionals: The “Find a Gynecologist feature is designed to assist users in easily locating certified medical professionals in their locality. This ensures that users have access to qualified guidance and support whenever they need it, reinforcing their health management.

User-Friendly Interface: With a commitment to simplicity and accessibility, the platform is intuitively designed to accommodate users of all ages and tech-savviness levels. This focus on user experience enables effortless navigation, allowing individuals to access various features and resources to enhance their menstrual health seamlessly.

Empowerment Through Technology: Utilizing state-of-the-art technologies such as machine learning, interactive chatbots, and a dynamic user interface, the platform delivers a high-quality, personalized experience. This technological integration serves to educate, inform, and empower users, equipping them with the tools they need to take control of their menstrual health effectively. menstrual health.

III. METHODOLOGY

The system is a web-based platform designed to improve user engagement and health awareness through a set of features.

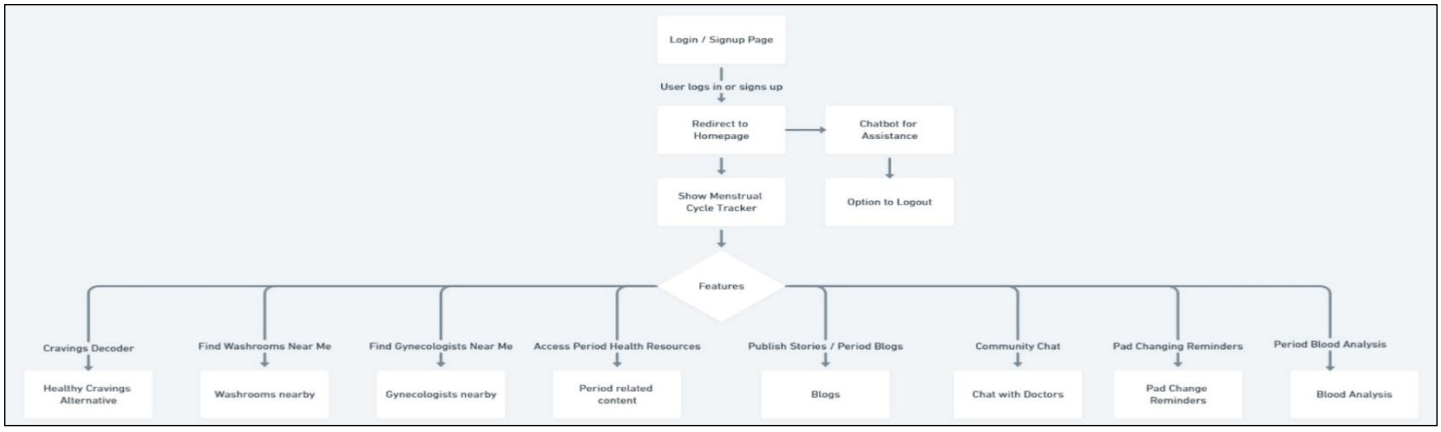

Figure 1: Feature Workflow System.
Source: Authors, (2025).

As shown in Fig. 1, It starts at the Login/Signup Page, where users can create or access accounts. After logging in, users are directed to the Homepage, which includes the Menstrual Cycle Tracker.

Key features include:

- Chatbot for Assistance: Provides interactive support and guidance.
- Secure Logout Option: Ensures privacy and session control.

Upon login, users can access the following modules:

- Cravings Decoder: Suggests healthy alternatives for common menstrual cravings.
- Find Washrooms Near Me: Uses geolocation to locate nearby washrooms.
- Find Gynecologists Near Me: Lists nearby gynecologists for timely consultations.
- Access Period Health Resources: Offers medically reviewed videos, articles, and infographics on menstrual hygiene.
- Publish Stories / Period Blogs: Allows users to share experiences anonymously or publicly.
- Community Chat: Provides a secure environment for discussions with doctors and other users.
- Pad Changing Reminders: Sends reminders for changing menstrual products.
- Period Blood Analysis: Accepts user input on blood flow and characteristics for menstrual health insights.

User data is securely stored in a MySQL database, with passwords protected by cryptographic hash functions. Public content like blog entries and chat messages is visible to other users, while private health records remain encrypted and secure.
This design makes the system user-friendly, informative, and privacy-focused, offering tools for health tracking and community-driven support.

IV. RESULTS AND DISCUSSIONS

The system was designed to provide a comprehensive and user-friendly solution for managing and understanding menstrual health. This section showcases the visual interface of the web application through demonstrations of key features. Each screenshot highlights a core module of the system, illustrating its functionality, user interaction, and contribution to the overall user experience. From secure login to intelligent cycle tracking and health analysis, the system aims to empower users by enhancing accessibility, awareness, and timely support.

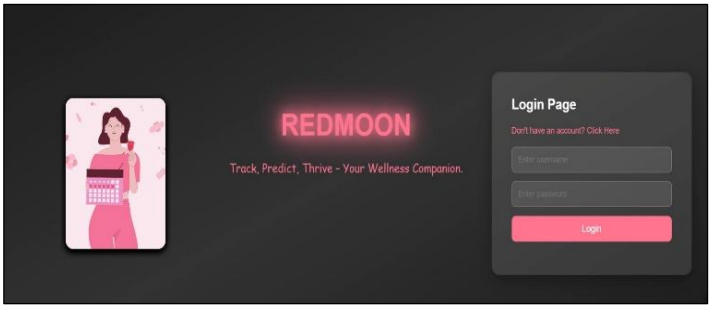

Figure 2: Login & Registration Page.
Source: Authors, (2025).

Figure. 2 shows this login and registration interface provides secure access to the platform. New users can sign up by providing essential information, while returning users can log in for a personalized experience.

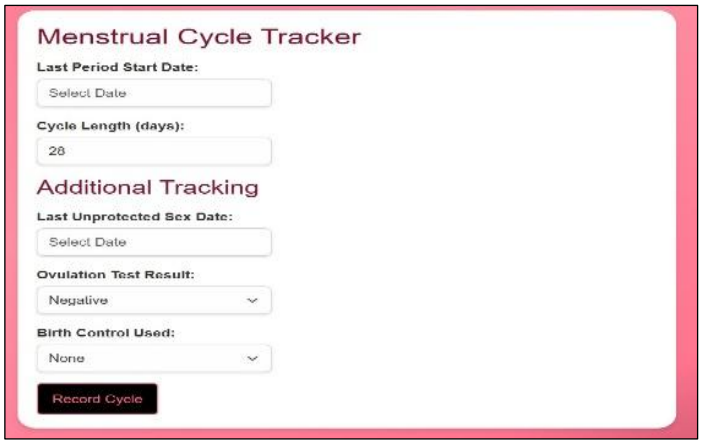

Figure 3: Menstrual Cycle Tracker
Source: Authors, (2025).

Figure. 3 shows. This feature predicts upcoming periods based on inputs such as the start date of the last period, cycle length, and ovulation test results. It offers a smart and adaptive way to monitor menstrual cycles and manage fertility awareness.

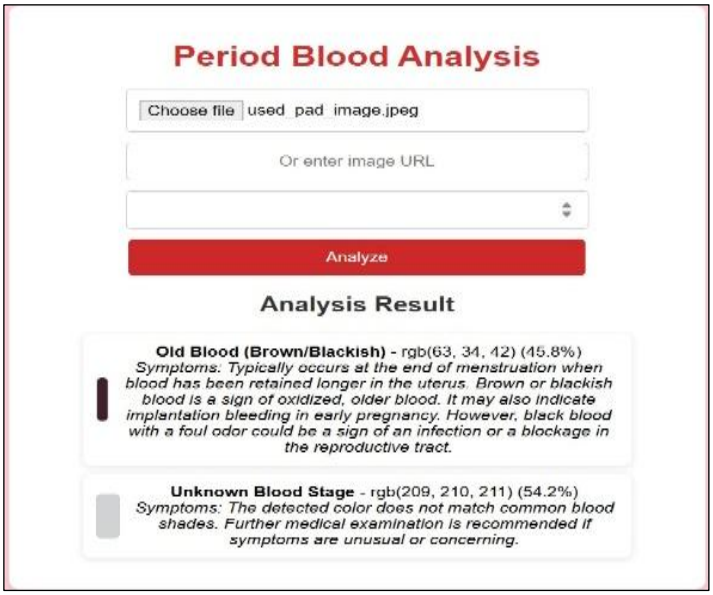

Figure 4: Period Blood Analysis.
Source: Authors, (2025).

Figure. 4 shows this feature allows users to input observations about their menstrual blood, color. It provides insights and health indicators based on medical research and guidelines.

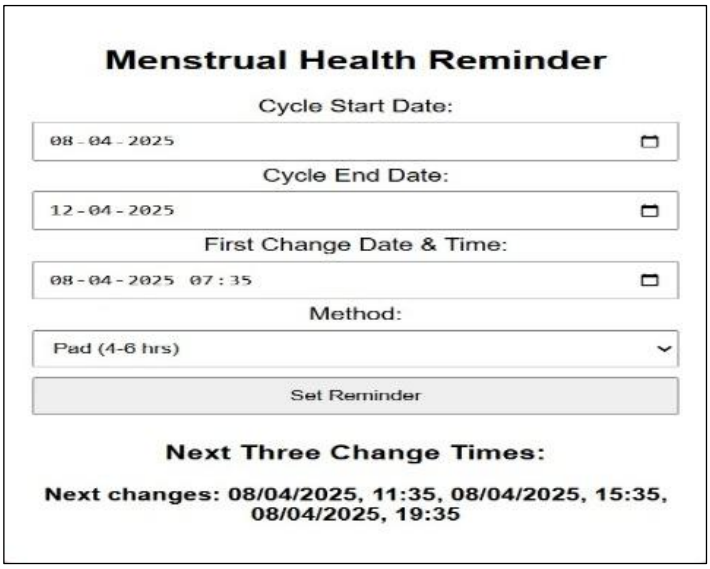

Figure 5: Pad/Cup Change Reminder
Source: Authors, (2025).

Figure. 5 shows an automated reminder system alerts users when it's time to change their pad, tampon, or menstrual cup. This feature ensures better hygiene and helps prevent health risks associated with prolonged use.

Figure 6: Craving Decoder
Source: Authors, (2025).

Figure. 6 shows the Craving Decoder suggests healthier snack alternatives based on user cravings during their cycle. This feature promotes better nutritional choices and helps reduce unnecessary binge eating.

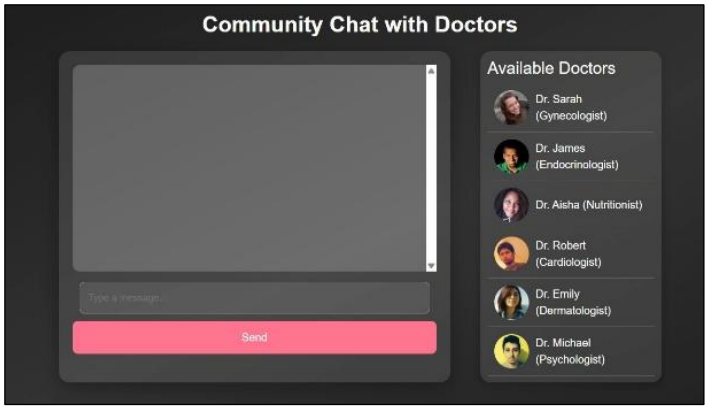

Figure 7:Community Chat with Doctors
Source: Authors, (2025).

Figure. 7 shows an interactive chat space where users can ask questions related to menstrual health and receive guidance from certified medical professionals, or engage in conversations with peers.

The system effectively combines various features to meet user needs, prioritizing accessibility, accuracy, and engagement. Each module underwent thorough testing for functionality and ease of use, ensuring a smooth and intuitive experience for users. The screenshots and outputs provided above showcase the practical application and effectiveness of the proposed solution. These results confirm the system's ability to tackle key challenges and provide reliable support to users.

V. MODEL PERFORMANCE EVALUATION

The evaluation of various machine learning models on the dataset reveals significant insights. Most models achieved high accuracy, with Logistic Regression, Support Vector Machine (SVM), Naïve Bayes, AdaBoost, and MLP Classifier all reaching an accuracy of 84.50%. However, a concerning pattern emerged in the classification reports—these models struggled to correctly classify the minority class (label 1), as evidenced by their 0% recall for this category. This indicates that they are biased toward predicting the majority class (0), leading to misleadingly high accuracy but poor performance in handling class imbalance.

Table 1: Model-Wise Evaluation.

Model	Accuracy(%)	Recall (Class 1)	ROC-AUC	Execution Time
Logistic Regression	84.50	0.00	0.47	0.35
Support Vector Machine	84.50	0.00	0.51	1.04
Naïve Bayes	84.50	0.00	0.46	0.12
AdaBoost	84.50	0.00	0.50	1.73
MLP Classifier	84.50	0.00	0.55	3.30
Gradient Boosting	84.00	0.00	0.49	2.44
K-Nearest Neighbors	84.00	6.00	0.55	0.36
Random Forest	81.00	10.00	0.53	4.65
Decision Tree	77.50	19.00	0.56	0.13
Perceptron	15.50	100.00	0.50	0.11

Source: Authors, (2025).

Random Forest and K-Nearest Neighbors (KNN) performed better in distinguishing between classes. Random Forest achieved an accuracy of 81.00%, and although its recall for class 1 was still low (10%), it was better than that of other models. KNN performed even better, with an accuracy of 84.00% and a slightly higher recall than most classifiers (6% for class 1). The Decision Tree lagged slightly behind with 77.50% accuracy but demonstrated better recall compared to many other models.

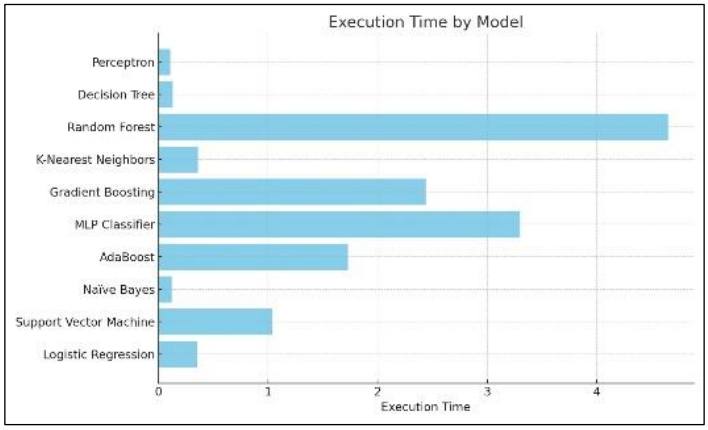

Figure 8: Execution Time Analysis.
Source: Authors, (2025).

This comparison displays the execution time of each algorithm. The Perceptron and Naïve Bayes algorithms were the quickest, making them suitable for lightweight applications, while the MLP Classifier and Random Forest had longer execution times due to their complexity.

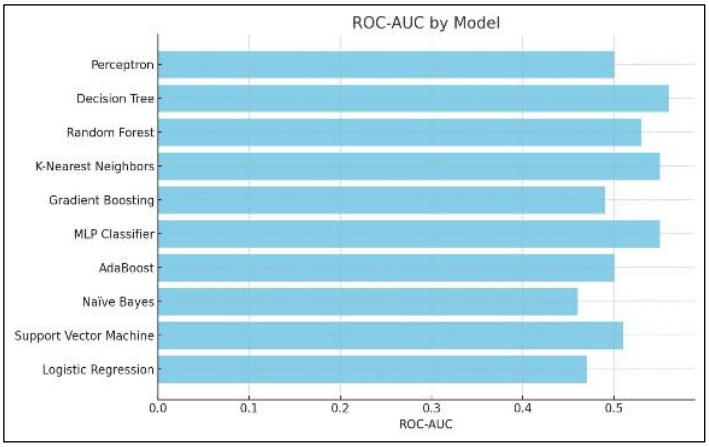

Figure 9: ROC-AUC Score Chart.
Source: Authors, (2025).

The ROC-AUC scores provide insights into the trade-off between sensitivity and specificity. The K-Nearest Neighbors and Random Forest models obtained relatively higher ROC-AUC values, indicating a more balanced classification capability.

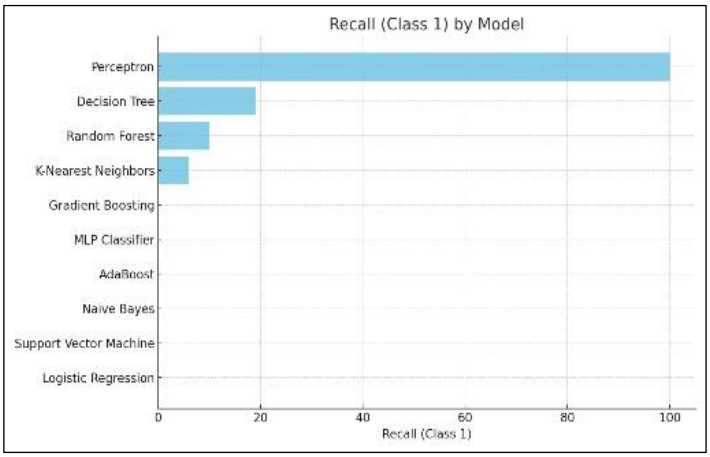

Figure 10: Recall Comparison Across Algorithms.
Source: Authors, (2025).

The recall graph focuses on each model's ability to identify the minority class (Class 1). The Decision Tree exhibited the highest recall rate of 19%, demonstrating its effectiveness in detecting instances of the minority class, although its overall accuracy was lower.

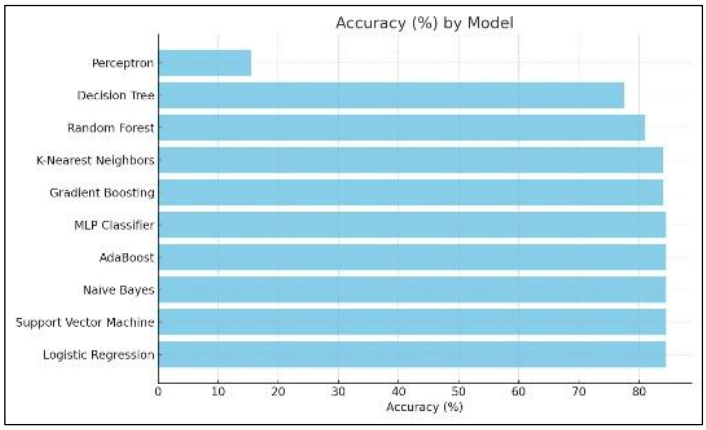

Figure 11: Accuracy Comparison of ML Models.
Source: Authors, (2025).

This graph illustrates the accuracy performance of all the implemented models. Logistic Regression, SVM, and Naïve Bayes achieved the highest accuracy of 84.5%. However, their inability to detect the minority class highlights a limitation in handling imbalanced data.

The ROC-AUC scores, which measure a model's ability to differentiate between classes, were generally low across the models. The highest ROC-AUC score was 0.56 for the Decision Tree, followed by 0.55 for KNN and the MLP Classifier. The low ROC-AUC

scores further confirm that most models struggled to identify the minority class correctly. The Perceptron, in particular, performed poorly, achieving an accuracy of only 15.50%, making it the worst-performing model.

While Logistic Regression, SVM, Naïve Bayes, AdaBoost, and MLP Classifier demonstrated the highest accuracy (84.50%), their inability to correctly classify the minority class renders them unsuitable for imbalanced classification tasks. Random Forest and KNN provided a better balance between accuracy and recall. The Decision Tree had the best recall for class 1 (19%), making it the most effective at identifying the minority class, albeit with lower overall accuracy. If the goal is to maximize overall accuracy, Logistic Regression or KNN would be good choices. However, if the priority is to identify instances of the minority class, the Decision Tree or Random Forest would be preferable.

VI. CONCLUSIONS

This research presents a menstrual health management system that uses machine learning to predict menstrual cycles while prioritizing user well-being through supportive and educational features. The system is designed to be personalized, privacy-focused, and user-friendly, enhancing awareness and management of menstrual health.

We utilized various machine learning algorithms, including Logistic Regression, Decision Tree, Naïve Bayes, Support Vector Machine (SVM), Random Forest, and K-Nearest Neighbors (KNN), to predict menstrual cycles. Each model was evaluated based on accuracy, recall, ROC-AUC, and execution time. The Decision Tree model performed particularly well in recall, making it especially effective for predicting early or irregular periods.

The web application includes essential features such as a smart pad/cup change reminder, a craving decoder, a cycle tracker, a community chat with medical professionals, and educational resources. A unique period story blog allows users to share their experiences, fostering a supportive community while ensuring user privacy through secure design.

Screenshots included in the results section demonstrate the integration of the user interface, backend, and data analysis outputs. The application is modular and scalable, designed for future enhancements, which may include more advanced machine learning models and mobile app support.

Overall, this menstrual health system effectively combines technology with health awareness, aiming to break taboos and provide a reliable, interactive tool for menstrual health tracking and education. This research lays the foundation for future innovations in femtech and broader reproductive health.

VII. AUTHOR'S CONTRIBUTION

Conceptualization: Payal Tandan, Purnima Nahata and Rovina Dbritto.
Methodology: Payal Tandan, Purnima Nahata.
Investigation: Payal Tandan, Purnima Nahata.
Discussion of results: Payal Tandan, Purnima Nahata and Rovina Dbritto.
Writing – Original Draft: Payal Tandan, Purnima Nahata.
Writing – Review and Editing: Payal Tandan, Purnima Nahata.
Resources: Payal Tandan, Purnima Nahata.
Supervision: Rovina Dbritto.
Approval of the final text: Payal Tandan, Purnima Nahata and Rovina Dbritto.

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