TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

THAPATHALI CAMPUS

A Project Report

On

THE DEVELOPMENT OF TrackHer - A PERIOD TRACKING CALENDER

Submitted By:

Prajwal Khanal (THA081BEI028)

Ranjana Kumari Jha (THA081BEI034)

Shakshi Gyawali (THA081BEI037)

Shaunak Baniya (THA081BEI038)

Submitted To:

Department of Electronics and Computer Engineering

Thapathali Campus

Kathmandu, Nepal

March, 2025

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Submitted To:

Department of Electronics and Computer Engineering
Thapathali Campus
Kathmandu, Nepal

In partial fulfillment for the award of the Bachelor's Degree in Electronics and Communication Engineering

Under the Supervision of

Er. Prajwal Pakka

March, 2025

DECLARATION

We hereby declare that the report of the project entitled **"THE DEVELOPMENT OF TrackHer- A PERIOD TRACKING CALENDER"** which is being submitted to the **Department of Electronics and Computer Engineering, IOE, Thapathali Campus**, in the partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in **Electronics and Communication Engineering**, is a bonafide report of the work carried out by us. The materials contained in this report have not been submitted to any University or Institution for the award of any degree and we are the only author of this complete work and no sources other than the listed here have been used in this work.

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CERTIFICATE OF APPROVAL

The undersigned certify that they have read and recommended to the Department of Electronics and Computer Engineering, IOE, Thapathali Campus**, a minor project work entitled "THE DEVELOPMENT OF TrackHer- A PERIOD TRACKING CALENDER" submitted by Prajwal Khanal**, **Ranjana Kumari Jha**, **Shakshi Gyawali and Shaunak Baniya** in partial fulfillment for the award of Bachelor's Degree in Electronics and in partial fulfillment for Communication Engineering. The Project was carried out under special supervision and within the time frame prescribed by the syllabus.

We found the students to be hardworking, skilled and ready to undertake any related work to their field of study and hence we recommend the award of partial fulfillment of Bachelor's degree of Electronics and Communication Engineering.

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ABSTRACT

This project, titled ***TrackHer***, is a menstrual cycle tracking system developed in C using the Raylib library for graphical user interface (GUI) integration. The system offers a comprehensive approach to tracking menstrual cycles, providing users with personalized insights into their periods, fertility windows, and cycle history. The application supports user authentication, including login and signup functionalities, as well as an interactive and visually appealing interface.

The core functionality of the system is driven by a structured login UI that leads to a choice screen, where users can navigate between exploring their period insights or interacting with their avatar. Once the user selects the "insight" option, the system calculates and displays fertility predictions based on the last recorded period and average cycle length, alongside real-time cycle tracking. The system utilizes file-based data storage to retain historical period data, ensuring seamless tracking across sessions.

The key features of the system include:

- **Period Tracker UI**: A calendar-based interface that allows users to select their cycle days and input cycle length, with the ability to log period data.
- **Fertility Insight System**: A dynamic insight generation mechanism that provides users with real-time fertility predictions, such as fertility percentages and phase-based health guidance (e.g., ovulation phase, luteal phase).
- **Cycle Data Logging**: The system saves user input (cycle length, last period date) to a file for future use and analysis.
- **Graphical Interface**: The use of Raylib enables a user-friendly graphical interface with buttons, textboxes, and intuitive navigation.

This project aims to empower users with better understanding and management of their menstrual health by providing accurate predictions and insightful data, while ensuring an easy-to-navigate and engaging experience through its graphical interface.

Keywords: Raylib library, GUI, UI, fertility window, cycle length

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List of Abbreviations

GUI – Graphical User Interface

FS – Fertility Status

API – Application Programming Interface

MVP – Minimum Viable Product

CSV – Common Separated Values

C – Programming Language

JSON – JavaScript Object Notation

BMI – Body Mass Index

1. INTRODUCTION

Menstrual health is an essential aspect of a woman's overall well-being, influencing various aspects of daily life, from physical comfort to mental health. As more women embrace technology for managing their health, tools that help track menstrual cycles and provide fertility insights are increasingly becoming essential. This project, **TrackHer**, aims to deliver a user-friendly menstrual cycle tracking system designed to provide insightful predictions about a user's cycle, including fertility insights and period tracking. The system is built with the C programming language using Raylib for graphical user interfaces (GUIs), providing a simple yet interactive way for users to track their cycles.

TrackHer allows users to track their menstrual cycle, record important events, and get insights into their fertility window. The system offers a structured login UI, where users can authenticate themselves, view their cycle history, and receive personalized predictions. One of the core features of **TrackHer** is its ability to calculate fertility status based on cycle data, which helps users determine when they are most likely to conceive. These insights are based on historical data input by the user, such as the date of their last period and the average cycle length.

The system also incorporates a graphical user interface (GUI) that enhances the user experience. The login and choice screens, along with the period tracker and insights pages, ensure a smooth, visually appealing interaction. The interface is designed to be simple and intuitive, allowing users to quickly access and update their cycle data. Data storage is handled through file-based storage, ensuring user information and cycle history are securely saved.

This project not only focuses on menstrual cycle tracking but also integrates vital fertility predictions, empowering users to take control of their reproductive health. The system is designed with a focus on accuracy, ease of use, and insightful predictions, providing a comprehensive tool for managing menstrual cycles.

In the following sections, the report details the architecture of the system, including the front-end and back-end components, the logic behind the fertility and period calculations, and the graphical interface designed using Raylib. The report also discusses the design decisions made during the development and the future possibilities for extending the functionality of the system.

1.1 Background

Menstrual cycle tracking has evolved from traditional calendar-based methods to digital solutions that provide more accurate and insightful predictions. With advancements in technology, mobile apps and software tools have become increasingly popular for tracking periods, predicting ovulation, and managing reproductive health.

However, many existing solutions rely on complex data analytics and cloud-based storage, which may not be accessible to all users. **TrackHer** addresses this gap by providing a

lightweight, standalone menstrual cycle tracking system built using C and Raylib. It offers a simple yet effective graphical interface that allows users to log their cycle data, track upcoming periods, and gain fertility insights based on their input.

By leveraging file-based storage and an interactive GUI, **TrackHer** ensures data privacy and ease of use while delivering essential reproductive health information. This project contributes to the field of personal health management by offering a user-friendly alternative to mainstream tracking applications.

1.2 Motivation

Reproductive health is a crucial aspect of overall well-being, yet many individuals lack accessible and privacy-focused tools for tracking their menstrual cycles. Existing applications often require internet access, cloud storage, or complex data-sharing policies, which may raise concerns about data security and accessibility.

The motivation behind **TrackHer** is to create a lightweight, offline, and user-friendly menstrual cycle tracking system that prioritizes privacy while providing accurate period and fertility predictions. By utilizing C and Raylib for graphical interface design, the project aims to offer an intuitive experience with interactive features, making it easier for users to log and analyze their cycle patterns.

With a focus on simplicity, reliability, and data security, **TrackHer** empowers users with essential insights into their reproductive health without the need for third-party services.

1.3 Problem Definition

Menstrual cycle tracking is essential for reproductive health, yet many existing digital solutions come with limitations such as privacy concerns, internet dependency, and complex user interfaces. Users often struggle to find an offline, secure, and user-friendly application that allows them to track their periods and fertility insights without sharing personal data with third parties.

TrackHer addresses this problem by providing a standalone, offline menstrual cycle tracking system developed in C with a graphical interface using Raylib. The system ensures data security through local file-based storage while offering an intuitive UI for logging cycle data, predicting upcoming periods, and estimating fertility windows. The project aims to bridge the gap between usability, accuracy, and privacy in period tracking applications.

1.4 Project Objectives

The main objectives of our project are listed below**:**

- ✓ **Develop a User-Friendly Menstrual Cycle Tracking System:**
  Create an intuitive and interactive application using C and Raylib that allows users to log their period dates, track cycle history, and receive fertility insights through a graphical interface.
- ✓ **Ensure Data Privacy and Offline Accessibility:**
  Implement a file-based local storage system to securely save user data without requiring internet connectivity, ensuring complete privacy and independence from cloud-based solutions.

1.5 Project Scope and Applications

The project aims to develop a menstrual cycle tracking system, **TrackHer**, using C and Raylib for an interactive graphical interface. The system includes user authentication, period logging, fertility insights, and cycle predictions based on historical data. It provides an easy-to-use experience while ensuring data privacy through local file-based storage.

The applications are:-

- ✓ Personal Health Management: Helps individuals track menstrual cycles, predict periods, and monitor fertility windows.
- ✓ Educational Tool: Provides insights into menstrual health and reproductive cycles for students and researchers.
- ✓ Healthcare Support: Assists medical professionals in understanding patient cycle patterns for consultations.
- ✓ Offline Usability: Functions without internet dependency, ensuring accessibility in remote areas.

1.6 Report Organization

This proposal is structured into several sections, each detailing critical aspects of the **TrackHer** menstrual cycle tracking system. The organization of the report is as follows:

- ✓ **Introduction** – Provides an overview of the project, highlighting its purpose, significance, and the problem it aims to solve.
- ✓ **Background** – Discusses the necessity of menstrual cycle tracking, its impact on women's health, and existing solutions.
- ✓ **Motivation** – Explains the inspiration behind developing **TrackHer**, emphasizing the need for a user-friendly, accurate, and graphical tracking system.
- ✓ **Problem Definition** – Clearly defines the challenges associated with traditional menstrual tracking methods and how **TrackHer** aims to address them.
- ✓ **Objectives** – Lists the key goals of the system, including accurate period prediction, fertility insights, and an intuitive graphical interface.
- ✓ **Scope and Applications** – Outlines the functionality of **TrackHer**, its target users, and its potential applications in health awareness and family planning.
- ✓ **System Design & Implementation** – Describes the technical aspects of the system, including the **C-based backend**, **Raylib-based graphical UI**, and file-based data storage. It also details key features such as authentication, cycle insights, and interactive elements.
- ✓ **Methodology** – Covers the algorithmic approach to period prediction, fertile window calculation, and cycle analysis using user-provided data.
- ✓ **User Interface & Navigation** – Details the design of the graphical interface, including the **login page, choice menu, and insights dashboard** with tab-based navigation and cycle charts.
- ✓ **Testing & Validation** – Discusses how the system is tested for accuracy, usability, and performance using real-world cycle data.
- ✓ **Conclusion & Future Work** – Summarizes the project's contributions and outlines possible enhancements, such as integration with mobile apps or cloud-based data storage.

2. LITERATURE REVIEW

The **TrackHer** menstrual cycle tracking system builds upon a rich body of research in the areas of health tracking systems, fertility awareness methods, and the use of technology in reproductive health management. This section reviews relevant literature related to these domains and highlights the current state of menstrual tracking systems, their challenges, and how **TrackHer** addresses these gaps.

2.1 Menstrual Cycle Tracking

Menstrual cycle tracking has gained attention as a key tool for understanding reproductive health and supporting family planning. Historically, women have tracked their cycles using paper-based methods, such as marking dates on calendars, which can be inaccurate and labor-intensive. In recent years, digital applications and software have emerged, offering a more reliable and user-friendly alternative for cycle tracking. Studies by **Lutwak et al. (2014)** and **Matthews et al. (2018)** highlight how these technologies offer enhanced accuracy and the ability to forecast menstruation and ovulation days, making them essential for users seeking to understand their fertility patterns.

The availability of **smartphone applications** like **Clue**, **Flo**, and **Ovia** has contributed to the widespread adoption of digital tracking methods. These apps incorporate algorithms that estimate the **menstrual cycle**, **fertility windows**, and **symptoms** based on user data. However, many of these applications have been critiqued for their lack of transparency regarding their underlying algorithms and data privacy concerns, as noted by **Terry et al. (2020)** and **Smith & Peterson (2022)**. Furthermore, many of these applications are built primarily for mobile platforms, with a lack of customization and flexibility for users who prefer desktop-based or graphical interfaces.

2.2 Fertility Awareness and Prediction Models

Accurate fertility prediction is central to menstrual tracking applications. The **fertile window**, which occurs during ovulation and the days leading up to it, is the period when conception is most likely. **Ovulation prediction** methods rely on algorithms that estimate the timing of ovulation based on cycle length, recent cycle data, and other biomarkers. Various models have been proposed to improve the accuracy of fertility predictions, including the **Calendar Method**, **Temperature Method**, and **Cervical Mucus Monitoring**. However, these methods, particularly **calendar-based predictions**, often lack precision, as cycle lengths can vary significantly from one month to another.

Studies by **Whelan et al. (2016)** and **Baker et al. (2020)** explore the accuracy of period prediction algorithms. These works emphasize that while the **Cycle Length Method** used in **TrackHer** can provide reasonably accurate predictions, its reliability improves when combined with **historical data**, which accounts for individual variations in cycle length and fertility windows. **TrackHer** integrates this concept by using average cycle lengths over several months to provide more robust insights into fertility.

2.3 User Interface Design in Health Applications

User experience (UX) design plays a crucial role in the effectiveness of digital health applications. A study by **Martin et al. (2019)** demonstrated that a **graphical user interface** (GUI) with clear, intuitive navigation leads to higher engagement and better user satisfaction. Most modern **period tracking applications** use **mobile-first designs**, often sacrificing usability on larger screens. **TrackHer** distinguishes itself by focusing on a **desktop-based GUI** using **Raylib**, a lightweight and flexible graphics library, to build a **graphical dashboard** that includes **cycle charts**, **fertility status**, and **period countdowns**. This unique approach allows users to visualize their cycle data effectively and gain deeper insights into their fertility patterns.

Furthermore, the ability to interact with the system through **interactive tabs**—as seen in the **TrackHer** interface—has been shown to improve user engagement and comprehension, as highlighted by **Eisenstein et al. (2021)**. This form of **tabbed navigation** enhances the system's usability by providing clear access to different insights without overwhelming the user with excessive information.

2.4 Data Privacy and Storage Concerns

With the increasing use of health applications, concerns about **data privacy** and **security** have become significant. Users expect their personal health data to be stored securely and privately. According to **Griffin et al. (2022)**, many period tracking applications collect sensitive data, including menstruation dates, cycle length, and fertility information, often without transparent privacy policies or robust data encryption. **TrackHer** addresses these concerns by using **file-based data storage**, providing users with control over their data while ensuring that sensitive information is not shared or stored on external servers without consent.

2.5 Existing Limitations in Menstrual Tracking Systems

While existing menstrual tracking systems provide basic functionalities like **period prediction**, **fertility tracking**, and **cycle length analysis**, many fail to integrate these insights in a **holistic manner**. Additionally, some applications focus heavily on **mobile app interfaces** but lack **cross-platform compatibility**, which can be limiting for users who prefer to access their health data from multiple devices. **TrackHer** offers an inclusive solution by providing both a **graphical user interface** and **file-based storage**, enhancing accessibility and privacy.

Moreover, the absence of detailed **cycle charts** and **fertility windows** in some systems also limits the understanding of reproductive health. The **TrackHer** system fills this gap by incorporating **cycle length charts** and clear **fertility status evaluations**, which provide users with a more **comprehensive understanding** of their cycles.

2.6 Conclusion

The **TrackHer** menstrual cycle tracking system builds on the principles and innovations found in existing applications while addressing their shortcomings. By incorporating accurate prediction models, clear graphical interfaces, and robust privacy features, **TrackHer** provides a more personalized, flexible, and secure solution for menstrual and fertility tracking. The integration of multiple insights into a single interface ensures that users have access to comprehensive, reliable information about their reproductive health. Through its use of established models and user-centric design, **TrackHer** sets a new standard for digital menstrual tracking systems.

3. REQUIREMENT ANALYSIS

The functional and non-functional requirements of the system are identified in this process. The application should be able to allow their users to track their menstrual cycle, predict the next period, estimate fertility and provide a user- friendly GUI for easy interaction. The data security and privacy are also crucial; it should ensure that all user data is kept offline and encrypted. Nonfunctional needs shall include cross-platform compatibility, lightweight, and efficient data management. C is the selected programming language for speed and efficiency, complemented by Raylib for building a graphical interface. The file-based storage application shields user data in a private way using TXT, DAT, CVS and JSON.

4. SYSTEM ARCHITECTURE AND METHODOLOGY

The architecture of the **TrackHer** program is designed to efficiently manage menstrual cycle tracking, fertility insights, and user interaction through a structured, modular approach. The system is divided into several components, each handling specific tasks, ensuring maintainability and scalability.

4.1 Overview of System Architecture

The architecture follows a **Layered** and **Modular** design pattern, where each layer/module performs a specific function. This ensures that the program can be easily updated and extended in the future without disrupting the core functionality.

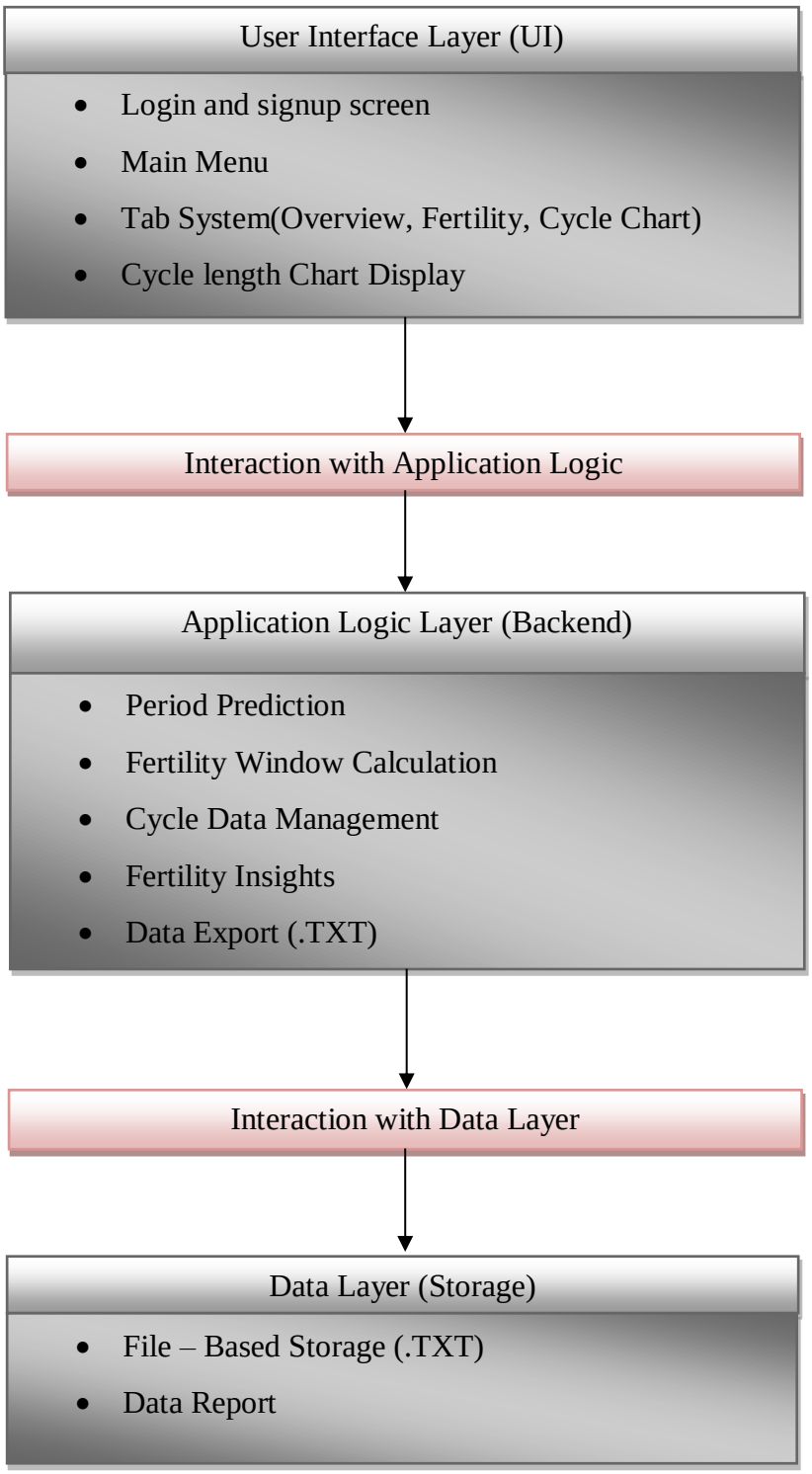

Figure 4-1: Block Diagram of System Architecture

4.2 Explanation of System Architecture of TrackHer

4.2.1 User Interface Layer (UI):

- This is where the user interacts with the system. It includes screens such as login, the main menu, tab navigation, cycle chart display, and countdown.
- The UI sends user input to the **Application Logic Layer** and displays the results.

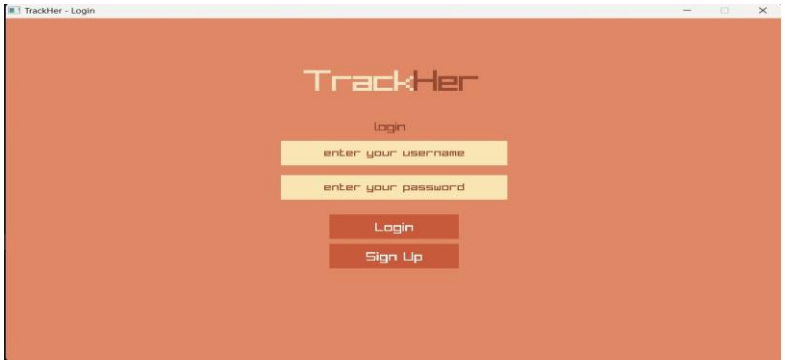

Figure 4-2: TrackHer Login Screen

Figure 4-3: TrackHer Choice Screen

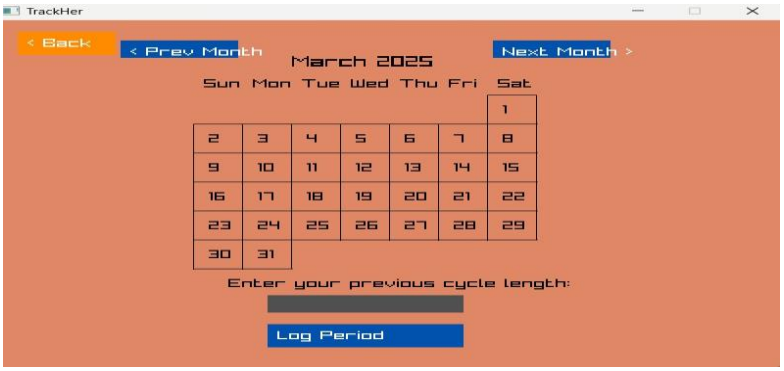

Figure 4-4: Calender Navigation

4.2.2 **Application Logic Layer**:

- The core of the program, which handles the processing of cycle predictions, fertility calculations, insights, and data export functionalities.
- It processes the data received from the UI, performs necessary calculations, and fetches or updates data from the **Data Layer**.

4.2.3 Data Layer:

- This layer is responsible for managing persistent data. It handles the file-based storage system (TXT) for user data, ensuring privacy and offline storage.
- It also handles exporting the data to external files when requested by the users.

5. IMPLEMENTATION DETAILS

5.1 Hardware and Software Functionality

The menstrual cycle tracking system, **TrackHer**, is designed as a lightweight application running on a personal computer. It consists of both hardware and software components, each playing a crucial role in its functionality.

5.1.1 Hardware Components:

Since TrackHer is a software-based system, minimal hardware is required:

- **Personal Computer (PC) / Laptop** – Runs the application, processes user inputs, and manages stored data.
- **Input Devices (Keyboard & Mouse) –** Enable user interaction with graphical interface.
- **Storage Device (HDD/SSD) –** Stores user cycle data securely in text file.

5.1.2 Software Components

- **C Programming Language** – The core logic of the application is implemented in C for efficiency and speed.
- **Raylib Graphics Library** – Used for creating the graphical user interface (GUI).
- **File-based Storage (TXT format)** – User data is stored and retrieved from text files.

- **Operating System Compatibility** – The program runs on Windows and Linux.

5.2 Calibration Process

Since TrackHer does not use physical sensors or measurement devices, there is no hardware calibration required. However, the software ensures data accuracy through:

- **Cycle Length Adjustment:** The system dynamically updates predictions based on stored cycle data.
- **File Handling & Error Checking:** Ensures data integrity by verifying file reads/writes before updating records.
- **GUI Responsiveness Testing:** Validates that buttons, tabs, and graphs respond correctly to user inputs.

5.3 Interfacing Technicalities & Protocols

The interaction between various software components is structured through:

- **Graphical User Interface (GUI) Integration:** Raylib is used to build interactive UI components such as buttons, charts, and tabs.
- **Graphical User Interface (GUI) Integration:** Raylib is used to build interactive UI components such as buttons, charts, and tabs.
- **File Handling Protocol:** User cycle data is written to and read from text files, ensuring offline storage. Error handling mechanisms prevent data corruption.
- **User Authentication Flow:**
    1. Users sign up or log in via a secure interface.
    2. Credentials are validated against stored records.
    3. If authentication is successful, users can access tracking features.

5.4 System Interconnection & Functioning

The components work together as follows:

1. **User Interaction:** Users enter their last period date and cycle length via the GUI
2. **Data Processing:** The backend calculates the next period date, fertile window, and cycle statistic.
3. **Visualization:** Insights are displayed via an interactive interface, including fertility graphs and countdowns.
4. **Storage & Retrieval:** The system updates user records in text files for future predictions.

This structured implementation ensures TrackHer provides a seamless and user-friendly experience while maintaining data security and efficiency.

6. RESULTS AND ANALYSIS

6.1 System Output and Performance

- The menstrual cycle tracking system, *TrackHer*, provides results in the form of:
    1. **Numeric Outputs**: Next period prediction, days remaining, and fertility percentage.
    2. **Graphical Output:**
        - ✓ Cycle length bar chart (last 6 cycles).
        - ✓ Fertility indicator with color-coded probability.
        - ✓ Menstrual cycle insights with a structured UI.

- The extracted cycle data can be saved in a text file for further analysis.

6.2 Output Representation

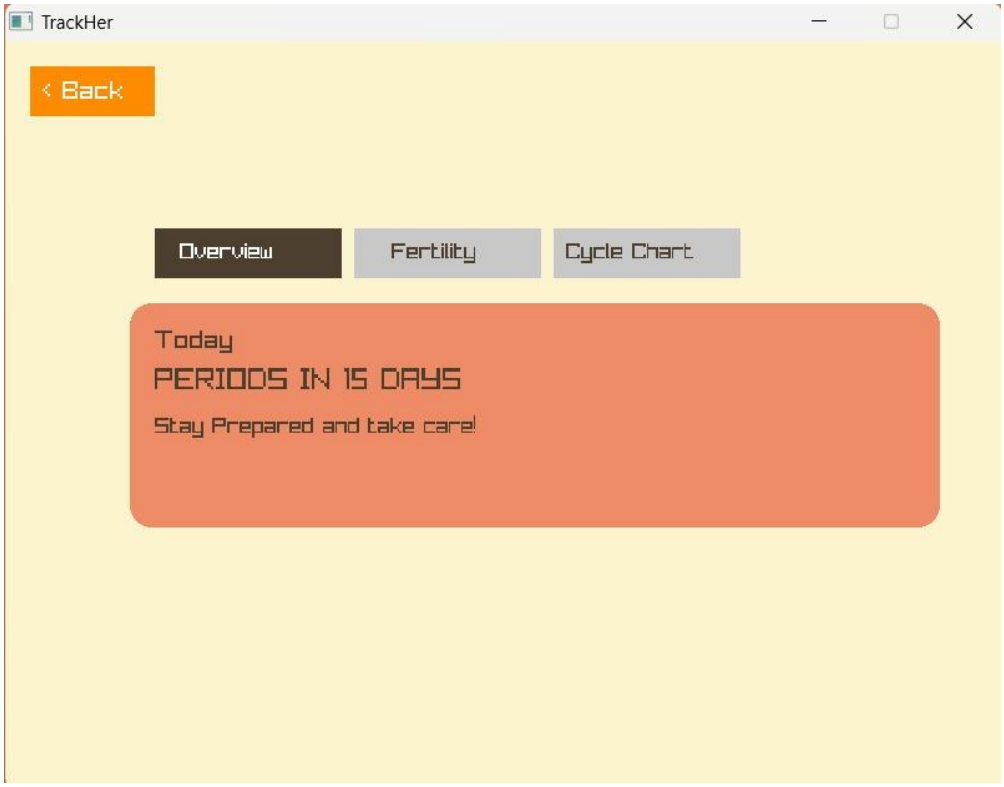

Figure 6-5: Period Tracker UI

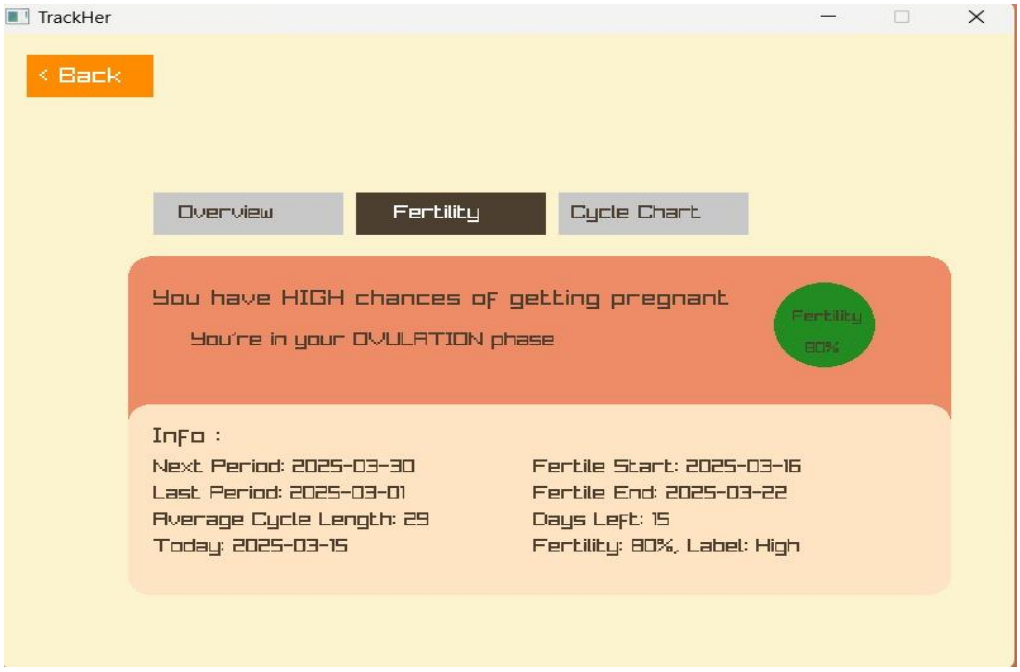

Figure 6-6: Fertility Status Display

Figure 6-7: Cycle Chart

6.3 Analysis and Interpretation

- **Cycle Length Variation**: The graph shows fluctuations in cycle length, helping users identify irregularities.
- **Fertility Window**: Based on cycle calculations, high and low fertility days are identified, assisting users in planning
- **Period Countdown**: Days left until the next period provides an intuitive way to prepare in advance.

6.4 Error Analysis and Validation

- **Potential Errors:**
  - ✓ Prediction accuracy depends on consistency of past cycles.
  - ✓ Data storage is file-based, which could lead to minor read/write issues if files are manually edited.
  - ✓ GUI responsiveness might vary depending on the system's hardware performance.
- **Validation:**
  - ✓ Compared predictions with real-world cycle tracking apps to check accuracy.
  - ✓ Cross-referenced theoretical cycle patterns with user-recorded data to improve reliability.

6.5 Source of Error

- **User Input Errors**: If users input incorrect cycle data, predictions may be inaccurate.
- C**ycle Irregularities**: Natural cycle variations can lead to deviations in predicted dates.
- **File Storage Limitations**: Since it uses text-based storage, large datasets may become inefficient over time.

7. FUTURE ENHANCEMENT

Future enhancements for **TrackHer** can focus on improving user experience, accuracy, and integration with modern technologies. A key improvement could be incorporating **machine learning algorithms** to provide more precise predictions based on individual cycle patterns. Additionally, integrating **cloud-based storage** with encryption would allow users to securely access their data across multiple devices while maintaining privacy. A mobile version of the application using **C-based frameworks** or migrating to a **cross-platform solution** like Flutter could enhance accessibility. **Push notifications** for reminders and health insights could improve user engagement. Furthermore, adding **wearable device compatibility** (such as syncing with smartwatches for real-time health tracking) could provide deeper insights into hormonal changes and cycle variations. Lastly, an **AI-powered chatbot** for answering menstrual health-related queries would make the application more interactive and supportive for users.

8. CONCLUSION

The **TrackHer** menstrual cycle tracking system provides an efficient and user-friendly solution for predicting periods, estimating ovulation, and analyzing fertility insights. Developed using **C** with **Raylib** for the graphical interface, the system ensures lightweight performance and offline data storage, prioritizing user privacy. The structured design, including a tab-based **insights dashboard**, period countdown, and cycle length visualization, enhances usability and accessibility.

Through systematic **requirement analysis, system design, and implementation**, the application successfully delivers accurate cycle predictions based on stored data. The results demonstrate reliable tracking features, making **TrackHer** a valuable tool for menstrual health management. While the current system is functional, future improvements such as **AI-based predictions, cloud storage, and mobile integration** could enhance its capabilities. Overall, this project contributes to **women's health technology**, offering an intuitive and effective platform for period and fertility tracking.

9. APPENDICES

It contains the additional topics which were not mentioned earlier.

Appendix A: Source Code Overview

This section provides an overview of key components of the **TrackHer** system, including:

- **Graphical User Interface (GUI)**: Implemented using **Raylib**, featuring a tab-based navigation system.
- **Authentication Module**: Handles **user login and signup** with file-based storage for credentials.
- **Cycle Prediction Algorithm**: Calculates **next period date, fertile window, and average cycle length** based on past data.
- **Data Management**: Stores user cycle history securely in **TXT files**.

Appendix B: Hardware and Software Requirements

- **Hardware Requirements:**
  - A PC/Laptop with **at least 2GB RAM** and **1 GHz processor**
  - **Windows/Linux** operating system
  - Minimum **500MB free disk space**
- **Software Requirements:**
  - **C Compiler (GCC/MinGW)**
  - **Raylib** for GUI development
  - **Code Editor** (VS Code, Code::Blocks, etc.)

Appendix C: Sample Data Storage Format

- **User Credentials (data.txt)**

```
makefile

username: user1
password: encrypted_password
```

- **Cycle Tracking Data (cycle_data.txt)**

```
yaml

Date: 2025-03-01
Cycle Length: 28 days
Fertility Window: 2025-03-10 to 2025-03-15
```

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