MATERNAL HEALTHCARE TECHNOLOGY

Smart Maternal Care Companion

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Published November 2026

Abstract

Smart Maternal Care Companion is a web-based healthcare support system designed to help pregnant women manage important pregnancy-related activities through a single, user-friendly platform. Pregnancy requires regular monitoring, proper nutrition, medication adherence, vaccination, medical appointments, and awareness of maternal health. Managing these activities manually or through multiple applications can be difficult and time-consuming. The proposed system provides a centralized platform for organizing pregnancy information and monitoring important healthcare activities. The system includes modules such as Pregnancy Tracker, Health Log, Medicine Reminder, Diet Planner, Vaccination Tracker, Doctor Appointment Management, and Emergency SOS. It also provides a framework for automatic health-data monitoring through supported wearable devices and health platforms. Health parameters such as heart rate, sleep, weight, blood pressure, and blood sugar can be stored and displayed when corresponding data sources are available. The system is developed using React.js for the frontend, Node.js and Express.js for backend services, and MongoDB for data storage. REST APIs are used for communication between the frontend and backend. The main objective of the system is to provide an accessible and organized digital platform that reduces manual healthcare management and brings essential pregnancy-related activities into one application. The proposed platform can be extended with AI-based personalized recommendations, multilingual support, mobile applications, advanced wearable integration, and real-time doctor consultation.

Keywords: Maternal Healthcare; pregnancy monitoring; mHealth; health monitoring; wearable devices; React.js; Node.js; MongoDB

1 Introduction

Pregnancy is an important period that requires continuous attention to maternal health, nutrition, medication, medical consultations, vaccination, and general well-being. Regular antenatal care helps identify potential complications and supports a positive pregnancy experience [1]. The World Health Organization emphasizes regular contact with skilled healthcare personnel during pregnancy and also recognizes the potential of digital interventions such as appointment reminders to support maternal healthcare [2].

With the increasing availability of smartphones, web applications, and wearable devices, digital healthcare systems can provide additional support for pregnancy management. Mobile health applications are already being used for pregnancy education, health tracking, communication, and reminders. However, studies have found that many pregnancy applications do not provide all desired functions in a single platform. In one systematic evaluation, more than 60% of evaluated applications lacked comprehensive coverage of health promotion, communication, health tracking, and notification/reminder functions [3].

The Smart Maternal Care Companion is proposed to address this limitation by combining multiple maternal healthcare functions into a centralized platform. The system provides pregnancy tracking, health monitoring, medication reminders, diet planning, vaccination tracking, doctor appointment management, and emergency support.

The main contributions of the proposed system are:

- Development of an integrated maternal healthcare management platform.
- Centralized management of pregnancy-related activities.
- Health-log functionality for monitoring supported health parameters.
- Reminder-based management of medicines and appointments.
- Diet and vaccination management.
- Emergency SOS support.
- A framework for integrating wearable and health-platform data.

2 Related work

2.1 Mobile health applications for pregnancy

Mobile health applications have become an important digital tool for supporting pregnant women. Frid et al. [3] evaluated pregnancy applications and found that existing applications provide different combinations of health education, tracking, communication, and reminders. However, many applications lack a comprehensive set of features.

Haddad et al. [4] reviewed mobile health technologies used in antenatal care and reported that such technologies have shown promising results in areas including healthcare-service adherence, pregnancy information, risk identification, and user satisfaction.

A more recent systematic analysis also found that pregnancy applications vary considerably in their functionality, evidence base, and quality [5]. This indicates the importance of designing healthcare applications with clear functionality and reliable healthcare information.

2.2 Digital interventions for maternal healthcare

Digital interventions can support healthcare delivery through mobile phones, computers, and other digital devices. WHO guidelines describe digital interventions as tools that can contribute to health-system improvement, while also emphasizing that digital technology should complement rather than replace functioning healthcare systems [2].

A systematic review of systematic reviews found that mHealth interventions have been studied for several maternal-health areas, including gestational weight management, diabetes during pregnancy, maternal healthcare utilization, mental health, and behavioral modification [6].

2.3 Wearable health monitoring

Wearable sensors provide another opportunity for maternal health monitoring. A systematic review of wearable sensors identified applications for monitoring maternal and fetal health, physical activity, and other pregnancy-related measurements [7]. However, the review also noted that many wearable-sensor studies were conducted in controlled environments, indicating the need for further practical integration.

The proposed CareBloom system therefore considers wearable and health-platform integration as an additional source of supported health information rather than relying entirely on manual data entry.

2.4 Research gap

Existing research demonstrates the usefulness of mobile applications, digital reminders, health monitoring, and wearable technologies. However, these functions are frequently distributed across different applications or platforms.

The proposed system attempts to address this gap by providing a centralized platform containing:

- Pregnancy tracking
- Health monitoring
- Medicine reminders
- Diet planning
- Vaccination tracking
- Doctor appointment management
- Emergency SOS
- Supported wearable-health integration

3 Methodology

3.1 System design

The proposed system follows a client-server architecture. The React.js frontend provides the user interface, while Node.js and Express.js provide backend services. MongoDB stores user information and healthcare records.

The overall architecture of the system is shown in Figure 1.

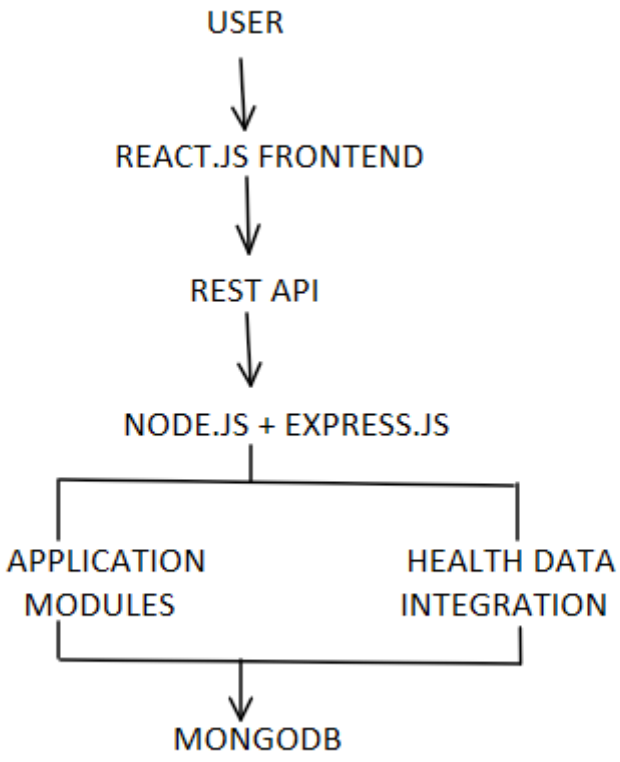


Figure 1. Overall architecture of the Smart Maternal Care Companion.

For supported wearable health integration, data pass along the following path: Fire-Boltt smartwatch → Da Fit → Google Fit → Health Connect → Android Health Bridge → CareBloom REST API → MongoDB → React health dashboard.

3.2 System modules

3.2.1 User registration and login

The registration module allows users to create accounts using personal information and credentials. Input validation is applied to important fields such as name, age, phone number, email, and password.

3.2.2 Pregnancy tracker

The Pregnancy Tracker provides pregnancy-related information and helps users monitor pregnancy progress. It can be extended to calculate pregnancy weeks and important milestones based on the user's pregnancy information.

3.2.3 Health log

The Health Log stores and displays supported health parameters such as:

- Heart rate
- Sleep duration
- Weight
- Blood pressure

- Blood sugar

The system can retrieve the latest health record from the backend using a REST API.

3.2.4 Medicine reminder

The Medicine Reminder allows users to maintain medication schedules and receive reminders for prescribed medicines.

3.2.5 Diet planner

The Diet Planner provides pregnancy-related dietary guidance and helps users organize their daily diet requirements.

3.2.6 Vaccination tracker

This module maintains vaccination information and helps users keep track of important vaccination records.

3.2.7 Doctor appointment

The appointment module allows users to maintain information about doctor consultations and scheduled appointments.

3.2.8 Emergency SOS

The Emergency SOS module provides quick access to emergency support or predefined emergency contacts.

3.2.9 Wearable health integration

The system is designed to receive supported health information through connected wearable and health platforms. The current integration approach follows the path:

Smartwatch → Da Fit → Google Fit → Health Connect → Android Bridge → CareBloom Backend.

The actual data available depends on the capabilities of the connected device and health platform.

4 Implementation

4.1 Frontend

The frontend is implemented using React.js. React components are used to create individual modules such as registration, login, pregnancy tracking, health monitoring, medicine reminders, diet planning, vaccination tracking, appointments, and emergency support.

Bootstrap is used for responsive user-interface design.

4.2 Backend

The backend is implemented using Node.js and Express.js. REST APIs handle communication between the frontend and database.

For example, the health-monitoring API provides POST /api/health/sync for storing health records and GET /api/health/latest/:userId for retrieving the latest health record of a user.

4.3 Database

MongoDB is used as the database because it provides flexible document-based storage.

A health record can contain the fields userId, heartRate, sleepHours, weight, bloodPressure, bloodSugar, source and recordedAt.

The userId connects the health record to the corresponding registered user.

5 Results

The developed prototype was tested for user registration, backend communication, database storage, health-data retrieval, and frontend health-data display. The results of the functional tests are summarized in Table 1.

Table 1. Functional testing of the proposed system.

Module	Test Function	Result
Registration	Create new user	Successful
Login	Authenticate registered user	Successful
Pregnancy Tracker	Display pregnancy information	Successful
Health Log	Retrieve health record	Successful
Medicine Reminder	Store reminder information	Successful
Diet Planner	Display diet information	Successful
Vaccination	Maintain vaccination information	Successful
Appointment	Maintain appointment information	Successful
Emergency SOS	Display emergency support	Successful
MongoDB	Store healthcare records	Successful
Health API	Sync and retrieve health data	Successful

The Health Log was successfully connected to the backend API and displayed health information retrieved from MongoDB. A sample health record contained a heart rate of 78 BPM, sleep duration of 7.5 hours, weight of 61.2 kg, blood pressure of 118/76 mmHg, and blood sugar of 96 mg/dL.

The prototype therefore demonstrates the basic end-to-end data flow: health data → backend API → MongoDB → React frontend → health dashboard.

Wearable integration was also explored through a Fire-Boltt smartwatch, Da Fit, Google Fit, and Health Connect. Supported activity data can be transferred through these platforms. However, the availability of individual measurements depends on the capabilities of the wearable and connected health applications.

6 Discussion

The proposed system combines several maternal healthcare functions into one platform. This addresses an important limitation identified in existing pregnancy applications, where different

applications may focus on separate functions such as education, tracking, communication, or reminders.

The integration of wearable and health-platform data can further reduce manual entry for supported measurements. However, wearable integration should be treated carefully because not every device provides every health parameter. In particular, the proposed system should display only measurements that are actually available from a connected and supported source.

The system is intended as a health-management and support platform, not as a replacement for professional medical diagnosis or treatment. This is consistent with WHO guidance that digital health technologies should complement healthcare systems rather than replace them [2].

7 Conclusion

The Smart Maternal Care Companion provides an integrated digital platform for managing pregnancy-related healthcare activities. The system combines pregnancy tracking, health monitoring, medicine reminders, diet planning, vaccination tracking, doctor appointments, and emergency support in a single application.

The implementation using React.js, Node.js, Express.js, and MongoDB demonstrates the feasibility of developing a centralized maternal healthcare-management system. The health-monitoring module also demonstrates how supported health data can be retrieved from a backend database and displayed through a web dashboard. Integration with wearable and health platforms provides an additional pathway for reducing manual health-data entry.

Future work can extend the system with AI-based personalized recommendations, multilingual support, mobile application development, advanced wearable integration, improved health-data synchronization, secure cloud deployment, and real-time doctor consultation. Additional validation with healthcare professionals and real users would also be important before clinical use.

Acknowledgment

The successful completion of this project, “Smart Maternal Care Companion,” would not have been possible without the guidance, support, and encouragement of many people. We would like to express our sincere gratitude to our project guide for providing valuable guidance, continuous support, and constructive suggestions throughout the development of this project. Their guidance helped us understand the requirements, improve the system design, and successfully implement the proposed solution. We are grateful to the Head of the Department for providing the necessary facilities, resources, and encouragement required to carry out this project. We would also like to thank the Principal and faculty members of our institution for their support and for providing a suitable academic environment for completing this work. We extend our sincere thanks to our friends and classmates for their valuable suggestions, technical assistance, and encouragement during the development and testing of the system. Finally, we express our heartfelt gratitude to our parents and family members for their constant support, motivation, and encouragement throughout the project. We are thankful to everyone who directly or indirectly contributed to the successful completion of the Smart Maternal Care Companion (CareBloom) project.

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