

Computer Science Department
Senior Project Final Report document – Spring 2025

Title of the project:	BopeTracker: Pregnancy Tracking App
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Executive Summary (10%)	
<p>Our project focuses on developing a comprehensive pregnancy tracking mobile application designed to support pregnant women throughout their pregnancy journey. The app provides personalized weekly updates on fetal development, a customizable calendar, health tracking tools, an AI-powered doctor chat, and a journal for medical records. The problem addressed is the lack of integrated, user-friendly tools that consolidate pregnancy-related information and health tracking in one platform.</p> <p>Problem Statement: Pregnant women need a centralized, user-friendly platform to track their pregnancy journey, access reliable health information, manage appointments, and monitor health metrics—while also enabling partner involvement.</p> <p>Key Objectives:</p> <ul style="list-style-type: none"> - Provide personalized weekly pregnancy updates (baby’s development, health tips). - Offer tracking tools (kick counter, contractions, weight, sleep). - Automate calendar management (appointments, protocol-based reminders). - Enable secure data storage (medical records, scans, journal entries). - Facilitate partner involvement via shared access. - Include an AI doctor chatbot for pregnancy-related queries. <p>Methodology:</p> <ul style="list-style-type: none"> - Frontend: Flutter for cross-platform compatibility. - Backend: Node.js + Express for API handling. - Database: PostgreSQL for structured data storage. - Features: User authentication, AI chat, PDF uploads, partner linking, and automated calendar events. <p>It resulted in a comprehensive all-purpose pregnancy app that included tracking pregnancy progress and health metrics, streamlining appointment and document management, enhancing engagement of partners, and providing AI-powered medical guidance.</p>	

The app follows a structured computing-based solution approach, addressing real-world needs through systematic design, development, and validation. We identified key challenges in pregnancy management which included information fragmentation, lack of tracking tools, and limited partner involvement. Also we defined functional needs (weekly updates, AI chat, calendar automation) and non-functional needs (security, scalability, usability).

Introduction (10%)

Pregnancy is a complex journey requiring continuous health monitoring, access to reliable medical information, and coordination between expectant mothers, partners, and healthcare providers. However, many women struggle with:

- **Fragmented information** – Reliance on multiple sources for tracking pregnancy progress.
- **Manual tracking difficulties** – Logging kicks, contractions, weight, and appointments is time-consuming and error-prone.
- **Limited partner involvement** – Partners often lack real-time updates on pregnancy milestones and medical appointments.
- **Lack of personalized guidance** – Generic advice may not address individual concerns, leading to anxiety or misinformation.

The motivation for this project comes from:

- The need for a centralized, easy-to-use platform that consolidates pregnancy tracking.
- The growing reliance on mobile health solutions for maternal care, especially in remote or busy lifestyles.
- The potential of AI-driven assistance to provide instant, reliable answers to common pregnancy questions.
- The desire to improve partner engagement, ensuring better emotional and logistical support.

This project contributes to:

- Empowering pregnant women with structured health insights.
- Reducing stress by automating and simplifying data logging.
- Enhancing medical compliance through protocol-based appointment scheduling.
- Encouraging partner participation, fostering a supportive pregnancy experience.
- Advancing digital healthcare by integrating AI, secure data storage, and cross-platform accessibility.

As for the solution, we created a comprehensive pregnancy tracking mobile app called BopeTracker that focuses on these points:

- Personalized weekly updates
- Health trackers
- AI-powered chat

- Secure journal
- Smart calendar
- Partner access

Background and Related Work(20%)

During the discussion of the problem, we analyzed the market of pregnancy tracking applications such as What to Expect, Ovia Pregnancy, Flo, and etc. Even though they offered quite decent functionalities, they still had some limitations:

- **Generic content** – Many provide static weekly updates without personalization.
- **Limited automation** – Few integrate protocol-based medical reminders (e.g., scan schedules).
- **No partner collaboration** – Most apps lack shared access for partners.
- **Minimal AI integration** – Few use AI chatbots for medical queries.
- **Data silos** – Medical records (ultrasounds, lab reports) are rarely stored securely in-app.

We also compared and contrasted various approaches to justify our methodology for this project. The results are presented in the tables.

Frontend:

Approach	Pros	Cons	Our selection
Native	<ul style="list-style-type: none"> - Full OS integration - High performance 	<ul style="list-style-type: none"> - Development would be doubled to both OS 	<u>NO</u> . Longer dev time and high cost
Hybrid	<ul style="list-style-type: none"> - JS ecosystem - Cross-platform 	<ul style="list-style-type: none"> - Native module dependant - Bottlenecks on performance 	<u>NO</u> . UI rendering is slow
Flutter	<ul style="list-style-type: none"> - Fast rendering - Codebase is single - UI customization 	<ul style="list-style-type: none"> - Larger app size - Scarcity of third-party libraries 	<u>YES</u> . Best balance between maintainability and speed

Backend:

Approach	Pros	Cons	Our selection
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Django	<ul style="list-style-type: none"> - Support on ORM - Rapid development 	<ul style="list-style-type: none"> - Less scalable - Monolithic 	<u>NO</u> . Overhead for our APIs
Spring Boot	<ul style="list-style-type: none"> - Scalability - Security 	<ul style="list-style-type: none"> - Wordy code - Setup is complex 	<u>NO</u> . Hard for beginners
Node.js + Express	<ul style="list-style-type: none"> - Scalable APIs - Non-blocking I/O - JS ecosystem 	<ul style="list-style-type: none"> - Callback hell 	<u>YES</u> . Best for real-time trackers and chatbot

Database:

Approach	Pros	Cons	Our selection
Firebase	<ul style="list-style-type: none"> - Easy setup - Sync in real-time 	<ul style="list-style-type: none"> - Costly - Limited query flexibility 	<u>NO</u> . Medical data requires complex SQL
MongoDB	<ul style="list-style-type: none"> - JSON storage - No schema 	<ul style="list-style-type: none"> - Poor for relational data - Weak ACID compliance 	<u>NO</u> . Unsuitable for appointment hierarchy
PostgreSQL	<ul style="list-style-type: none"> - Robust SQL queries - ACID compliance 	<ul style="list-style-type: none"> - Manual scaling 	<u>YES</u> . Ideal for structured medical records

Additionally, we chose JWT for authentication and compared it with session-based and OAuth authentications. The reason why we chose JWT is that:

- **Stateless Security.** No server-side sessions, which reduces load on the backend.
- **Fine-Grained Access.** Tokens can embed roles (“partner” and “pregnant woman”).

Session-based auth is simple to implement but poorly scalable and can lead to server-side memory overhead. OAuth has quick social logins but depends on third parties and has concerns regarding privacy. That is why our choice fell on JWT.

Project Approach (20%)

BopeTracker is a mobile app for tracking pregnancy processes developed using a cross-platform approach to provide access both for IOs and android users.

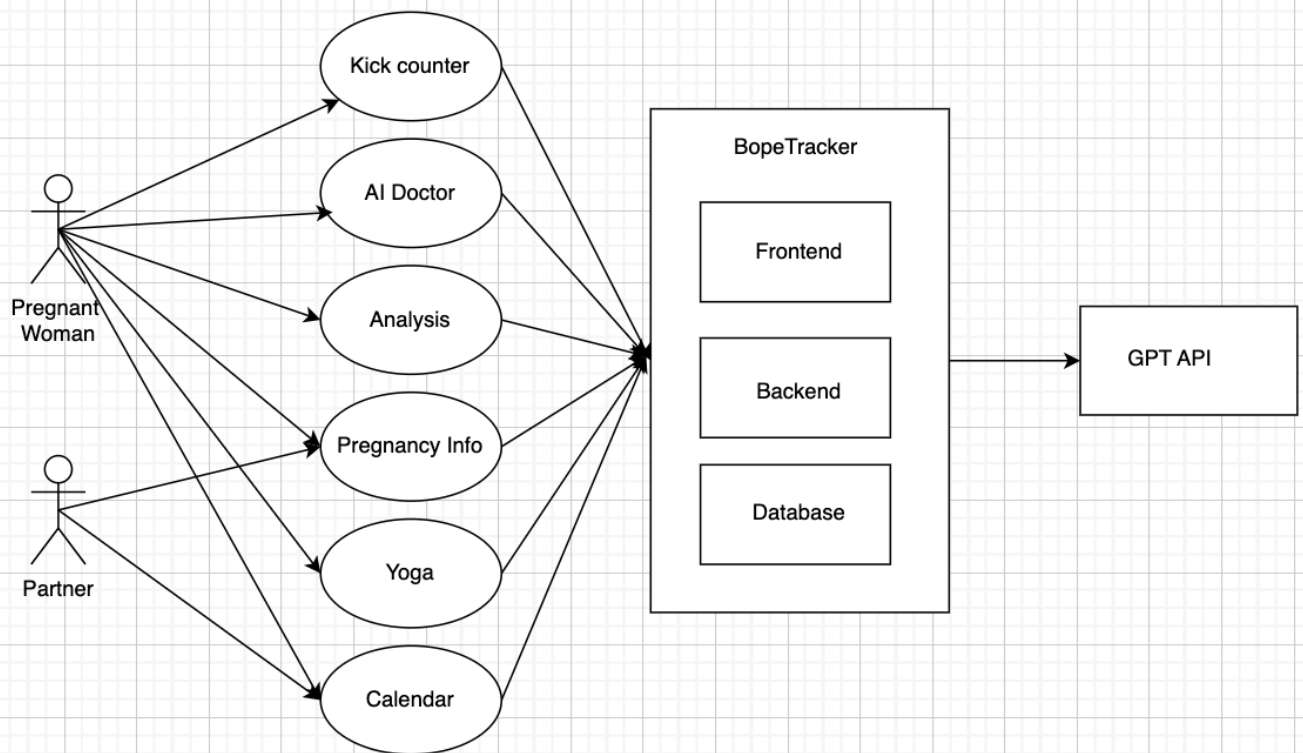
Frontend in Flutter, due to its single codebase and flexible UI rendering capabilities.

Backend was developed with Node.js and Express and supports RESTful APIs for real-time data processing. This stack was selected due to its lightweight, asynchronous architecture.

PostgreSQL was utilized for DataBase to handle structured medical records, user profiles, event scheduling, and journal entries. It was selected for its strong ACID compliance, enabling reliable storage of sensitive data.

Authentication implemented by using JWT that allows embedding users' roles such as "partner", "pregnant woman".

Open AI's API was used to implement AI Doctor. System prompt and manually collected FAQ's were integrated to achieve best performance.



Project execution (15%)

Our project development process followed an agile methodology with all development stages being worked on in parallel.

Planning and Technology Selection

In the first semester, we have analyzed various project technological stacks for building a pregnancy tracking app. We decided to use **Flutter** for frontend development due to its cross-platform capabilities, standard widget library and ease of use. At one point we considered building a native iOS app separately, but the limited client reach and extended development time led us to choose Flutter as the most efficient option.

For the backend, we chose **Node.js with Express** due to its lightweight, event-driven nature. At the planning stage we thought of using Google's Firebase for storage, but due to its high costs we decided to choose **PostgreSQL** as our primary database. Its structured schema and robust query capabilities were ideal for handling medical records and event scheduling.

During this period, the frontend and backend teams worked in parallel. Some team members focused on learning Flutter's architecture and building the initial UI/UX, while others set up the backend infrastructure, server, and PostgreSQL integration.

By the end of the first semester, we had developed a prototype with several core frontend pages and a partially functional backend.

Second Semester: Feature Expansion and Workflow Refinement

In the second semester, we enhanced the app's core functionality and began expanding the feature set. We followed the direction of our project advisers on the prioritized development goals for the week. We brought on an interface designer to improve visual consistency and user experience. Although the app's core architecture remained the same, we have reworked the design for better usability and aesthetics.

We also adopted **GitHub** as our central platform for version control and collaborative development. This helped us manage multiple working branches, easily update server code with pulls, and streamline merges across a growing codebase.

We have expanded the feature set in the second semester. These included:

- **Weekly fetal development tracker**, displaying size, weight, and pregnancy-related facts both about mom and the baby.
- **Custom calendar** to manage doctor appointments, personal events, and reminders, including automatic generation of medical protocol-based events.
- **Partner page** to allow shared access to pregnancy updates.
- **AI-powered chat** for instant answers to pregnancy and health-related queries.
- **Health trackers** for kicks, contractions, weight, and sleep.
- **AI-powered chat** for instant answers to pregnancy and health-related queries.
- **App localization** to Kazakh and Russian

- Additional features such as **document scanning**, **baby name suggestions**, and a **personal journal** with personalized health information.

Roles and Responsibilities

Our teams consisted of five members, each contributing to specific components:

- **Maxim Dunaitsev** (Team Lead, Frontend): Focused on the frontend architecture, home screen, calendar, authentication flow, settings, localization, and backend integration.
- **Madi Skakov**: Led database management, backend support for partner functionalities, server deployment, and project documentation.
- **Aldiyar Yessimkhanov**: Implemented activity trackers, journal pages, and contributed to frontend components.
- **Ayan Issatay**: Served as the primary backend developer. He designed the backend infrastructure, API architecture, and ensured smooth frontend-backend communication.
- **Meir Aliyev**: Focused on the ChatGPT-powered AI page, AI prompt logic, pregnancy protocol handling, and additional frontend components.

We have carried out team communication through weekly meetings and continuous updates on GitHub and messaging platforms. Collaborative problem-solving and knowledge sharing were a key part of our workflow, particularly when integrating backend APIs with frontend features or resolving deployment-related issues.

Evaluation (10%)

1. Introduction

This report presents the testing process of a mobile application for pregnant women carried out in a mother and child center. Five users took active participation in the evaluation and used the application while contributing their feedback and recommendations. The evaluation aimed to establish the strengths of the application and receive recommendations for improvement to better clarify whether the application solved the issues specified in its description.

Project Objectives:

Support to the health of pregnant women.

Management of medical data and tests

Pregnancy planning and postpartum recovery assistance.

2. Evaluation Process

The process of evaluation included gathering feedback from five women who underwent the test of the application. The participants utilized the major functionalities of the application, such as the calendar, AI doctor, health journal, exchange card, and To-Do list. Participants were all able to offer in-depth feedback, sharing areas of satisfaction and ways to enhance the interface and functionality.

Data were captured through questionnaires to inquire about users' perceptions of the design, functionalities, usability, and general effectiveness of the app. It was tested under real-life conditions where participants were able to apply the app to real-world life.

3. Structure of Participant Responses

1) User 1

Positive Aspects

The doctor, calendar, events, and health journal page were valued.

The user mentioned that the software as a whole was liked and all the key features were beneficial.

Recommendations for improvement

The user proposed the addition of statistical analysis for more in-depth data analysis. This will enable users to more effectively monitor progress over medical markers.

2) User 2

Positive Aspects

The task planning and calendar, along with the embedded AI serving useful suggestions, were appreciated.

Recommendations for Enhancement

It was proposed to display the calendar at registration in months rather than in years and to use only 9 months of gestation for the sake of simplicity and clarity.

The application's design was also mentioned to require improvement, particularly the color scheme, in order to be more aesthetically pleasing.

Adding store integration to make it easier to purchase was proposed.

More users preferred actual 3D photos of babies as compared to graphical images of fruits.

3) User 3

Positive aspects

Appreciation was extended to the AI doctor, the tracking of tests, the utilization of protocols of Kazakhstan, the exchange card, and the To-Do list.

Recommendations for Improvement

It was proposed to link the app with Apple Health to allow tracking of sleep automatically from smartwatches to better capture the quality of sleep.

The participant proposed incorporating music content designed to enhance the mood and relaxation of pregnant women.

It would also be useful to include the capability of tracking exercises performed and progress achieved.

4) User 4

Positive points

We enjoyed the doctor mode AI, the fitness programs, the option to add another partner for shared data usage, the exchange card, and the To-Do list.

Recommendations for Enhancement

A suggestion was made to include the ability to automatically complete tasks to make daily tasks easier for the user.

The user proposed including a marketplace to make shopping easier.

They made a wish to restore symptoms and make them personal so that the app could track the user's health correctly.

The participant suggested including more resources and information that have been vetted by doctors and the option to reference medical sources.

5) User 5

Positive aspects

The advice and recommendations supplied by the AI capability were valued. The intuitive nature of the app was also observed by the participant.

Having the capability to add a partner for data sharing and health tracking was very popular. The main features, particularly the health journal and AI doctor, were rated very high.

Recommendations for Development

The member volunteered to include options for presentation interface customization, like modifying the color of the interface background.

There was a requirement to include postpartum support in the app at least until the first year or 40 days postpartum.

Adding links to peer-reviewed medical sites to enable self-study of information was proposed.

Integrating with a marketplace will be helpful for buying products.

4. Data Analysis

Important Positive Features

All the users cited the high level of usefulness of the AI doctor, who offers personalized consultations and suggestions in line with the user's data.

Calendar and Journal: Both the calendar to use for planning and the health journal were rated very useful for recording major events and medical information.

Exchange Card and To-Do List: Both of these were seen as significant for planning and tracking the health conditions of pregnant women.

Partner Integration: Users were very glad to have the option of integrating a partner to share data tracking.

Suggestions for Improvement:

Design and Personalization: Design, particularly the palette of colors, was significant. Participants called for enhancing the visual aspects and the option of personalizing the interface.

Integration with Stores: Every participant preferred to include a marketplace to enable simple buying of things related to pregnancy.

Postpartum Care Elements: The addition of postpartum care features were favored by all participants.

Including links to reputable medical sources was proposed so users could read the information for themselves.

Integration with Apple Health: For better functionalities, the app was suggested to be integrated with Apple Health to automatically monitor sleep through the use of smartwatches. This will give accurate sleep data, and it is essential to monitor health.

5. Conclusion

The testing of the application demonstrated that it successfully tackles the majority of the concerns of pregnant women. Users were very positive about the AI doctor and the planning and tracking of health. Yet, in order to enhance user satisfaction, it will be required to:

Refine the design, enhancing the color scheme and including customization features.

Include postpartum services and improve assistance in the first year of the baby's life.

Integrate with stores to make shopping easier.

Make medical information accessible by including links to reputable sources. Integrate with Apple Health to automatically log sleep from smartwatches to increase the accuracy of data. User feedback will assist in enhancing the application and extending its capabilities to make it more useful for pregnant women.

Conclusion and possible future work (5%)

What are the key findings?

Our testing achieved significant engagement through intuitive interfaces among pregnant users. Medical compliance was improved with the support of protocol-based calendar automation. Partners who used the shared tracking feature reported feeling more involved in the pregnancy journey.

Future work

For the future, we want to focus on these goals to enhance the power of our application:

- **Clinical portal.** Allowing doctors to use application to view patient logs and communicate through application
- **Wearable integration.** Syncing with smartwatches for on-hand use of trackers in the app.
- **Predictive analysis.** Using the data from the user's log history to address potential risks.

Areas for improvement

We also considered the challenges we want to address:

- **AI Hallucinations:** Implement stricter moderation to prevent misleading medical advice.
- **Data Storage Costs:** high-resolution ultrasound storage needs optimization for PDF compression.
- **Offline Functionality:** Use case of caching for people with limited access to the internet.

This project delivered a comprehensive pregnancy management solution by:

- Solving Real Problems: Centralized tracking, automated scheduling, and AI-driven support.
- Advancing Technical Standards: Secure architecture, cross-platform design, and NLP integration.
- Empowering Users: Improved accessibility for both expectant mothers and partners.

Future work will focus on interoperability (i.e. wearables), predictive features, and doctor integration. By bridging gaps in maternal healthcare technology, this app lays a foundation for safer, more informed pregnancies worldwide.

References (5%)

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