University of Miami

Project Proposal: Tiny Tempo - A Fetal Monitoring Mobile Health Application

Prepared by:

Sloan Atkins, Kate Brykalova, Ella Hartsell

Prepared for:

Dr. Hien Nguyen

CSC431 Introduction to Software Engineering

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Table of Contents

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1. About us

1.1. Sloan Atkins

I am a junior majoring in Computer Science and Mathematics. I currently work in a research lab, where I use Python to display data and perform data analysis, which has given me experience working with structured datasets and understanding how data moves through a system. I also work as a web developer assistant, where I design and maintain websites and work across both the frontend and backend, including UI design and database systems such as Firebase. For this project, I am responsible for system architecture planning, backend requirements documentation, and contributing to both the Software Requirements Specification (SRS) and the Software Architecture Specification (SAS). I also help manage the overall project by ensuring documentation across sections stays consistent, technically accurate, and aligned with project goals.

1.2. Kate Brykalova

I am a senior Computer Science major with a minor in User Experience Design. I have developed fundamental technical skills through coursework such as CSC 220 and CSC 314,

which have strengthened my understanding of software design and development. I also have a strong interest in user experience and am continuing to build my knowledge of front-end development, which I hope to actively contribute to the team. For this project, I will be responsible for coordinating team efforts and supporting the development of mockups and prototypes, with a primary focus on the Software Architecture Specification (SAS). I bring strong communication and organizational skills, and I hope these will support collaboration within the team and help ensure that everyone stays aligned throughout the project.

1.3. Ella Hartsell

I am a junior studying Computer Science and Interactive Media at the University of Miami with a strong interest in game design, UI/UX, and interactive systems. Much of my work at the university's NERDLab centers on building interactive experiences through game development using tools such as Unity and Unreal Engine, where I enjoy experimenting with mechanics and exploring how design choices influence user behavior. For this project, I am responsible for documentation management, requirements validation, and quality assurance. My role includes organizing and maintaining the Software Requirements Specification (SRS) and Software Architecture Specification (SAS), supporting requirements review, managing version control in GitHub, and ensuring all project deliverables are clear, consistent, and aligned with project goals and course standards.

2. Project Overview

2.1. Project Name

When naming our project, we wanted a title that reflected the core features of our product while still feeling warm and approachable. *Tiny Tempo* refers to the natural rhythms of fetal development, including heart rate, movement, and contractions.

2.2. Project Description

Our project is a mobile health app designed to make late-stage pregnancy monitoring more accessible, engaging, and reassuring by combining wearable fetal monitoring with an intuitive, parent-friendly interface. The app is meant to help expecting parents feel more informed and connected between prenatal appointments while also providing useful summarized data for doctors.

2.3. Target Users

The system is designed to collect, analyze and store fetal data. Our primary target users would be expecting parents who want to have accurate, real-time and data-based insights into their pregnancy. These users prioritize having early awareness of potential issues and want simple explanations of their data so they can feel more informed during medical appointments. In addition, doctors and healthcare providers are secondary users who may analyze collected data to help provide better care and more informed treatment for their patients.

2.4. The Problem

Many parents experience anxiety between prenatal appointments, particularly those with complicated or high-risk pregnancies. With visits often spaced four weeks apart, families have no way to check on the health of their baby during that time. This lack of information creates unnecessary stress and uncertainty. Currently, there is no widely accessible solution for regular fetal monitoring outside of clinical visits. This software would allow families to track pregnancy progress on a daily basis, offering reassurance and peace of mind, especially for those who have faced pregnancy or fertility challenges.

2.5. Alternative Solution

Currently, appointments are primarily scheduled once every four weeks and as a result, one alternative to our app is waiting until the next in person appointment. During these gaps in between visits, parents have no knowledge of the health of their pregnancy and must wait until their next appointment to have any information or reassurance.

In addition to scheduled office visits, there is a small number of remote fetal monitoring devices that currently exist. One example is Nuvo which is a medical grade monitoring device that is prescribed and overseen by a physician. While the device may be used remotely in the parent's home, the sessions are supervised by the physician and this system is not intended for independent, everyday use by the parents.

Another example is Kali Healthcare, which is also designed to help parents have improved access to pregnancy monitoring. However, this product is still under development and has not yet been FDA approved. These alternatives highlight an unmet need in the current market for an accessible and parent friendly device that can be used independently between monthly appointments. Our proposed solution focuses on providing reassurance, accessibility and education for expecting parents.

3. Proposed Solution

3.1. Solution Overview

Our proposed solution is a health app that works with a wearable monitoring device that allows expecting parents to have real-time insights into the well being of their pregnancy outside of scheduled office visits. This product is designed to collect information including heart rate, movement and contractions, and present it in an easy to understand way. By displaying data in visual summaries, this application helps educate parents and significantly reduce uncertainty and

anxiety. Our solution will help compliment and improve pregnancy care by providing comprehensive data that can better support in person visits.

3.2. Core Functions / Features

Heart Rate Monitoring: The system includes a belly band with a Doppler-style sensor (conceptual) for periodic readings instead of constant monitoring to reduce anxiety. It displays heart rate as a safe range rather than a single number, plays a soft heartbeat sound, and shows trends over time.

Baby Movement Detection: Motion sensors detect bursts of movement with features including a kick counter and daily movement summary to help parents track activity patterns.

Braxton Hicks Contractions: Pattern recognition identifies irregular, non-progressive contractions and differentiates them from labor contractions, meant to reduce unnecessary anxiety for parents.

Actual Contractions: The system detects stronger, more rhythmic pressure patterns, tracks increasing frequency and duration, includes manual confirmation from the parent, provides a contraction timer, and alerts when it may be time to go to the hospital.

3.3. Project Justification

This project is worth developing because there is a current gap between clinical pregnancy monitoring tools and parent-friendly health technology. By making fetal health information more accessible and understandable we hope to reduce parental anxiety from parents and make the experience more fun. The system benefits users by allowing expectant parents to track fetal heart rate, movement, and contractions in a reassuring, non-diagnostic way that supports bonding and reduces anxiety between prenatal visits. For the development team, the

project offers strong learning value through designing a safety-conscious, wearable-integrated system that prioritizes usability, privacy, and ethical data handling.

4. Cost Estimation

4.1. Efforts Costs

The total estimated development time is 12 weeks with a team of three members. The workload will be distributed across conceptual design and selection (2 weeks), service interface design (3 weeks), implementation and integration (4 weeks), validation (2 weeks), and deployment and evolution planning (1 week). Each team member will contribute approximately 15-20 hours per week throughout the development cycle, totaling approximately 540-720 hours of combined team effort.

4.2. Hardware and Software Costs

Software and Infrastructure Costs: Secure cloud hosting (HIPAA-aware) estimated at $500 per month, database storage and backups at $250 per month, API hosting and load balancing at $200 per month, and logging and monitoring tools at $150 per month, totaling approximately $13,200 annually. Development tools include GitHub Team plan at $500 per year, Figma Professional at $1,200 per year, and testing tools and CI services at $800 per year, totaling approximately $2,500 for tooling. Total estimated annual infrastructure cost: $13,200. Total estimated tooling cost: $2,500.

Security and Compliance Costs: Data encryption services, secure authentication (OAuth, MFA), and compliance consulting (theoretical) with an estimated security and compliance cost of approximately $10,000.

Wearable Hardware Costs: Sensor research and testing estimated at $10,000, prototype belly band components (20-30 units) at $15,000, and hardware validation and iteration at $10,000. Total estimated hardware cost: $35,000.

Development Computers and Testing Devices: Development computers and testing devices including iOS and Android smartphones are already owned by team members. Total cost: $0 (using existing equipment).

5. Plan of Work

5.1. Tools

The development of this project will use a set of tools that support both efficient implementation and strong team collaboration. The backend will be built in Python using either Flask or FastAPI to manage application logic, data processing, and API functionality. The frontend will be developed with JavaScript and React, allowing us to create a clean, responsive interface that presents health data in a clear and approachable way. GitHub will be used for version control so the team can collaborate effectively, track changes, and manage code updates throughout development. Communication will take place through Slack and Messages to support regular check-ins and quick problem-solving. Design and prototyping will be done in Figma, giving the team space to iterate on interface ideas before moving into full implementation. Together, these tools allow for an organized, iterative workflow that supports both technical development and team coordination.

5.2. Keys to Success

The success of this project depends on clear communication, defined roles, and consistent collaboration throughout the development process. Each team member has clearly outlined

responsibilities to ensure accountability and prevent overlap or confusion. Meetings will be held to review progress, address challenges, and adjust plans as needed. The team will follow an iterative approach, using ongoing testing and feedback to refine features and improve overall functionality. By maintaining open communication, staying organized, and regularly evaluating progress against project goals, the team can ensure steady development and a high-quality final product.

5.3. Schedule and Workplan

Weeks 1-2: Conceptual Design & Selection. Establish project scope, define detailed user requirements, research existing solutions and technologies, create initial project documentation, and set up development environment and tools.

Weeks 3-5: Service Interface Design. Develop comprehensive UI/UX designs in Figma, create wireframes and interactive mockups, design database schema and system architecture, define API endpoints and data flow, and gather feedback on designs from potential users.

Weeks 6-9: Implementation & Integration. Develop backend APIs and database integration, build frontend components and user interface, implement wearable device integration (conceptual), develop data visualization and trend analysis features, create user authentication and data security measures, and conduct continuous integration and unit testing.

Weeks 10-11: Validation. Conduct comprehensive unit testing and integration testing, perform user acceptance testing with target audience, identify and fix bugs and performance issues, refine features based on user feedback, and optimize application performance and user experience.

Week 12: Deployment & Evolution Planning. Deploy the application to production environment, prepare comprehensive final documentation including user guides and technical documentation, create presentation materials, and present the completed project to stakeholders.

6. Conclusion

TinyTempo addresses a significant gap in prenatal care by providing expecting parents with accessible, real-time monitoring between clinical appointments. Through careful integration of wearable technology and an intuitive mobile interface, the application will reduce parental anxiety while providing valuable data to healthcare providers. The development team is well-equipped with the necessary technical skills and resources to complete this project within the proposed timeline and budget. The learning outcomes from this project will prepare team members for future work in health technology, user-centered design, and safety-critical systems development. By the end of the 12-week development cycle, we will deliver a functional, user-tested application that demonstrates both technical proficiency and genuine value to expecting families.