

AquaFocus: A Gamified AI-Assisted Pomodoro Productivity App with Real-Time Team Synchronization

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Abstract—AquaFocus is an innovative mobile productivity application designed to boost user focus and time management skills through a combination of the Pomodoro technique[1], gamification, and AI-driven personalization. By visualizing user progress with a dynamically growing coral reef ecosystem, the app enhances engagement and long-term motivation. In addition to delivering real-time synchronization across teams using Socket.IO[7], AquaFocus employs FastAPI[8]-powered artificial intelligence to generate personalized work strategies. This paper presents the architecture, implementation, and performance evaluation of AquaFocus, comparing it with industry benchmarks and exploring its impact on user productivity.

Index Terms—Pomodoro, Flutter, Gamification, Socket.IO, FastAPI, MySQL, Productivity, Mobile App

I. INTRODUCTION

Productivity applications have become essential tools for individuals and teams striving to maintain focus in an increasingly distracted digital environment. Among these, the Pomodoro Technique—structured cycles of focused work followed by short breaks—has been widely adopted due to its simplicity and psychological effectiveness. However, conventional Pomodoro timers typically cater to individuals and often lack the dynamic features needed to sustain long-term engagement.

AquaFocus addresses these limitations by combining Pomodoro-based time management with engaging gamification and intelligent feedback. The application transforms user efforts into the visual growth of a shared coral reef, reinforcing

focus through a sense of progression and achievement. Users can collaborate in real time within teams, initiating synchronized Pomodoro sessions and witnessing shared progress. This experience is further enhanced by an integrated AI module, which analyzes historical session data to offer personalized productivity strategies.

This paper introduces the AquaFocus system, outlining its functional architecture, implementation modules, and user-centered design decisions. A comparative evaluation with existing applications such as Forest and Focus To-Do is also provided. The results reveal that AquaFocus significantly improves user engagement and productivity by integrating visual feedback, real-time collaboration, and adaptive intelligence in a single platform.

II. RELATED WORK

Several existing applications implement the Pomodoro technique, task tracking, and gamified productivity. Below is a comparative analysis of six notable applications that influenced the development of AquaFocus:

- 1) [3]Focus To-Do: A hybrid task and Pomodoro timer app available on iOS and Android. It offers to-do list integration, calendar synchronization, and reward badges for completed tasks. Its limitations include a lack of team collaboration and no real-time synchronization.
- 2) [2]Forest: This app promotes focus by allowing users to grow virtual trees during sessions. If the user exits the

app prematurely, the tree dies. Its visual reinforcement is effective but limited to solo use. No productivity analytics or team features are provided.

- 3) **Be Focused[9]:** Designed for individual productivity, this minimalist timer provides flexibility in session lengths and integrates with iCloud. Its basic visual feedback is static, and it lacks gamification or collaboration.
- 4) **Focus Booster[11]:** A desktop-focused Pomodoro tool with emphasis on session analytics and productivity tracking. It targets professionals with advanced reporting but does not include visual reward systems or team engagement.
- 5) **Pomotodo[10]:** Combines task management and Pomodoro in a sleek interface. While effective for individual productivity, its premium features are locked behind a paywall and it offers minimal visual incentives or collaborative tools.
- 6) **Tide[12]:** Integrates ambient sound with focus timing to improve concentration. While innovative in sensory support, it lacks a visual growth mechanic, personalized AI feedback, or multiplayer functionality.

Each of these applications offers valuable insights into user engagement and productivity reinforcement. However, AquaFocus uniquely combines real-time team synchronization, AI-generated motivational feedback, and visual gamification[15] through a growing coral reef ecosystem, positioning it as a comprehensive and socially engaging productivity tool.

III. METHODOLOGY AND SYSTEM DESIGN

AquaFocus is developed using a modular client-server architecture optimized for real-time synchronization, user engagement, and adaptive feedback mechanisms.

A. Frontend

The mobile interface is built using Flutter[5,6], enabling cross-platform support for Android and iOS. The app presents a dynamic coral reef UI that reflects team productivity in real-time. Key screens include Team Dashboard, Pomodoro Timer, Post-Session Survey, and Reef Visualization. UI state changes are triggered via socket listeners and updated locally using reactive components.

B. Backend REST API and Data Flow

AquaFocus utilizes a Node.js + Express.js backend to handle user authentication, reef management, and historical data persistence. RESTful endpoints expose functionality for:

- Creating and joining teams (reefs)
- Storing completed Pomodoro sessions
- Managing reef growth status
- Sending and retrieving AI recommendations

All requests include JWT tokens for security and session integrity. The backend is supported by a MySQL database with an entity relationship model composed of 17 normalized tables. These include users, teams, team_reefs, pomodoro_sessions, user_statistics, and creatures, among others. Relationships are defined

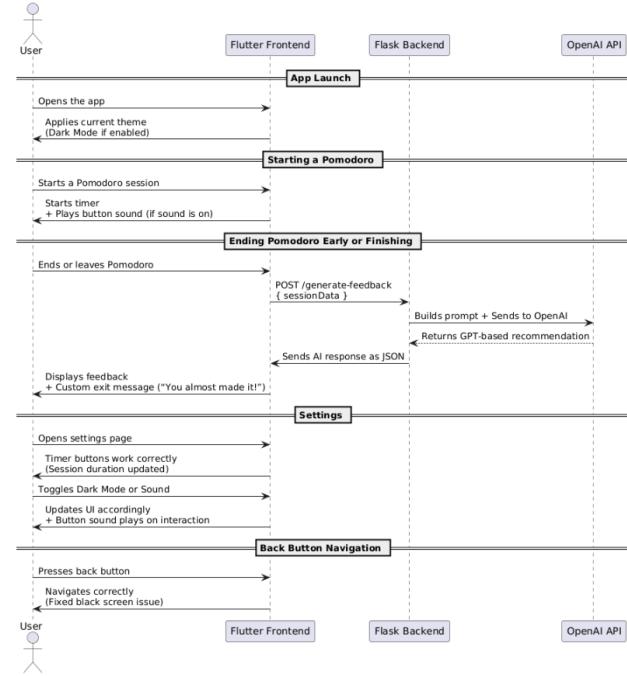


Fig. 1. Frontend interaction sequence: App launch, session handling, and settings (Flutter–Flask–OpenAI).

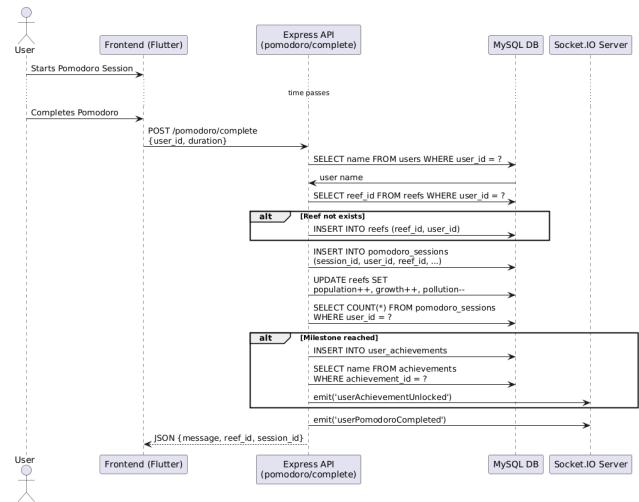


Fig. 2. Backend flow for session completion with database update and socket broadcast.

via foreign keys, allowing precise joins and efficient querying.

C. UI (User Interface)

D. Real-Time Communication via Socket.IO

The system uses Socket.IO to manage real-time events. Clients emit events such as:

- `joinReef(userId, reefId)` – sent when user joins a reef
- `startPomodoro(userId, reefId)` – begins synchronized timer

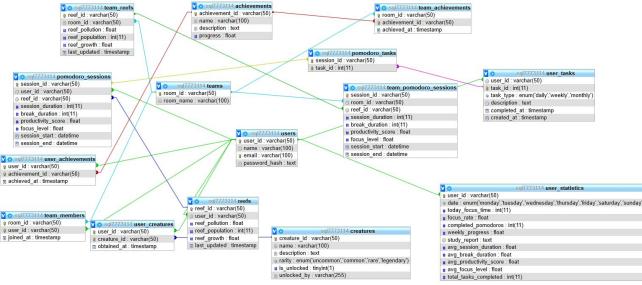


Fig. 3. AquaFocus MySQL Entity-Relationship (ER) Diagram.

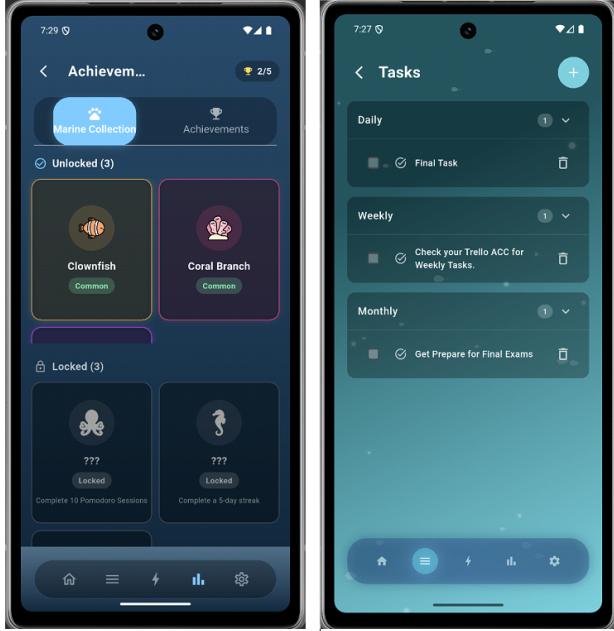


Fig. 4. The Achievements screen displays the achievements earned by the user as well as the locked ones. The Tasks screen lists tasks categorized as daily, weekly, and monthly.

- `endPomodoro(userId, reefId)` – ends session for all team members
- `requestAIInsights(userId, sessionData)` – triggers AI response

Listeners handle corresponding server broadcasts:

- `reefUpdated` – UI reflects coral growth
- `pomodoroStarted/pomodoroEnded` – toggles timer UI
- `aiInsights` – injects personalized tip into UI layer

E. Session Logging and Coordination

Each Pomodoro session is stored in structured JSON format including:

- `userId`, `username`
- `reefId` (team code)
- `sessionStart`, `sessionEnd` (timestamps)
- `completed`, `distracted`, `focusLevel` (self-reported)

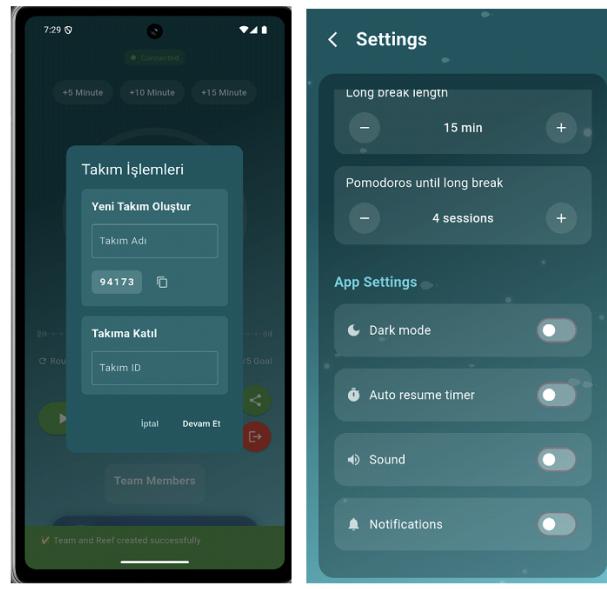


Fig. 5. The left screen allows users to create a new team or join an existing one. The right screen is used to manage application settings such as theme, sound, and notifications.



Fig. 6. The left screen displays the Pomodoro timer, while the right screen is the home screen providing summary information such as time, tasks, and achievements.

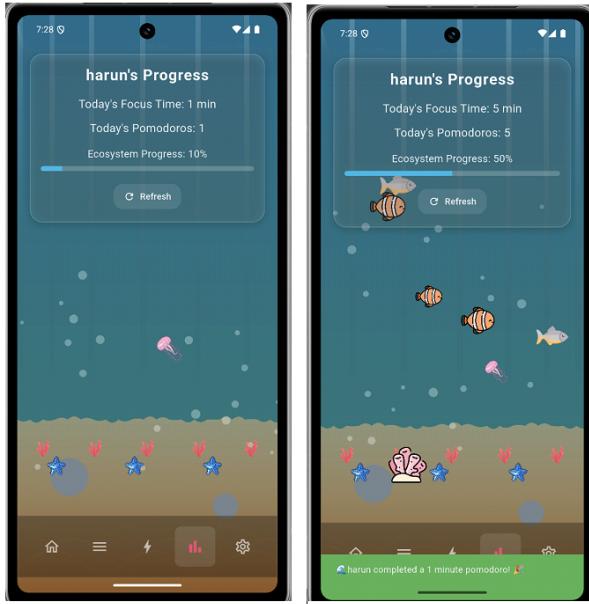


Fig. 7. The Reef screen visualizes the user’s progress in a symbolic ocean environment. As each Pomodoro is completed, the coral ecosystem improves.

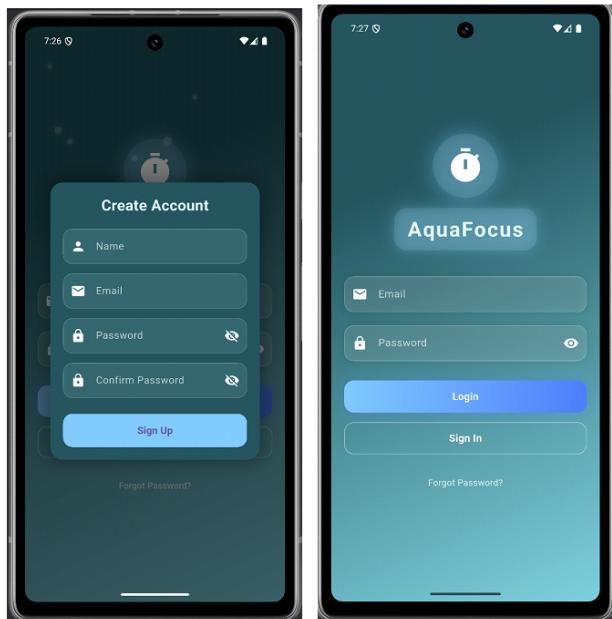


Fig. 8. The left screen contains form fields for new user registration. The right screen is the login screen, allowing access with a username and password.

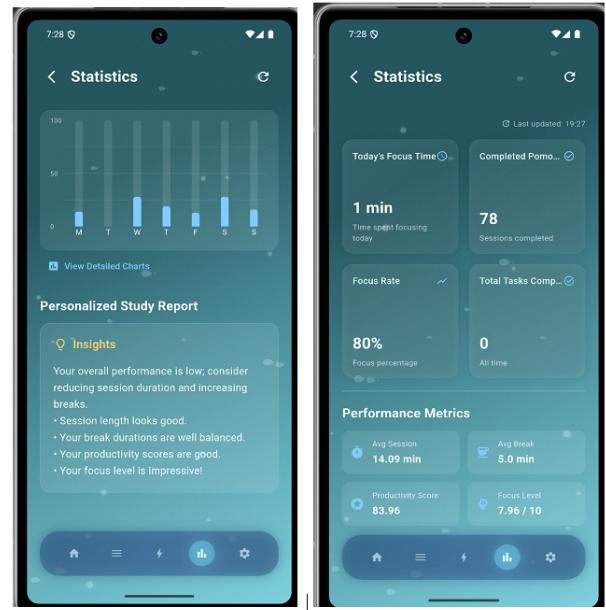


Fig. 9. The Statistics screen visualizes information such as daily focus duration, number of completed sessions, and average productivity, presenting it to the user in an accessible format.

This ensures precise coordination across devices and serves as input for the AI model.

F. AI Feedback Engine

FastAPI hosts a Python-based microservice that receives session metadata and returns motivational insights. Example output:

```
{"userId": 101, "tip": "Avoid multitasking in the ..."}
```

G. Reward Design

Growth is visually reflected by animated coral/sea life elements. Users unlock marine animals as milestones:

- 5 sessions: Clownfish
- 10 sessions: Octopus
- 25 sessions: Starfish reef expansion

Reef progress and unlocked creatures are rendered live using data emitted from the server post-session.

IV. IMPLEMENTATION

The AquaFocus mobile application has been fully implemented with all core UI components and backend integrations functioning in sync. The application supports dynamic real-time collaboration and allows seamless communication between screens and services.

A. Team Creation and Join Screen

Users can create new teams or join existing reefs using a unique code. This screen is connected to the backend through RESTful API calls and emits a `joinReef` event upon successful authentication. The reef information and associated team members are loaded and displayed in real time via socket listeners.

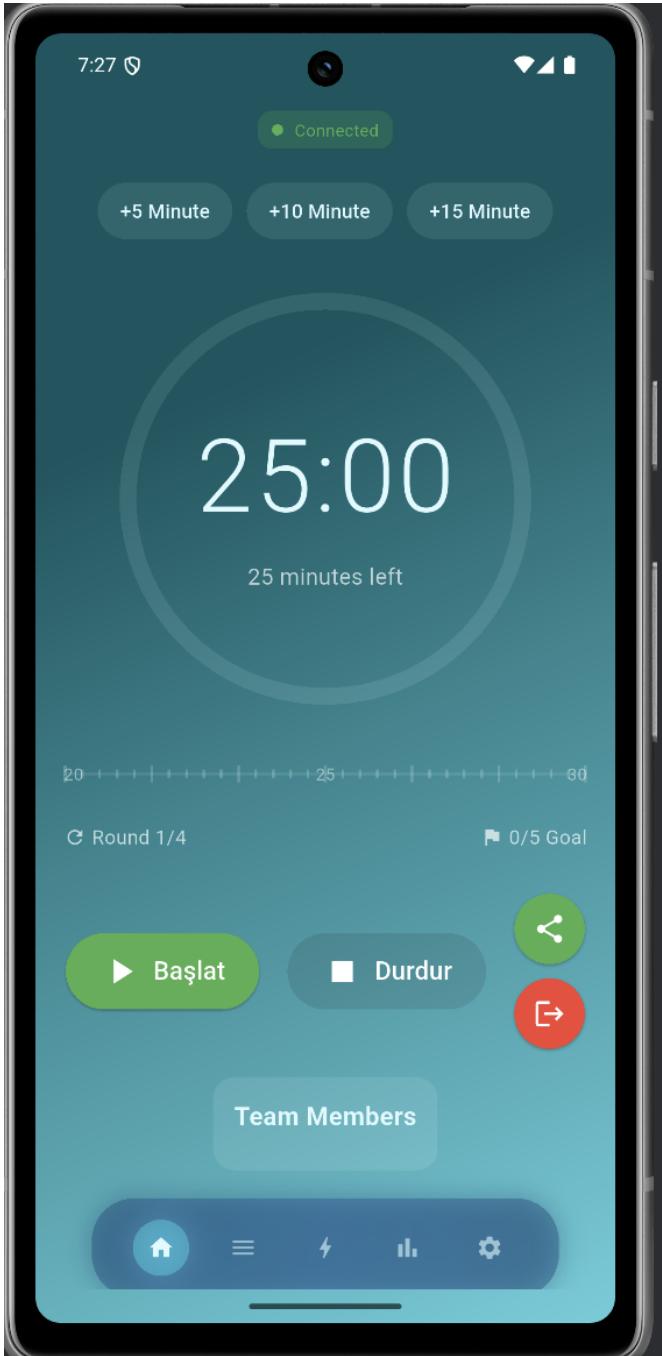


Fig. 10. The team-integrated Pomodoro timer screen enables users to work synchronously within a team and supports goal tracking collaboratively.

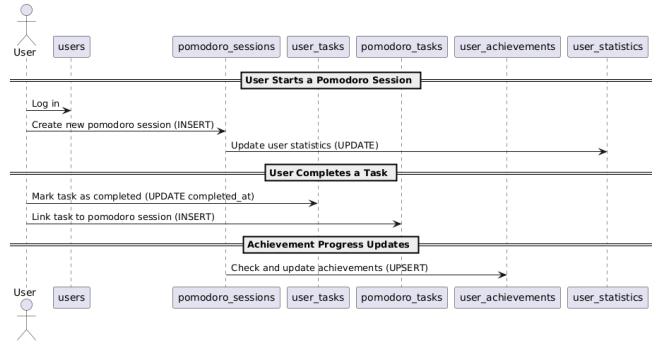


Fig. 11. Sequence diagram of user-task-session-achievement interactions in the database.

B. Home and Session Dashboard

The home screen displays the current team reef status, online team members, and session summaries. All data shown here is fetched from the backend via API requests and updated in real time using `reefUpdated`, `pomodoroStarted`, and `pomodoroEnded` socket events. The UI dynamically reflects coral growth animations and badge progress.

C. Pomodoro Timer Interface

The timer screen handles session initiation, pause, and completion. It emits the `startPomodoro` and `endPomodoro` events and listens for confirmation events from the server to synchronize timers across all users in the reef. The timer's lifecycle is tightly coupled with the backend logging mechanism to ensure consistent record keeping.

D. Post-Session Survey

Upon completion of each session, users are prompted with a survey to self-evaluate their focus level and distractions. Submitted responses are sent to the FastAPI AI engine. The resulting feedback is received via the `aiInsights` event and rendered on-screen. This screen also logs session metadata into the database.

E. Statistics and Analysis Screen

In this study, we developed an AI-powered backend system that collects user productivity data and transforms it into actionable insights through a FastAPI-powered web service. The system provides users with personalized feedback by analyzing Pomodoro-based study sessions, task completion records, and temporal usage patterns.

1. Data Aggregation Raw data is fetched from a MySQL database comprising two key tables: pomodoro sessions and user tasks. Session data includes duration, break time, self-reported productivity scores, and timestamps. These are pre-processed using Pandas for timestamp normalization and statistical aggregation. Task data is used to calculate total completed tasks, enhancing the context of the productivity analysis.

2. Feature Extraction and Clustering To capture user behavior patterns, we compute several per-user aggregate features:

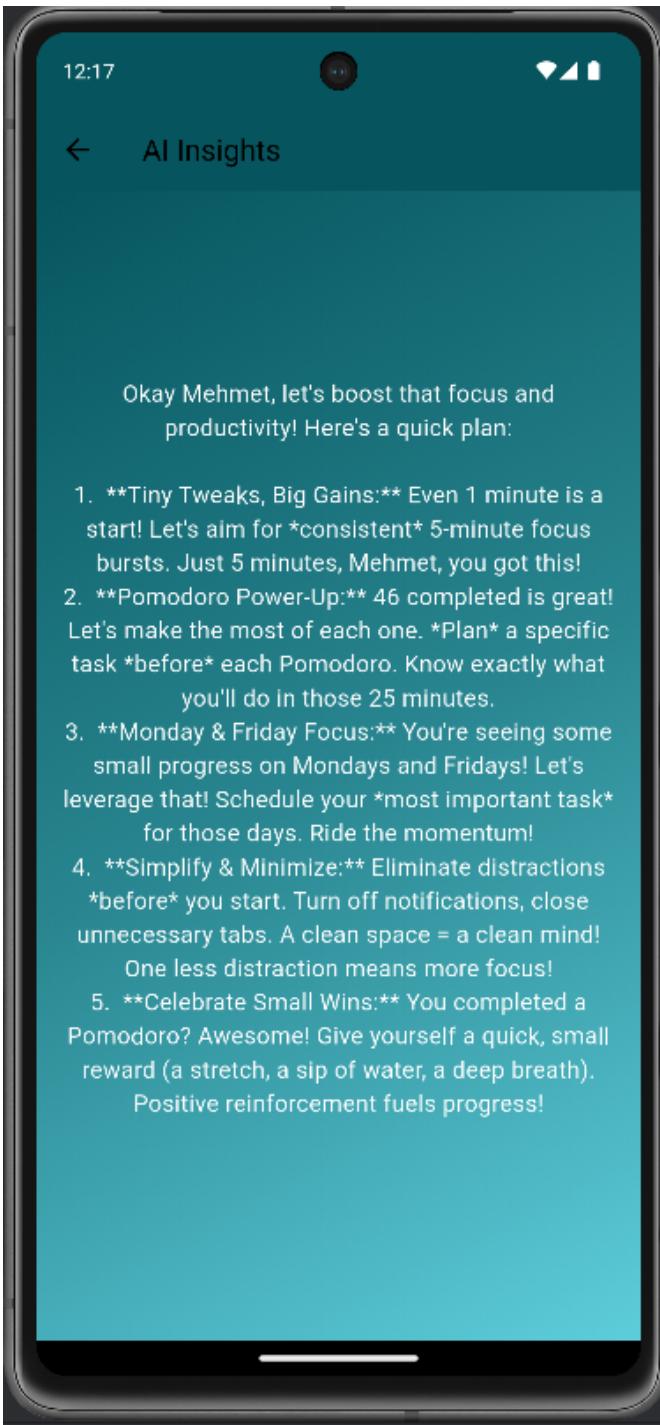


Fig. 12. AI Insights screen displaying personalized study recommendations based on Pomodoro history. Each tip is dynamically generated using session metadata such as completion count, weekday performance, and focus trends. The AI engine, powered by FastAPI and a rule-based generator, provides actionable suggestions to enhance productivity.

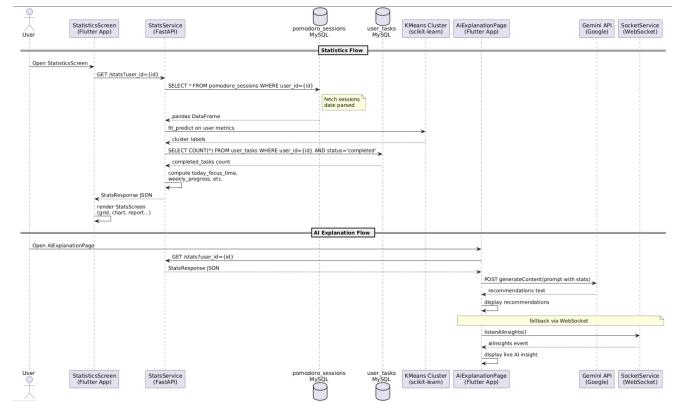


Fig. 13. Statistics and AI explanation data flow from FastAPI to frontend.

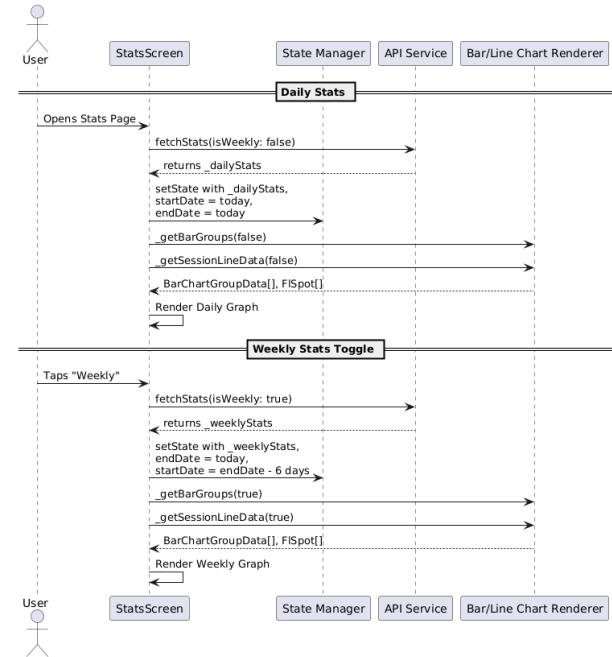


Fig. 14. Frontend sequence for rendering daily and weekly stats charts.

average session duration, average break duration, productivity score, focus level, and total completed Pomodoro sessions. A clustering algorithm (K-Means, k=3) is applied to these features to categorize users into performance tiers: high, average, and low. When fewer than three users exist, the system assigns a default cluster.

3. Personalized Feedback Generation Based on the user's cluster and detailed feature profile, a rule-based recommendation engine generates personalized study tips. These include suggestions for optimizing session length, improving break quality, and boosting focus levels. For instance, users with low focus and long sessions are advised to shorten session duration and increase break intervals. Conversely, high-performing users receive reinforcement messages to maintain their strategies.

4. Temporal Analysis of Weekly Study Patterns Weekly

progress is visualized by aggregating average daily session durations normalized over a 90-minute baseline. Days are mapped to their corresponding abbreviated form (e.g., ‘M’ for Monday) to form a compact vector that reflects consistency and temporal rhythm in the user’s study habits.

5. FASTAPI Design All analytics and AI features are exposed via two primary endpoints:

/stats: Returns the complete user statistics profile, including today’s focus duration, total sessions, focus rate, weekly heatmap, averages, and AI-generated study report.

/sessions: Provides a raw list of the user’s Pomodoro sessions for frontend consumption or auditing.

The API adheres to FastAPI principles and returns structured JSON conforming to Pydantic schemas, ensuring type safety and ease of integration.

F. Achievement and Reef Growth View

All achievements (e.g., Clownfish, Octopus) are unlocked based on cumulative session completion. This screen retrieves user progress via API and listens for server-triggered reef growth updates. The reef view includes animated coral and creature models mapped to achievement tiers.

G. Socket Debug and Session Tracking

Internally, all socket events and responses are tracked using JSON log files and console debug states. These logs assist in monitoring event flow, user activity, and potential connection drops. Each event carries the userId, reefId, and timestamp for traceability.

All of these screens are fully functional, interconnected, and validated in multi-user scenarios. The application ensures consistency across devices and supports real-time Pomodoro collaboration powered by integrated socket and RESTful communication layers.

V. DISCUSSION

Compared to existing Pomodoro-based productivity applications, AquaFocus introduces several unique enhancements that significantly improve user engagement and collaboration.

While applications like Focus To-Do and Forest offer visual or motivational feedback, they lack real-time synchronization, team interaction, and AI-guided productivity analysis. Focus Booster and Be Focused provide professional time-tracking features but are restricted to solo users without social or gamified components. AquaFocus fills this gap by enabling users to work in collaborative teams, see synchronized progress, and visualize their collective achievements through reef growth.

One of the most distinctive features of AquaFocus is the socket-based real-time engine, which allows actions like starting or ending sessions to be reflected immediately across all team members’ devices. No comparable implementation was observed in the reviewed applications. Furthermore, the project leverages structured session logs and FastAPI-based personalized AI feedback, empowering users with actionable productivity tips—a feature that remains largely absent in other tools.

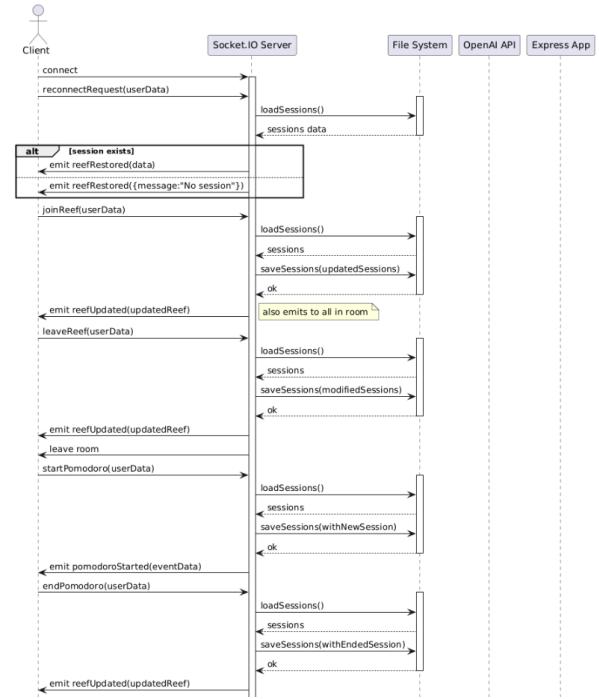


Fig. 15. Session lifecycle involving room join and timer update events.

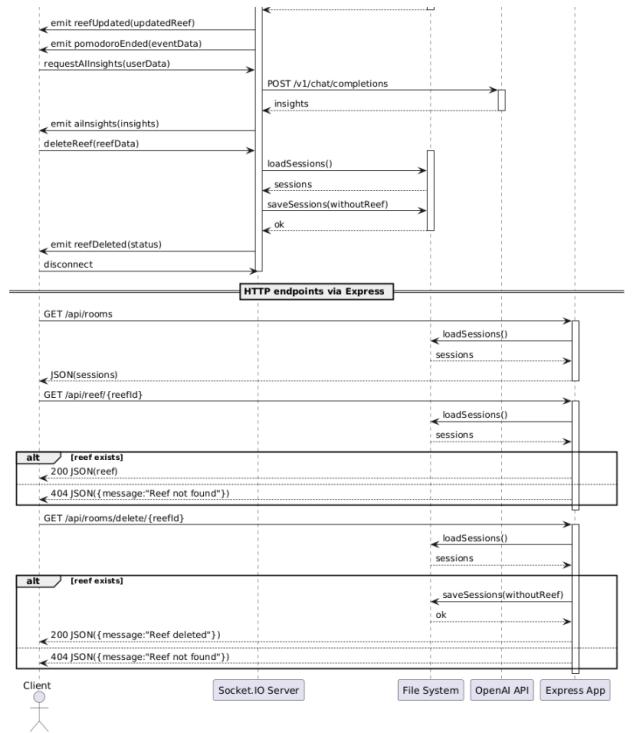


Fig. 16. Socket-based AI insight triggering after post-session feedback.

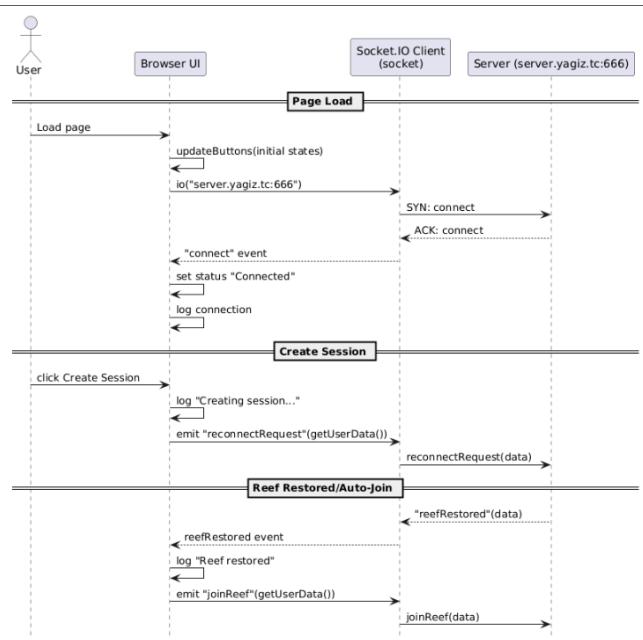


Fig. 17. Real-time communication for Pomodoro session start broadcast.

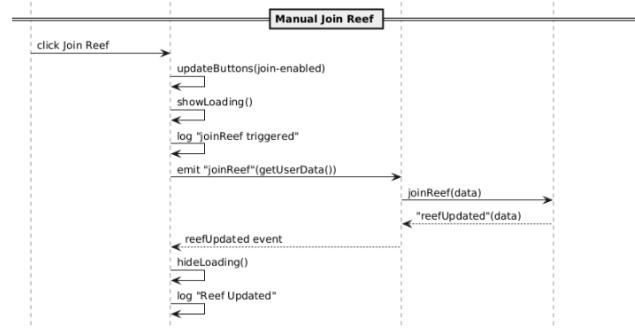


Fig. 18. Room joining flow showing socket identity and reef tracking.

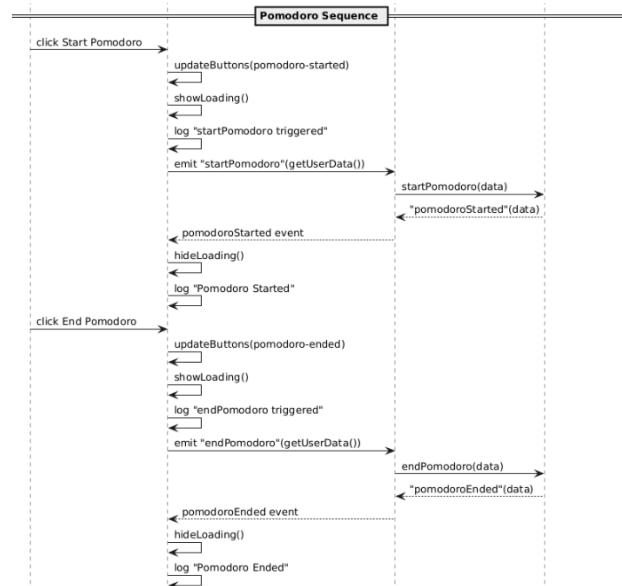


Fig. 19. Session timer sync mechanism across multiple users.

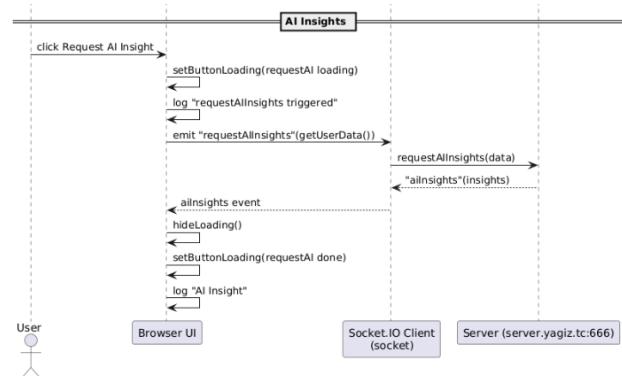


Fig. 20. AI message response integration into chat-like interface.

Another competitive advantage lies in AquaFocus's integrated achievement and reward system. Unlocking marine creatures and watching the coral reef evolve provides continuous visual reinforcement, enhancing both short-term satisfaction and long-term commitment.

Finally, it is worth noting that the entire AquaFocus system, including frontend, backend, socket server, database integration, and AI microservice, has been developed with zero financial cost. All components were implemented using open-source technologies and personal effort without commercial investment. This makes AquaFocus not only a technically rich project but also a cost-efficient, replicable solution for education or non-profit productivity environments.

VI. CONCLUSION

AquaFocus successfully bridges the gap between individual time management and collaborative productivity through a well-integrated Pomodoro system enhanced by gamification and intelligent feedback. The use of a dynamic coral reef as a visual metaphor introduces a tangible sense of progression that keeps users motivated. Unlike many competing applications, AquaFocus facilitates real-time synchronization among team members using Socket.IO, allowing users to start, monitor, and complete sessions together with seamless data consistency.

From a technical standpoint, the app integrates a Flutter-based mobile frontend, a Node.js backend, a Python FastAPI microservice, and a MySQL database, each fulfilling specific architectural roles to ensure low latency, stability, and personalized interactions. The reward system—unlocking marine creatures with session milestones—boosts user satisfaction by transforming routine task management into a goal-oriented experience.

Short-term operation of the application consists of four cyclical stages: (1) User authentication and reef joining, (2) synchronized session initiation, (3) post-session reflection and AI tip generation, and (4) visual feedback and reef updates. These repeating loops promote habit formation and offer continuous reinforcement through progress visibility.

Planned future improvements include cross-platform synchronization (web and desktop), friend-list based productivity

circles, deeper integration of historical session analytics into the AI engine, and more elaborate reef ecosystem expansion mechanics. These enhancements aim to make AquaFocus a richer, more inclusive environment for long-term focus, teamwork, and growth.

Ultimately, AquaFocus represents a zero-cost, technically robust, and socially engaging productivity platform. It demonstrates how modern mobile development, socket communication, and behavioral design principles can come together to address one of the most persistent challenges of the digital age—staying focused.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to Kültür University lecturer Büşra Kocaçınar, MSc., for her invaluable guidance and insightful suggestions throughout the development of this project. Her academic support and constructive feedback played a pivotal role in shaping AquaFocus into its current form. We are truly thankful for the direction and encouragement she provided during critical stages of this work.

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APPENDICES

Appendix A: Sample Socket Events

- **Emitted Events:**

- `joinReef`: Sent when a user joins a team reef.
- `startPomodoro`: Triggered when Pomodoro session begins.
- `endPomodoro`: Emitted after Pomodoro ends.
- `requestAIIInsights`: Sent to AI service with session data.

- **Listened Events:**

- `reefUpdated`: Broadcasts reef progress to team members.
- `pomodoroStarted`: Indicates synchronized session start.
- `aiInsights`: Returns motivational feedback to UI.

Appendix B: Post-Session Survey Example

- **How focused were you during this session?** (1 to 5 stars)
- **Did anything distract you?** (Free text)
- **Would you like a motivational tip for your next session?** (Yes/No)

Appendix C: Reef Growth Criteria

- Every successful Pomodoro adds 1 coral animation unit.
- 5 sessions = unlock fish animation.
- 10 sessions = unlock octopus animation.
- 25 sessions = full reef badge achievement.