



ANERIS

Operational Sensing Life Technologies for Marine
Ecosystems

D4.1 - AMAMER Code and Documentation

Lead Beneficiary: Dribba

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Preface

ANERIS introduces **Operational Marine Biology (OMB)** as a dynamic system for biodiversity tracking. This system emphasizes consistent, long-term monitoring of marine and coastal ecosystems, aiming for quick analysis and sharing of this vital data.

Our approach includes pioneering the next wave of scientific tools and methodologies for marine life detection. We're focusing on crafting instruments that blend diverse sensing technologies - **genomics, imaging-bio optics, and community-driven science**. A key tool, **AMAMER**, exemplifies our commitment to community-led scientific discovery.

We will employ a collaborative design strategy, engaging stakeholders from **academia, industry, civic groups, and government**. This approach will be applied in varied case studies, using ANERIS innovations, existing commercial tools for enhancement, and leading research infrastructures (RI).

Part of our project includes a specialized training program, targeting all stakeholders, especially RI personnel, on using these new technologies effectively.

Ultimately, the core goal of our project is enhancing the 'quintuple helix' model of innovation, promoting the sharing of knowledge across various sectors:

Academic institutions: Adopting cutting-edge technologies for research.

Industrial sectors: Leveraging novel technologies and methods.

Governments: Utilizing improved data and systems for environmental governance.

Civil Society: Fostering engagement and extensive network collaborations through participatory technologies.

Research Infrastructures: Incorporating state-of-the-art sensing tools, with specialized training for their personnel.

Purpose

What is the aim of this document?

The purpose of this document is offering a detailed overview of the AWIMAR code and its accompanying documentation, which have been developed under the EU Horizon Europe ANERIS Project. This document is primarily intended to:

- Outline the key specifications and objectives of AMAMER.
- Elaborate on the functionality of AMAMER, detailing its features and the connection with other ANERIS initiatives.
- Delve into the technical construction of AMAMER.
- Detail the forthcoming phases of the AMAMER project.

Who is responsible for creating/updating this document?

Dribba stands as the principal architect behind AMAMER, tasked with crafting a cross-platform Flutter mobile application for both iOS and Android, as well as other essential software components. This concerted effort is directed at actualizing the AMAMER project. Regarding the creation and updates of this document, the responsibility lies with **Dribba's** dedicated team, ensuring that the information remains accurate, up-to-date, and in alignment with the ongoing development of AMAMER.

Key stakeholders and target audience

The objective of this document is to equip stakeholders, researchers, and developers with a clear understanding of AMAMER's objectives, capabilities, and technical underpinnings, thereby ensuring its effective deployment, use, and ongoing enhancement.

List of Abbreviations

APK - Android Application Package

CD - Continuous Deployment

CI - Continuous Integration

QA - Quality Assurance

UI - User Interface

UX - User experience

What is AMAMER?

AMAMER, standing for **A**dvanced **M**ultiplatform **A**pp for **M**arine **l**ife **R**eporting, serves as a pioneering mobile application designed to streamline the reporting, sharing, and examination of marine life data. It is a multiplatform tool that extends the participatory citizen observatory model to mobile users on both iOS and Android devices. The application is closely aligned with UNESCO's Sustainable Development Goals (SDG), specifically focusing on SDG14 'Life Below Water' and SDG15 'Life On Land', making it a key player in mobilizing citizen scientists towards these global objectives.

While its counterpart, AWIMAR, caters to web-based interactions, AMAMER offers a user-friendly, adaptive interface for mobile platforms, encouraging a wider participation in the documentation of marine biodiversity. AMAMER is crafted to address the need for a specialized tool that not only supports terrestrial data but also emphasizes marine observations, which have been historically underrepresented in citizen science observatories. This mobile application aims to engage a diverse and extensive community of volunteers in marine life monitoring and conservation efforts. AMAMER's significant features and its role in the wider network of ANERIS projects highlight its commitment to enhancing marine biodiversity reporting and supporting environmental sustainability goals.

Turning AWIMAR more accessible with AMAMER

In the realm of user-contributed data, particularly for applications like AMAMER, mobile devices inherently offer several advantages over traditional web browsers for inputting observations. This is primarily due to the ubiquitous nature of smartphones and their built-in functionalities that facilitate on-the-go interaction and data capture. AMAMER leverages the mobile platform to make the process of submitting observations more accessible to users, as it follows:

Convenience and Portability

- **Immediate Data Capture:** Mobile phones allow users to capture and input data instantaneously. When observers encounter a marine species, the convenience of pulling out a smartphone and directly inputting the observation into AMAMER is unmatched by the web-based approach.
- **One-Device Solution:** Unlike web browsers that may require a camera and a computer for the complete process, smartphones consolidate these tools into one, providing an all-in-one solution for capturing and uploading observations.

Integrated Hardware Capabilities

- **GPS Functionality:** Smartphones are equipped with GPS, enabling precise location tagging of observations automatically. This is crucial for the accuracy of marine life reporting.
- **Camera Integration:** High-quality cameras on smartphones simplify the process of documenting observations with photos or videos, which can be directly uploaded to AMAMER.

Intuitive User Interface

- **Touchscreen Input:** The touchscreen interface of mobile devices is inherently user-friendly for data entry. Allowing a quick, tactile interaction with the app, making the submission process faster and more intuitive than typing on a web browser.

- **App Design:** Mobile apps are designed with the user's touch interaction in mind, often resulting in a more streamlined and simplified data entry process compared to web forms.

Connectivity and Accessibility

- **Offline Capabilities:** Mobile apps like AMAMER can offer offline capabilities, allowing users to input observations without an immediate internet connection and synchronization later.
- **Push Notifications:** AMAMER can utilize push notifications to remind users to report their observations, something that is more immediate and noticeable on mobile devices than on website browsers.

Engaging User Experience

- **Interactive Features:** Mobile apps can incorporate interactive elements like swiping, tapping, and pinching to zoom, which can make the experience of inputting data more engaging.
- **Gamification:** The mobile version of AMAMER can more easily integrate gamification elements to encourage frequent and consistent reporting from users.

How does AMAMER work?

AMAMER operates through a streamlined and user-friendly three-step process that mirrors the functionality of its web-based counterpart, AWIMAR. This process is designed to engage users in the active documentation and sharing of biodiversity observations, fostering a collaborative community approach. It works as follows:

- **Capture and Identify Species:** The first step in the AMAMER experience involves users capturing images of marine species. This could be anything from a rare fish to a commonly found seaweed. The focus here is on taxonomy - the identification and classification of species. Users can take pictures using their mobile devices, which can

then be tagged with relevant taxonomic information. This feature is not only integral for data collection but also serves as an educational tool for users to learn more about marine biodiversity.

- **Upload to the Platform:** Once the picture is captured, the user uploads it to the AMAMER platform. This step is crucial as it involves the transition of the observation from a personal encounter to a shared data point. During the upload process, users are encouraged to add additional information such as the location of the sighting, environmental conditions, and any other observations that might be relevant. The platform is designed to be intuitive and efficient, ensuring that the upload process is as seamless as possible.
- **Community Interaction:** The final step involves the community aspect of AMAMER. Once an observation is uploaded, it becomes part of the larger AMAMER database, accessible to other users. This fosters a sense of community as users can interact with each other's findings, provide identifications, share insights, or even collaborate on marine life research. The platform's interactive features allow for discussions, comments, and even voting on identifications, which not only enriches the data but also engages users in a meaningful way.

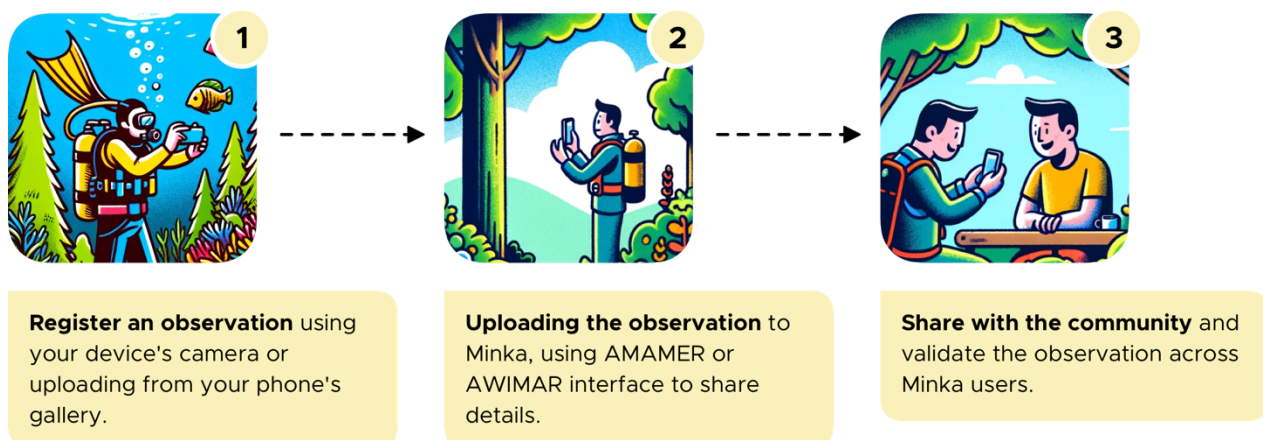


Figure 1 Process on how AMAMER (via MINKA) works.

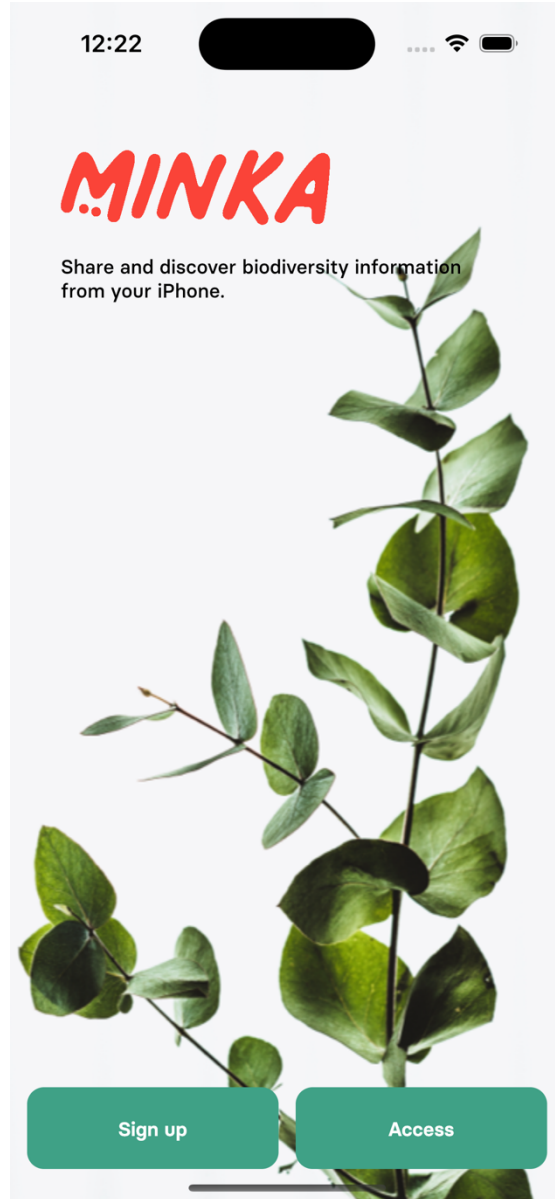


Figure 2 Authentication/Main Screen for Minka (AMAMER)

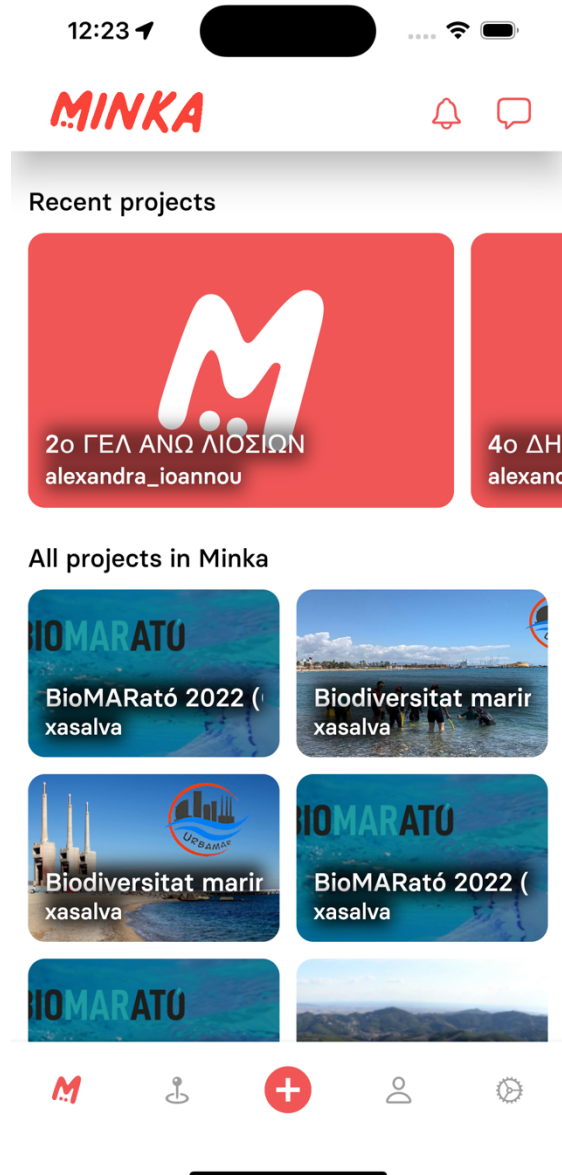


Figure 3 Projects in Minka

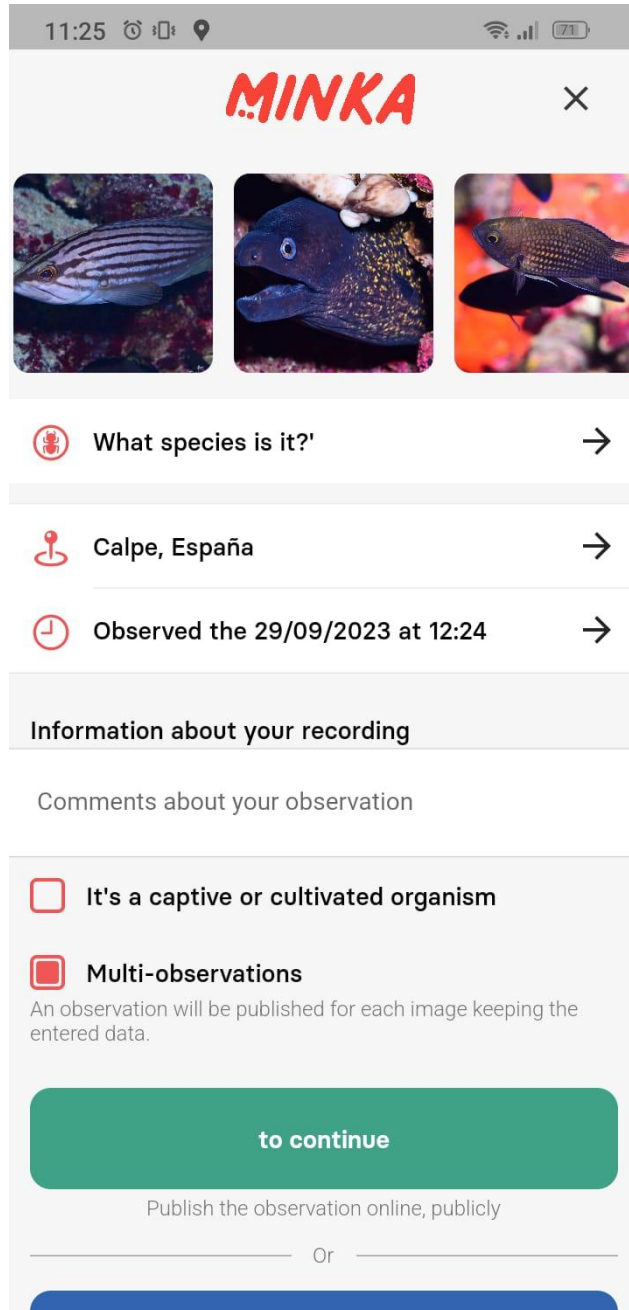


Figure 4 Reporting observation in Minka

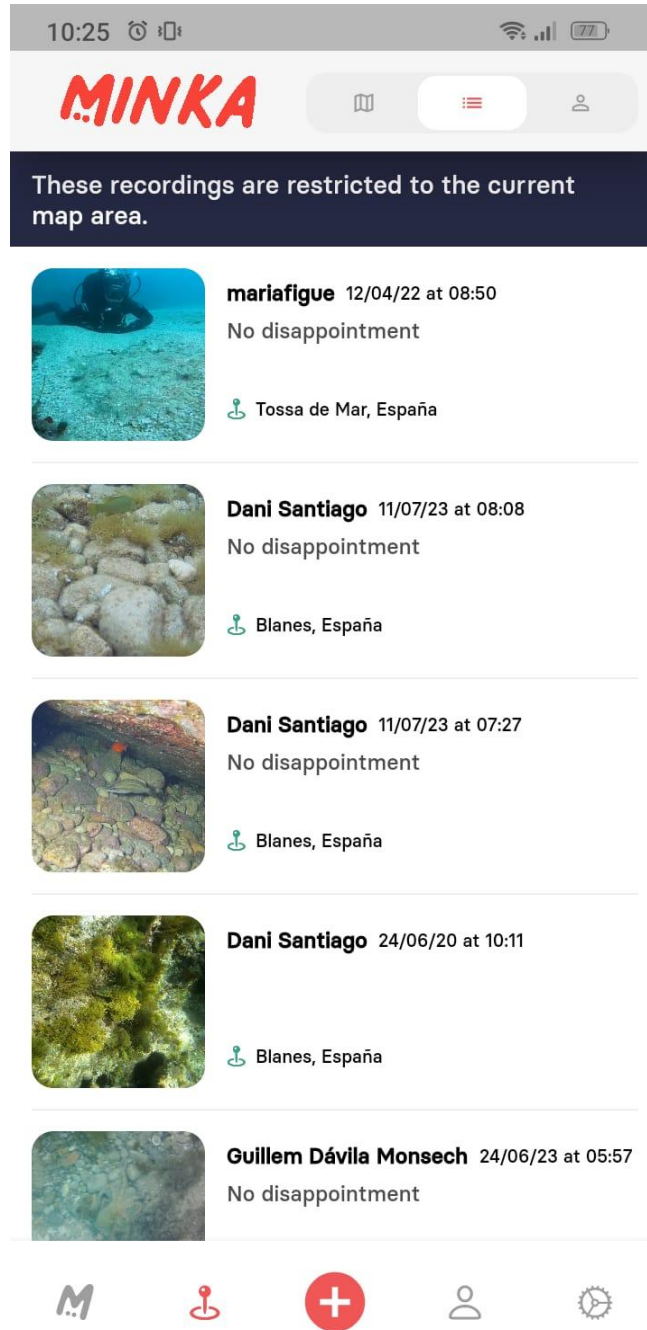


Figure 5 Observation exploration in Minka

Similarities and differences between AWIMAR and AMAMER

While both AMAMER and AWIMAR share the fundamental process of capturing, uploading, and community interaction regarding marine life, each one has unique strengths and functionalities based on their respective technologies. Understanding these differences is key to leveraging each tool effectively.

- **Mobile Device Advantage:** AMAMER stands out for its speed and ease of use, primarily due to its mobile-based platform. The ubiquity of smartphones allows users to quickly capture and upload images of marine species. This immediacy is a significant advantage, especially in fieldwork or casual observations where a laptop might not be readily accessible.
- **Direct Data Extraction:** Another key feature of AMAMER is its ability to directly utilize the smartphone's capabilities. It can automatically extract vital data such as geographical location, time, and other picture metadata. This not only streamlines the data entry process but also enhances the accuracy of the information associated with each observation.
- **On-the-Go Interaction:** AMAMER is particularly effective in increasing user engagement outside of traditional settings like offices or laboratories. Its mobile nature allows users to interact with the platform in various environments, which could be during a beach walk, a diving trip, or a research trip. This flexibility encourages more frequent and spontaneous contributions from a diverse user base.
- **Optimized for Bulk Data Handling:** AWIMAR, being web-based, is more suited for extensive data reporting and tagging. The comfort and ease of using a laptop or desktop computer facilitate the handling of large amounts of data. Users who need to upload and tag multiple observations at once, or who require a more detailed analysis and categorization of data, may find AWIMAR more convenient and efficient.
- **Comprehensive Reporting Tools:** Additionally, the larger screen and more robust processing power of desktop systems make AWIMAR ideal for detailed reporting and analysis. It offers a more comfortable interface for long-term work sessions and complex data management tasks, which are essential for thorough marine life study and reporting.

Requirements Analysis

Functional requirements

Integration of AWIMAR improvements and up-to-date functionalities

To maintain its relevance and effectiveness alongside its web-based counterpart, AWIMAR, AMAMER is set to undergo significant enhancements, particularly in the realm of essential variables reporting. This development aligns AMAMER with AWIMAR's expanded scope, which now includes the reporting of critical environmental data observations alongside biodiversity observations.

- **Independent Environmental Observations:** Following feedback from ANERIS partners, AMAMER will also work towards enabling the reporting of environmental observations that are independent of biodiversity data. This means users will have the flexibility to submit observations focused solely on environmental variables, thereby enhancing the app's utility for a broader range of research and monitoring activities.
- **User Interface and Experience:** In terms of UI/UX, AMAMER will ensure that the process of recording environmental variables is as intuitive and seamless as the current process for biodiversity observations. This consistency in design will aid user adoption and ease of use.

Implementation of an offline solution

Offline capabilities in applications are critically important, especially for tools like AMAMER that are used in environments where internet connectivity is inconsistent, limited or non-existent, such as remote marine locations. By incorporating offline functionality, AMAMER ensures that researchers and citizen scientists can continue to record and access vital marine life data without having continuous internet connection. This feature not only enhances the usability of the application in remote fieldwork situations but also ensures that data can be captured in real-time and synchronized later when a connection is re-established, thereby preventing data loss and ensuring the integrity of the information collected.

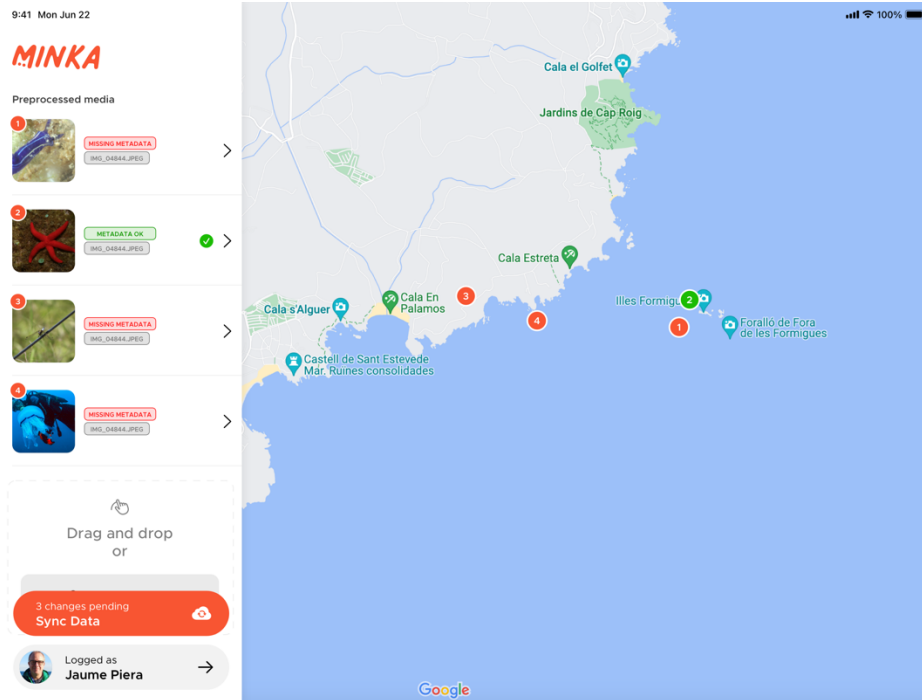


Figure 7 AMAMER offline implementation for Desktop or Tablet devices.

To implement offline capabilities using Flutter for desktop, developers can take advantage of Flutter's cross-platform nature, which allows for the creation of a unified codebase that runs on multiple operating systems, such as Windows, macOS, and Linux. Below there are key steps and considerations for achieving offline functionality in a Flutter desktop application:

- **Local Data Storage:** Implementing local storage solutions like SQLite to store data locally on the device.
- **Data Synchronization:** Designing a data synchronization mechanism that handles the transfer of data between the local storage and the server when the application goes online. This might involve the use of background services or daemons that periodically check for connectivity and sync data accordingly.
- **State Management:** Employing robust state management solutions to track the application's state across offline and online scenarios. This is crucial for providing a seamless user experience, where the app's UI reflects the current state accurately.
- **Error Handling:** Developing comprehensive error-handling strategies to manage scenarios where data cannot be synced immediately due to lack of connectivity. The

application should be able to queue data for synchronization and inform the user appropriately.

- **User Interface Considerations:** Adjusting the user interface to inform users of the offline or online status and to enable them to interact with the stored data. Indicators and notifications can be implemented to alert users when the app goes offline or comes back online.
- **Testing:** Rigorous testing of the offline mode to ensure data integrity and consistency. This includes testing the app's behavior in various network conditions to ensure that the user experience remains consistent.

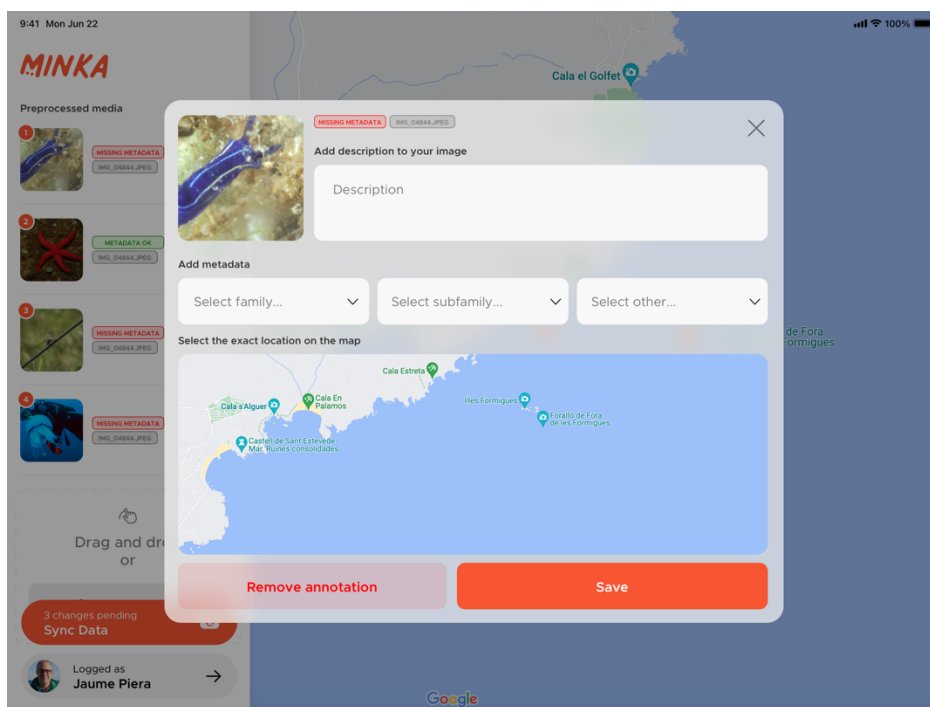


Figure 8 Observation management in offline mode

By incorporating these strategies into the development of AMAMER's offline desktop application, the tool becomes significantly more resilient and user-friendly for those in the field. Researchers can record observations at the moment without the risk of losing data, making the application a reliable tool for marine conservation and study. The use of Flutter's desktop

framework provides a scalable and efficient way to build this functionality, leveraging its rich set of libraries and its single codebase philosophy to create a robust offline-capable application.

Bug fixing and maintenance

Maintaining a bug-free environment in AMAMER (MINKA mobile) is essential for ensuring a high-quality user experience. The performance and reliability of software products are directly linked to their quality, and frequent bugs can significantly diminish user trust and application credibility. In the context of citizen science and data collection, where accuracy and dependability are paramount, the presence of bugs can lead to erroneous data capture, thereby undermining the integrity of research findings and conservation efforts.

Regular updates and bug fixes are not just about rectifying errors, but a commitment to the app's continuous improvement and adaptability. Updating packages is an integral part of this process, as it helps protecting it against security vulnerabilities, ensures compatibility with the latest operating system versions, and provides access to improved functionalities. In the case of Flutter applications, staying up-to-date with the latest Flutter SDK and its packages can lead to performance optimizations, quicker runtime, and a more seamless user interface.

Non-functional requirements

UI and UX improvements

In the pursuit of excellence, the AMAMER project has placed user feedback at the heart of its user interface (UI) and user experience (UX) design strategies. Recognizing that an intuitive and engaging platform is crucial for the effective reporting and analysis of marine life data, our team has committed to an iterative design process that is responsive to user input. This dedication to improvement is reflected in a series of enhancements that have been methodically integrated into AMAMER.

- **User-Centric Design Philosophy:** Our UI/UX improvements begin with a user-centric design philosophy. By conducting comprehensive surveys and focus groups, we have gathered actionable insights directly from our users. These insights have driven the evolution of AMAMER's interface to be more aligned with the needs and expectations of marine researchers and citizen scientists.

- **Iterative Design and Feedback Loops:** We have implemented continuous iterative design cycles, which allows us to rapidly prototype, test, and refine our UI/UX. This process has led to the creation of a more intuitive navigation structure, simplification of complex workflows, and optimization of the app's overall layout for greater usability.
- **Intuitive Data Entry and Reporting:** The data entry and reporting interfaces have been overhauled to reduce the time and effort required to log observations. We have simplified form elements, enhanced auto-complete functions, and restructured data entry fields to minimize errors and improve the speed of data submission.
- **Performance Optimization:** Recognizing that performance is a key component of user satisfaction, we have optimized the application's performance to ensure quick load times and smooth transitions between different sections of the app. This optimization minimizes frustration and enhances the overall user experience.

As we continue to refine and enhance AMAMER, a key focus for our upcoming development phase is the expansion of onboarding and educational resources. This initiative is currently in our product backlog and is slated as a priority for our next steps in the project's evolution.

- **Enhanced Onboarding Experience:** Recognizing the importance of a smooth and informative onboarding process, we plan to develop a more robust system to welcome and guide new users through the functionalities of AMAMER. This enhanced onboarding experience will aim to quickly acquaint users with the core features and capabilities of the app, ensuring that they can start contributing to marine life reporting and analysis with ease and confidence.

Update of legal aspects and privacy policy

AMAMER, in its dedication to user privacy and legal adherence, has evolved its privacy policies and terms and conditions to align with those established by its companion project, AWIMAR. This harmonization facilitates a cohesive user experience and ensures regulatory compliance across both technologies. Below there is an overview of the adaptations made to AMAMER's legal frameworks in correspondence with AWIMAR's established protocols:

- **Terms of Use:** AMAMER has adopted AWIMAR's Terms of Use, upholding a comprehensive legal agreement that dictates user engagement with the platform. This

includes eligibility criteria, usage guidelines, and the permissions granted by users to AMAMER. The terms now incorporate clear instructions for account deactivation and personal data removal, adhering to privacy laws.

- **Privacy Policy:** The Privacy Policy of AMAMER has been revised to mirror the protective measures of AWIMAR, detailing data storage practices and the specifics of data handling. The policy explicitly outlines the rights of users concerning their data, such as the right to access, amend, delete, or transfer their personal information, and elaborates on consent management procedures.
- **Consent Commons Framework:** AMAMER has integrated the Consent Commons framework, a user-friendly guide to personal data usage that employs visual cues to demystify data practices. This initiative underscores AMAMER's investment in making data privacy more transparent and comprehensible to its users.

Data Licensing Options: Reflecting AWIMAR's commitment to intellectual property rights, AMAMER has introduced various Creative Commons licensing alternatives for user-generated content such as images, data sets, and audio files. These licenses range from Public Domain Dedication to several Attribution models, enabling users to specify how their contributions are utilized within the community.

These changes signify AMAMER's commitment to user-centricity, privacy, and compliance, ensuring a trusted environment that respects user autonomy and promotes transparency.

Incorporation of Continuous Integration

Incorporating Continuous Integration and Continuous Deployment (CI/CD) practices into the development lifecycle is pivotal for enhancing productivity and accelerating time to market. By leveraging Xcode Cloud for iOS and Fastlane for Android, we can streamline the build, test, and deployment processes, ensuring that new features, updates, and bug fixes are delivered quickly and efficiently.

- **Xcode Cloud for iOS** is a continuous integration and delivery service built into Xcode and designed specifically for Apple platforms. It enables us to automate the compilation, testing, and distribution of iOS applications. With Xcode Cloud, every commit can trigger an automated build process, run tests in a clean, encapsulated environment on Apple's

servers, and ensure that the main branch is always release-ready. Moreover, it allows for simultaneous testing across various devices and configurations, highlighting issues that may arise from device-specific conditions. Once the testing is successfully completed, Xcode Cloud can automatically distribute the build to testers, stakeholders, or directly to the App Store.

- **Fastlane for Android** is an open-source platform aimed at simplifying Android deployments. It automates tedious tasks like generating screenshots, dealing with signing issues, and releasing your application. Fastlane integrates with Android's build tooling to compile and package releases, while also managing metadata and deployment to the Google Play Store. Automated testing is part of the process, ensuring that each release meets quality standards. When combined with a robust version control system, Fastlane's actions can be triggered on specific branch commits, ensuring that the master branch remains stable and that any issues are caught and dealt with early in the development cycle.

By implementing CI/CD with Xcode Cloud and Fastlane, we can achieve several benefits:

- **Increased Productivity:** Developers spend less time on repetitive tasks and can focus on creating value through new features and improving existing code.
- **Higher Quality:** Automated testing means that issues can be detected in an early stage, and code quality is consistently maintained.
- **Faster Release Cycles:** Streamlined workflows enable more frequent releases, helping us to respond to market demands and user feedback swiftly.
- **Improved Team Collaboration:** With automated processes, team members can integrate their work more frequently and with less effort, reducing the chances of conflicts and ensuring that the codebase is always in a deployable state.
- **Scalability:** As the project grows, the CI/CD setup scales with it, handling increased loads and more complex workflows without a significant increase in overhead.

System architecture

AMAMER represents a cutting-edge application in the realm of marine life reporting, and its technological architecture is a testament to its advanced capabilities. Built on the robust and versatile Flutter framework, AMAMER exemplifies modern app development, harnessing the power of cross-platform compatibility while ensuring a seamless user experience.

The Core of AMAMER

- **Cross-Platform Efficiency:** Flutter, developed by Google, stands out for its ability to create natively compiled applications for mobile, web, and desktop from a single codebase. This means that AMAMER, while primarily a mobile application, retains the flexibility to expand and adapt to other platforms without significant redevelopment. This cross-platform efficiency is crucial for maintaining consistency in functionality and design across various user devices.
- **Rich UI Capabilities:** Flutter is renowned for its rich set of UI components and the ability to create custom, aesthetically pleasing interfaces. This aligns perfectly with AMAMER's goal of providing an engaging and intuitive user experience, crucial for encouraging user participation in marine life reporting.
- **Enhanced Performance and Simplicity:** AMAMER utilizes GetX, a lightweight yet powerful solution for state management, navigation, and dependency injection in Flutter applications. The choice of GetX contributes to a more organized codebase and an efficient way of managing the app's state, leading to better performance and a smoother user experience.
- **Reactive Programming:** GetX supports reactive programming in Flutter, allowing the AMAMER app to update its UI in real-time in response to data changes. This is particularly useful for displaying updated environmental data, user interactions, and real-time notifications within the app.

Flutter as the core of AMAMER

Flutter, Google's open-source UI software development kit, plays a pivotal role in the development and ongoing maintenance of AMAMER. Its unique features and capabilities make it an ideal choice for building a robust, cross-platform application like AMAMER, which is designed for both iOS and Android, and adaptable for desktop platforms.

- **Single Codebase:** Flutter allows developers to write a single codebase for multiple platforms. This significantly reduces the development and maintenance costs, as the same code can be deployed on iOS, Android, and desktop platforms. It eliminates the need for separate teams to work on different platform versions, leading to more efficient resource utilization and cost savings.
- **Rapid Development with Hot Reload:** Flutter's 'hot reload' feature enables developers to see the changes in code almost instantly, without the need for recompiling the entire app. This accelerates the development process, allowing for quick iterations and faster bug fixes, which in turn keeps maintenance costs low.
- **Rich Set of Pre-Designed Widgets:** Flutter provides a comprehensive suite of pre-designed widgets that conform to specific design languages, such as Material Design for Android and Cupertino for iOS. This reduces the time and effort required to create custom UI elements, lowering the design costs.
- **Performance:** Flutter compiles to native ARM code, which ensures high performance for critical app functions. This performance efficiency is crucial for scaling the app as the user base grows and as more complex features are integrated.
- **Ease of Integration with Existing Code:** Flutter can be integrated into existing applications, allowing for gradual scaling. This means that AMAMER can start as a purely Flutter app or integrate Flutter modules into existing native code, providing flexibility in scaling the app's capabilities.
- **Streamlined Testing Process:** Since the same code runs on multiple platforms, the testing process is streamlined. This ensures that scaling up (adding more features or supporting more users) does not exponentially increase the testing workload.
- **Responsive Framework:** Flutter's responsive framework makes it easy to build UIs that dynamically adapt to various screen sizes and orientations. This adaptability is essential for ensuring that AMAMER provides a seamless user experience on all devices, from the smallest smartphone to the largest desktop screen.
- **Strong Community and Support:** Flutter has a strong community and backing from Google, which ensures regular updates and a plethora of resources. This community support is invaluable for keeping up with the latest developments and implementing fast changes in the app.

Data sharing using the Minka API

The integration of AMAMER with MINKA/AWIMAR is a cornerstone of its functionality, enabling a seamless exchange of data and a unified user experience across platforms. This integration is facilitated through the MINKA REST API, a robust interface that plays a crucial role in the harmonization of data and services between the mobile application (AMAMER) and the web-based platforms (MINKA/AWIMAR).

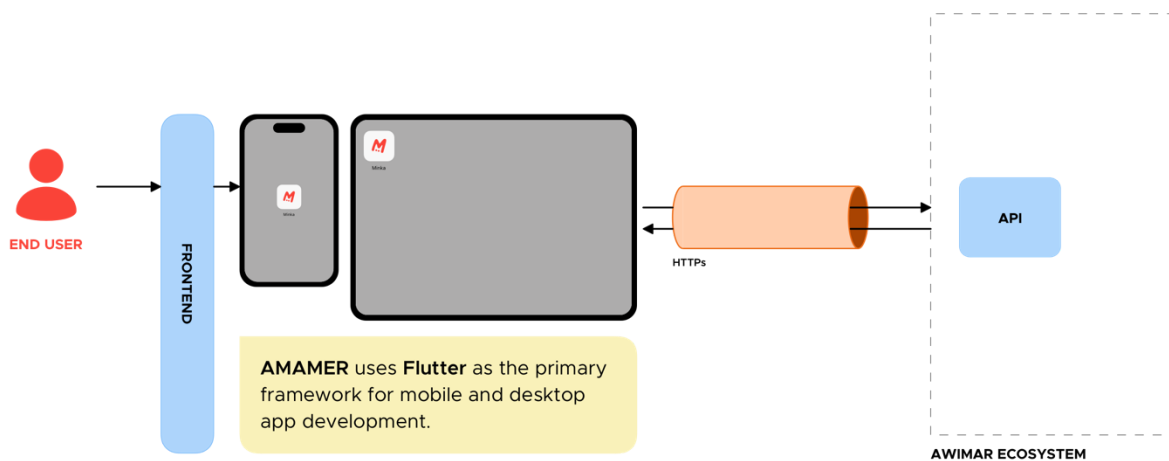


Figure 9 Integration of AMAMER with AWIMAR with the Minka Open API

Understanding the MINKA REST API

- **API Endpoint:** Located at <https://minka-sdg.org:4000/v1/docs/>, the MINKA REST API provides comprehensive documentation and endpoints for various functionalities. This RESTful API is designed to be intuitive, efficient, and secure, ensuring that data transmission between AMAMER and the MINKA/AWIMAR servers is reliable and scalable.
- **Secure Access:** The API utilizes HTTPS for secure communication, ensuring that all data transferred is encrypted and protected. This is critical, given the sensitive nature of the biodiversity and environmental data being handled.

Key Functionalities of the MINKA REST API

- **Data Submission and Retrieval:** The API allows AMAMER to submit new observations, including images and associated metadata, directly to the MINKA/AWIMAR databases. It also enables the retrieval of existing data, facilitating access to a vast repository of marine life information for AMAMER users.
- **User Authentication and Management:** Through the API, AMAMER integrates user authentication processes, including sign-up, login, and user profile management. This ensures that user experiences are consistent across AMAMER, MINKA, and AWIMAR, fostering a cohesive community of users.
- **Environmental Variables Reporting:** The API supports the submission and retrieval of environmental variables, aligning with AMAMER's recent enhancements. Users can report data on various environmental factors, such as temperature and water clarity, which are then made available across the MINKA/AWIMAR network.
- **Real-Time Updates:** Leveraging the API's capabilities, AMAMER can provide users with real-time updates and notifications based on their interactions and interests, enhancing the dynamism and interactivity of the platform.

Benefits of the Integration

- **Unified Data Ecosystem:** The integration creates a unified ecosystem for marine life data, enabling researchers, citizen scientists, and enthusiasts to contribute and access data across different platforms without barriers.
- **Enhanced Data Accuracy and Richness:** With multiple platforms feeding into a single database, the richness and accuracy of the data are significantly enhanced, providing a more comprehensive picture of marine biodiversity.
- **Community Building:** This integration fosters a sense of community, as users from AMAMER, MINKA, and AWIMAR can interact, collaborate, and share insights across platforms.
- **Scalability and Future Expansion:** The RESTful nature of the API ensures that the system is scalable and can accommodate future expansions in terms of features, user base, and data volume.

QA and Testing

In the development process of AMAMER, a critical step in ensuring the application's stability and reliability before any updates or new features are released to the production environment is thorough testing in a staging environment. This practice is a fundamental aspect of our deployment strategy, prioritizing quality and user experience.

- **Purpose and Setup:** The staging environment is essentially a mirror of the production environment. It includes the same configurations, databases, and system architectures as the production servers. This setup is crucial as it provides a realistic and controlled platform for testing.
- **Final Testing Phase:** Before any code is pushed to production, it undergoes extensive testing in the staging environment. This is the final testing phase where the app is evaluated in conditions that closely mimic the actual usage scenarios by end-users.

Benefits of Testing in Staging

- **Issue Identification and Resolution:** Testing in staging helps identify and solve any issues that might not arise during earlier testing phases. This includes bugs, performance bottlenecks, and security vulnerabilities.
- **User Experience Verification:** It allows verification of the user experience in a production-like setting, ensuring that any changes or additions to the app does not negatively impact the usability or overall user satisfaction.
- **Load Testing and Scalability:** The staging environment is also ideal for load testing, assessing how the app performs under high traffic or data processing loads, which is crucial for an app like AMAMER that handles a significant amount of user-generated data.
- **Minimizing Downtime and Risk:** By rigorously testing in staging, the risk of introducing errors into the production environment is significantly reduced, thereby minimizing potential downtime or user inconvenience.
- **Replication of Real-World Scenarios:** In staging, tests are designed to replicate real-world scenarios as closely as possible. This includes testing the integration points, data exchange with the MINKA/AWIMAR API, and ensuring all functionalities work as expected.

- **Stakeholder Involvement:** Sometimes, key stakeholders may be involved in the staging testing process to provide their feedback, especially for major releases or features that significantly impact the user experience.
- **Deployment Readiness:** Only after the application has passed all tests in the staging environment and is deemed stable and efficient, is it cleared for deployment to the production environment.

Deployment and Maintenance

Version control

In the development of AMAMER, Git is employed as the version control system, with GitFlow being the chosen workflow strategy. This combination offers a structured and efficient approach to managing the project's codebase, ensuring that development progresses smoothly, and releases are stable and well-coordinated.

- **Central Repository:** Git serves as the central repository for all the source code, documentation, and other essential files related to AMAMER. This centralized approach enables developers to track changes, revert to previous versions if necessary, and maintain a comprehensive history of the project.
- **Branching and Merging:** Git's branching and merging capabilities are key to managing different development stages and features. This allows multiple developers to work on various aspects of the project simultaneously without interfering with the main codebase.

Benefits of Using Git and GitFlow in AMAMER

- **Organized Development:** GitFlow provides a clear and organized structure for managing various development stages, from feature development to releases.
- **Collaboration and Parallel Development:** Multiple developers can work on different features simultaneously without affecting the stability of the main codebase.
- **Quality Control:** The use of pull requests and code reviews promotes high code quality and adherence to project standards.
- **Flexibility and Speed:** The ability to create hotfixes ensures that critical issues can be quickly addressed and deployed.
- **Traceability and Accountability:** Every change in the codebase is tracked, providing a clear history of modifications and contributions from each team member.

Continuous integration

In the deployment process of AMAMER, Xcode Cloud and Fastlane play pivotal roles in streamlining and automating the release of the application to the App Store and Google Play

Store. This process is meticulously designed to ensure a smooth and efficient deployment, following the rigorous testing in staging environments, as previously mentioned. As required in the section [Functional Requirements](#).

Deployment Using Xcode Cloud for iOS

- **Automated Builds:** Xcode Cloud automates the build process for the iOS version of AMAMER. Once the code is deemed stable and has successfully passed all tests in the staging environment, it triggers an automated build process in Xcode Cloud.
- **Continuous Integration:** Xcode Cloud, as a CI (Continuous Integration) tool, ensures that every change made in the app's codebase is integrated smoothly. It performs automated tests on each build to verify that the integration is successful and that there are no new issues.
- **Preparation for Release:** After a successful build, Xcode Cloud prepares the application for release. This includes bundling the application with the necessary provisioning profiles and certificates required for the App Store.
- **App Store Submission:** Once the app is ready, Xcode Cloud facilitates the submission of the app to the App Store. This includes uploading the app bundle and any metadata associated with the app.

Deployment Using Fastlane for Android

- **Automation with Fastlane:** For the Android version of AMAMER, Fastlane is used to automate various deployment tasks. This includes managing screenshots, metadata, and the building and signing of the app.
- **Testing and Building:** Fastlane also integrates with the Android build process, ensuring that the app is thoroughly tested and properly built before deployment.
- **Play Store Deployment:** Fastlane streamlines the process of deploying the app to the Google Play Store. It automates the submission process, including uploading the APK or App Bundle, updating app listings, and managing release tracks.

Conclusions

As we approach the culmination of this phase of the AMAMER and AWIMAR projects, it is imperative to reflect on the importance of maintaining these platforms with up-to-date features and actively promoting their use in the upcoming months. The successful implementation and continued evolution of these applications are crucial in driving forward the goals of marine life conservation and environmental awareness.

- **Adapting to Technological Advances:** Continuous updates ensure that AMAMER and AWIMAR stay aligned with the latest technological advancements. This includes integrating new features, enhancing user interfaces, and ensuring compatibility with the latest device and operating system updates.
- **Responding to User Feedback:** Regular updates allow for the incorporation of user feedback, which is vital in ensuring that both platforms remain user-friendly and effectively meet the needs of their diverse user base.
- **Ensuring Data Accuracy and Security:** Keeping the apps updated is crucial for the accuracy of data collection and analysis, as well as for maintaining high standards of data security and privacy.

Future Lines of Work for AMAMER

As AMAMER continues to evolve, several key areas have been identified for future development. These enhancements are aimed at refining the app's functionality and user experience, ensuring that it remains at the forefront of marine life reporting and environmental data collection. The following are the primary lines of work that will be focused on in the upcoming phases:

Enhanced Testing Protocols

- **Robust Testing Framework:** Future efforts will be directed towards strengthening the existing testing framework, incorporating more comprehensive automated tests that cover a broader range of scenarios and use cases.

- **Performance and Load Testing:** Special attention will be given to enhancing performance and load testing, ensuring that AMAMER can handle increased user traffic and data processing demands efficiently.
- **User-Centric Testing Approaches:** Incorporating more user-centric testing methods, such as beta testing with a diverse user group, will be a priority. This will help in identifying and addressing real-world usage issues more effectively.

Reporting of Environmental Variables

- **Expanded Data Collection:** A significant upgrade will involve adapting AMAMER to report a wider range of environmental variables, such as water quality metrics, air temperature, and pollution levels.
- **Integration with External Sensors and Devices:** Exploring the integration of AMAMER with external environmental sensors to automate the collection of environmental data will be a key development area.
- **Data Visualization Tools:** Enhancing the app with advanced data visualization tools for environmental variables will be another focus, allowing users to interpret and understand the data more intuitively.

Improved Offline Capabilities

- **Advanced Data Syncing:** Efforts will be made to enhance offline capabilities, particularly focusing on more sophisticated data syncing mechanisms that ensure seamless data integration once the device reconnects to the internet.
- **Expanded Offline Functionality:** Expanding the range of features available in offline mode, such as advanced data entry and access to previously downloaded data, will be a priority.
- **Reliability in Remote Areas:** Enhancing the reliability and usability of AMAMER in remote areas with limited or no connectivity is essential, given the nature of marine life observation.

UI/UX Improvements Based on User Feedback

- **Continuous UI/UX Refinement:** The UI/UX of AMAMER will undergo continuous refinement based on user feedback. This includes simplifying navigation, improving the aesthetic appeal, and ensuring accessibility compliance.

- **Feedback Mechanisms:** Strengthening the feedback mechanisms within the app to gather more insightful and actionable user feedback will be a focus.
- **Personalization Features:** Introducing more customisation options, allowing users to tailor the app according to their preferences and usage patterns.