Group 9: Echo Locate Final Report Summary

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Echo Locate aims to move whale conservation from reactive tracking to proactive prediction. By building a centralized platform that fuses data from satellite tags, acoustic buoys, actual recorded sightings and oceanographic databases, we can use machine learning models and forecast whale movements with high accuracy. The main goal is to provide conservationists and maritime industries with a crucial tool to prevent ship strikes and protect endangered populations. Collisions are the leading cause of death worldwide for large whale species and warming oceans are shifting prey locations, prompting whales to alter their migration routes and increasing their exposure to shipping lanes. The aim is a statistically significant decrease in whale fatalities and injuries from ship strikes verified by official sources, somewhere between 25 and 40%.

Echo Locate will be an app that must be compatible with both Android and iOS platforms for broad accessibility and field use. It also needs robust processing capabilities to handle large volumes of data from multiple sources without performance lag. Partnership with organizations like the National Oceanic and Atmospheric Administration (NOAA) and the Woods Hole Oceanographic Institution (WHOI), for their expertise in marine data collection will be essential as well as access to the Argos satellite for tracking tags and the NOAA buoy system to listen for whale vocalizations. Conservationists and Marine Biologists will also assist in initial training of the algorithm for predictions to ensure accuracy.

The important functional requirements are to track and store whale locations with 90% of data processed within 10 minutes, train and update ML models monthly, achieving ≥70% accuracy, generate predictions every 3–4 hours, completing within 20 minutes, deliver alerts within 60 seconds of risk zone creation, and to display interactive maps with ≤5-second load time and 2-day offline cache. Echo Locate also aims to keep the system running 99% of the time and if possible allow adding new data sources and features without breaking core features. With these requirements in mind the system is decomposed into loosely coupled subsystems, allowing independent scaling and updates.

To achieve this, the system is built on a client-server architecture. This is the best choice due to the fact that mobile apps and web clients need access to centralized prediction data, as well as multiple users need access to the same whale location and prediction data. Vessels at sea also have unstable internet connectivity, so clients can cache data locally while the server maintains the data. The system will be broken down into core subsystems: data ingestion which collects and validates data from satellites, buoys, databases, the prediction engine which executes ML models to generate migration forecasts and risk zones, the alerting system which manages real-time, fail-safe notifications to vessels, and the user interface which serves interactive maps and data via mobile and web clients. The system implements multi-tier storage (cache, database) for performance and historical analysis as well as data persistence.

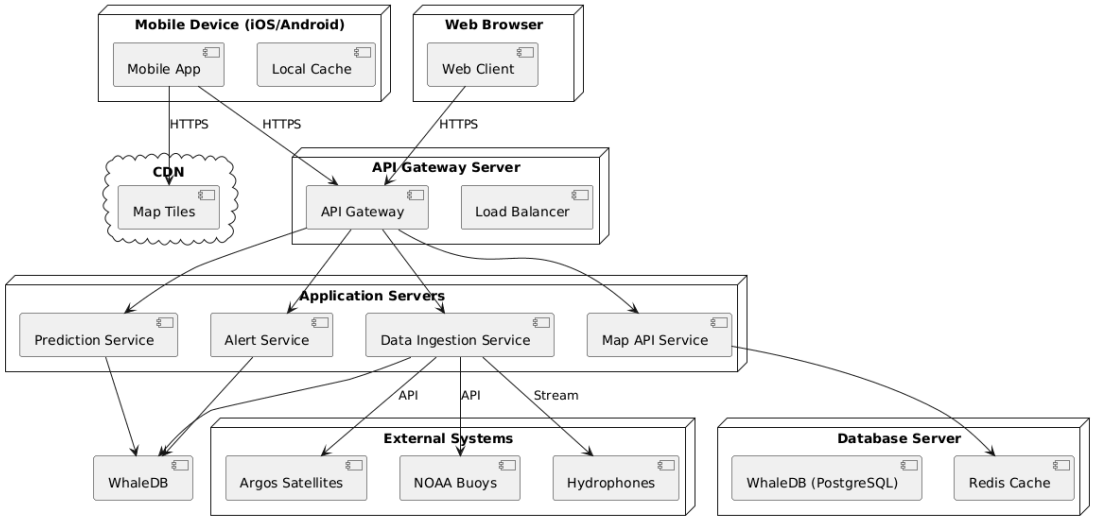

Figure 1. *High-Level System Architecture Diagram for Echo Locate.*

Future developers may run into potential risks that could cause the project to fail/underperform include: lack of access to training data, ML model not meeting expected accuracy, technical problems with integrating external data sources, external sources changing their data formats or access rules, and the system taking more time or computing resources than the project scope originally predicted. The project will also require a significant time investment due to integration with partner systems, data gathering and negotiations, and the development and training of the ML model. Additional costs include the computing resources needed to train and test the ML model and the storage required to maintain large datasets used during development and maintenance. There may also be indirect costs such as coordination time with external partners and potential delays that impact the project schedule.

In conclusion, Echo Locate represents a significant leap forward in marine conservation technology. By unifying real-time data streams and applying machine learning, the platform empowers users to prevent whale-ship collisions through proactive decision-making. The project's success will be measured not only in technical performance but in tangible conservation outcomes—protecting endangered whale populations while supporting safe and efficient global shipping.