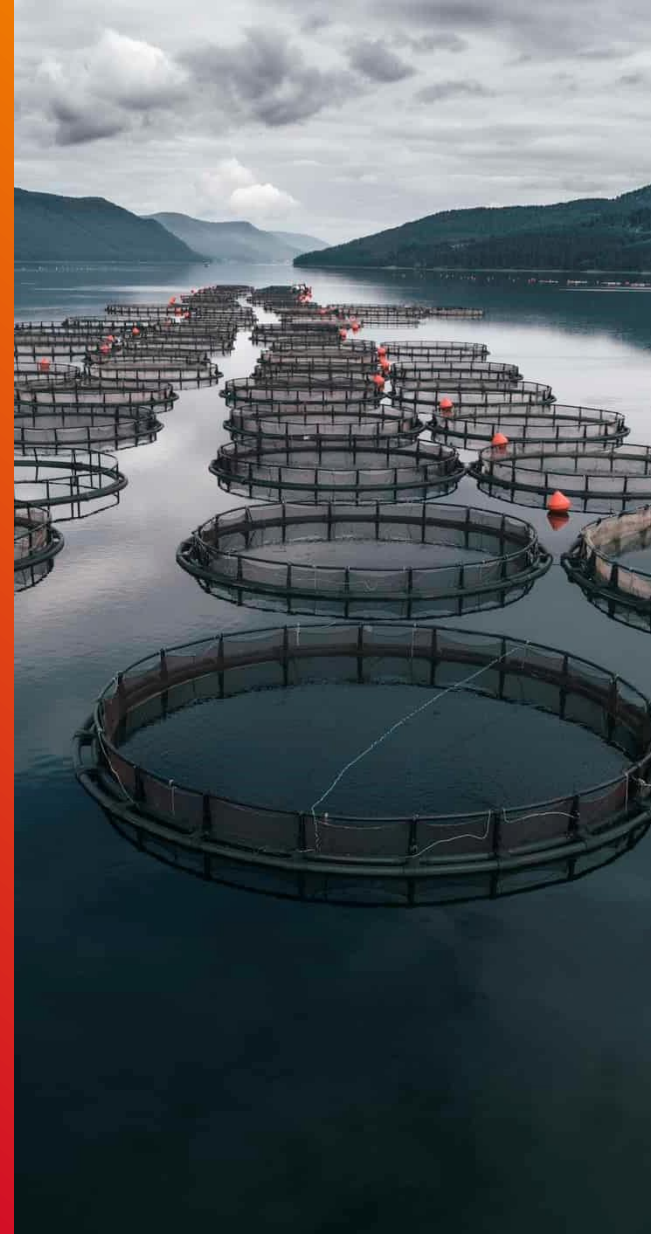
FISH WATCH

AIoT based SaaS Solution for Fish Farm Monitoring



The world is how we shape it

sopra steria

Content

01

Problem Statement

Problem Statement

Company Overview

Livestock Insights Incorporated, a company headquartered in Scotland, but operating globally offers Fish Watch that is used Fish Farmers around the world to monitor their fish, and the fish farms in general. Fish Watch Service can collect information about individual fish, water quality, and weather information & help fish farmers use this information to understand the health of their livestock, check for signs of parasites and disease, and work out the best time to harvest.

Problem Statement :

- Farmers need to be able to see the collected information in dashboards which they can customize
- They also need to be able to specify thresholds at which alerts should be triggered this could be simple things like a PH going out of bound, but could also involve advanced warnings of adverse weather events which are expected
- Farmers track information about the fish harvested from each farm, and this information together with the raw data being collected should be used to build a model of what factors produce good harvests
- Each farm may have a variety of different fish specie. For large customers, they will want to be able to drive insights across several farms.
- It’s vital that alerts be generated in a timely manner - a sharp degradation in water quality or adverse weather event could have massive implications if the farmer doesn’t have enough warning.
- It’s assumed that more detailed information about fish behavior and water quality etc. will become richer over time as we are able to deploy more powerful device
- Fish Watch needs to be accessible from several devices, including rugged industrial devices used on the sea during harvest
- Fish farms are often in remote locations, where cellular signal may be poor, but You can assume that the hardware devices to capture water information and
- detect fish behavior already exist, but you need to define how these devices will send the information to the system
- Livestock Insights Inc is considering providing similar capabilities to cattle, and allowing aquariums to use the system to look after fish health

02

- Requirements
- Contraints
- Assumptions

sopra steria

Requirements

Functionality and Usability

- Intuitive user interface with interactive features for easy navigation and access to fish farm data.
- Integration of visualization tools dashboards & IOT devices for comprehensive monitoring and decision-making.
- User-friendly applications for farmers, workers, and owners to manage Enclosure operations within single Farm or multiple farms efficiently.

Security and Compliance

- Implementation of robust data encryption and access control mechanisms to ensure data security.
- Compliance with industry regulations and standards to protect sensitive fish farm data and maintain privacy for each of its user.
- Regular security audits and updates to mitigate potential vulnerabilities and threats.

High Availability and Performance

- Reliable cloud infrastructure with redundancy and failover mechanisms for continuous data availability.
- Scalable architecture to accommodate increasing data processing requirements and ensure optimal performance.
- Monitoring tools for performance optimization and proactive maintenance to prevent downtime.

Integration and Scalability

- Seamless integration of IoT devices, data analytics tools, and AI functions for a cohesive and interoperable system.
- Scalability planning to support the growth of aquaculture operations and the influx of data from sensors and devices.
- Compatibility testing and system validation to ensure smooth integration and scalability.
- Ensure data availability from IOT devices even in case of low network

Data Management, Reporting & Alerts

- Efficient data storage and retrieval mechanisms for managing large volumes of fish farm data.
- Data governance policies and procedures for organizing, categorizing, and securing data assets.
- Reporting tools for generating actionable insights, trends, and performance metrics for informed decision-making.
- Timely alerts related to water, environmental & fish heath to take preventive actions & effective decision making

Constraints

Functionality and Usability

- Complexity in designing user-friendly interfaces that cater to the diverse needs of farmers, workers, and owners.
- User adoption challenges due to unfamiliarity with advanced technology and data-driven decision-making tools

Security and Compliance

- Resource constraints in implementing and maintaining robust security measures to safeguard farm data.
- Compliance limitations in meeting evolving data protection regulations and privacy requirements.

High Availability and Performance

- Budget constraints in investing in high availability infrastructure and performance optimization tools.
- Technical limitations in achieving optimal performance levels under varying workloads and data processing demands.

Integration and Scalability

- Interoperability challenges in integrating legacy systems with new technologies and platforms.
- Scalability constraints related to resource allocation, data storage capacity, and processing capabilities.
- Data Integration constraints due to low network area.

Data Management, Reporting & Alerts

- Data silos and fragmentation issues that hinder centralized data management and reporting.
- Reporting constraints in generating real-time insights and predictive analytics due to data complexity and volume.
- Constraints in sending alerts on time during the low network

Assumptions

Functionality and Usability

- Users have basic knowledge of operating digital interfaces for efficient navigation.
- Users will have access to adequate training and support for utilizing the system effectively.
- Feedback from users will be collected and incorporated for continuous improvement of functionality.

Security and Compliance

- Industry-standard encryption protocols will be implemented to secure sensitive data.
- Access control mechanisms will be in place to restrict unauthorized access to critical data.
- Data privacy policies and procedures will be established to ensure compliance with legal requirements.

High Availability and Performance

- The cloud infrastructure will be designed to handle peak loads and maintain optimal performance.
- Budget allocation for high availability infrastructure will be sufficient to meet performance objectives.
- Monitoring tools will be utilized to proactively identify performance issues and prevent downtime.

.

Integration and Scalability

- IoT devices, data analytics tools, and AI functions will seamlessly integrate to create a cohesive system.
- Compatibility testing will be conducted to ensure smooth integration of new technologies with existing systems.
- System validation will verify the interoperability of different components for seamless integration.

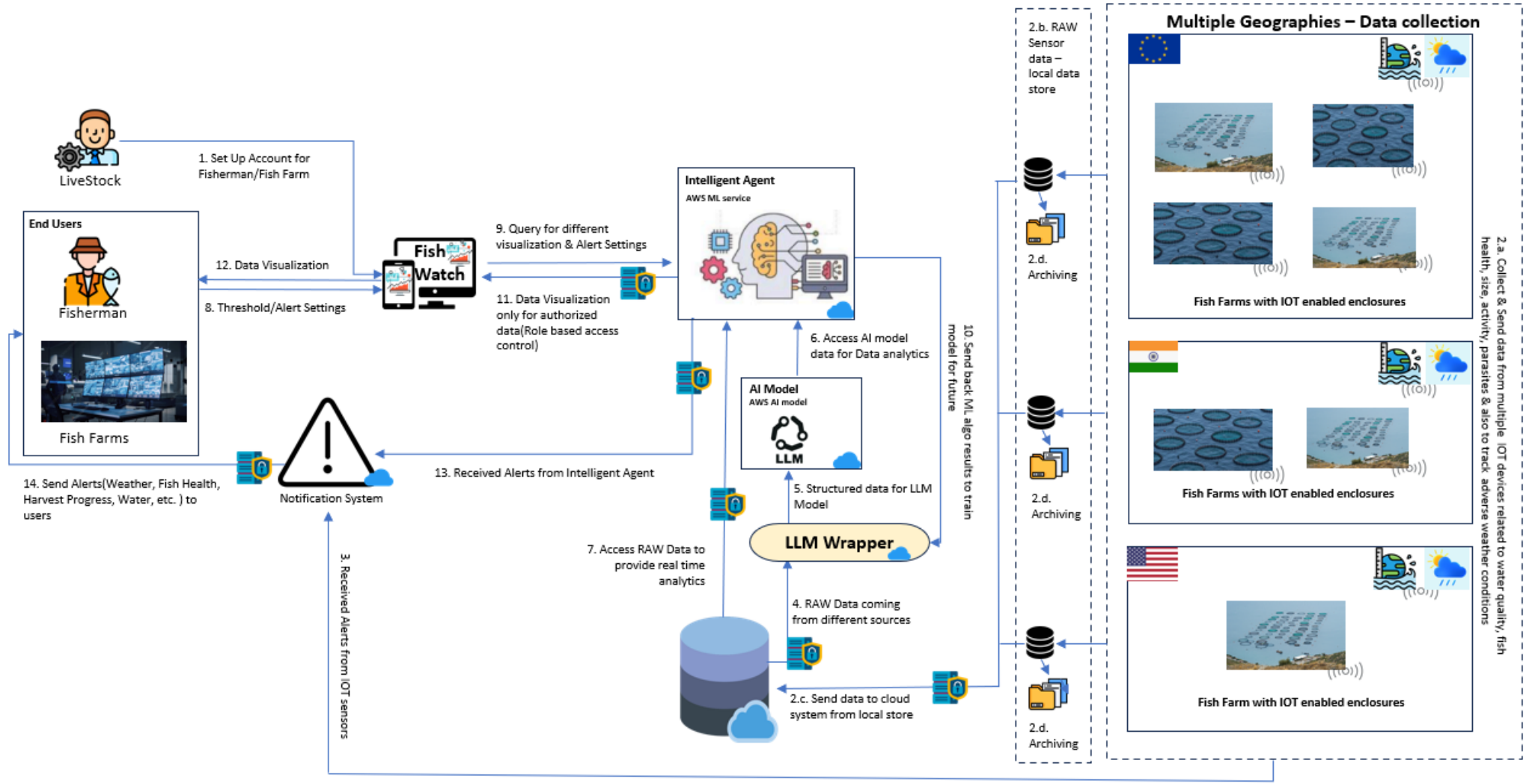
Data Management, Reporting & Alerts

- Data governance policies will be established to organize and secure data assets effectively.
- Data complexity and volume will be managed to ensure accurate and reliable reporting.
- Efficient data storage mechanisms will be in place to handle large volumes of fish farm data.

03

Solution Architecture Diagram

Solution Architecture Diagram



sopra steria

Solution Overview

Fish Watch encapsulates IOT devices, communication tools, and software that collaborate autonomously. It represents the amalgamation of the physical world with the digital realm, facilitating efficient monitoring the health condition of water & fish in Fish Farms. Fish watch helps to predicts the best ways to harvest & help to improve revenue to fish farmers with help of AI & ML techniques.

Physical Representation:

- Utilizes a network of sensor devices strategically distributed across Fish Farms.
- Sensors collect and transmit real-time data, forming the foundation of the real environment within the solution.

Virtual Environment Integration:

- Integrates sensors capable of real-time data collection and transmission for Fish farms.
- Data is processed using machine learning models and deep learning techniques, creating a virtual environment capable of remote farm monitoring.

AIoT Based Framework:

- Monitors fish behavior, fish health, possible parasites, estimates growth, and assesses the aquaculture environment's water quality.
- Incorporates low-cost hardware devices and best in class software tools for visualization and big data analytics.
- Solution provides the predictive analysis to user about good harvest based on environmental & other factors.
- Allows user to set the various parameters & thresholds to receive notification & alerts for any emergency to avoid any loss

Fish Watch Core Services:

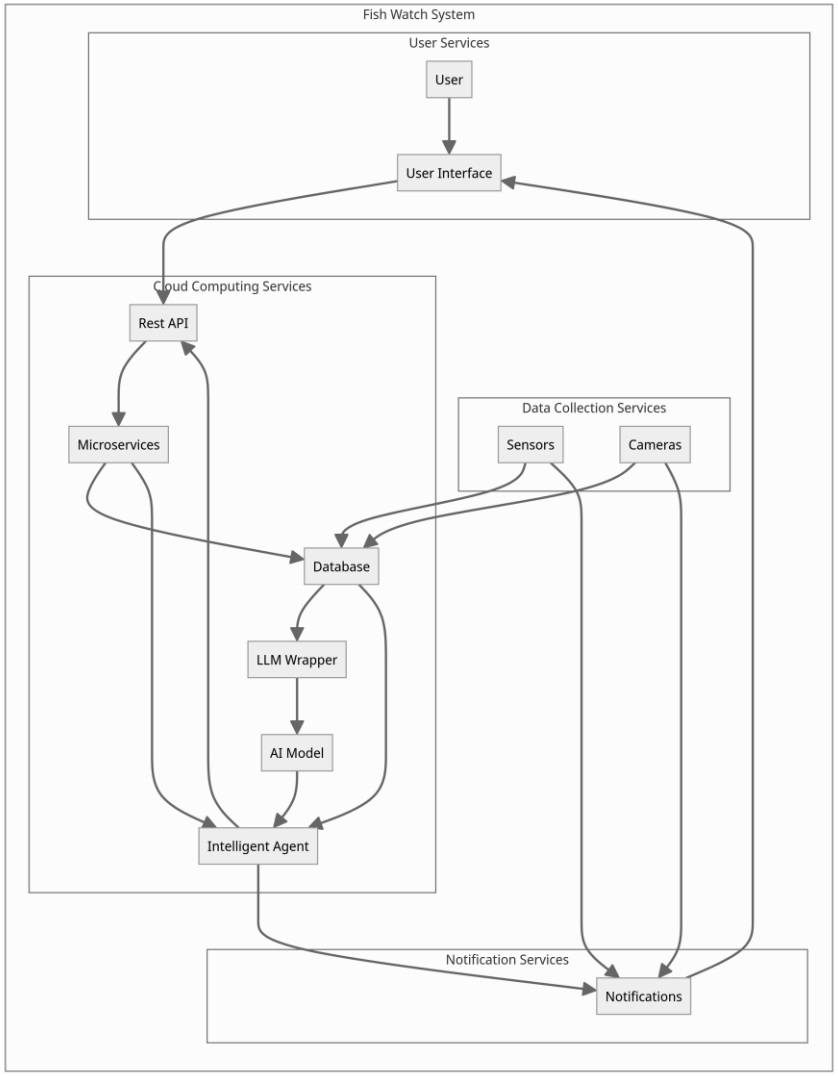
- **Data Collection Service:** Collects data from sensors and cameras.
- **Cloud Computing Service:** Processes data for storage over the cloud, predictive analysis and alters sending to user for better decision making. .
- **Analytical Service:** Provides customized data visualization through dashboards, web, and mobile applications.

04

Diagrams

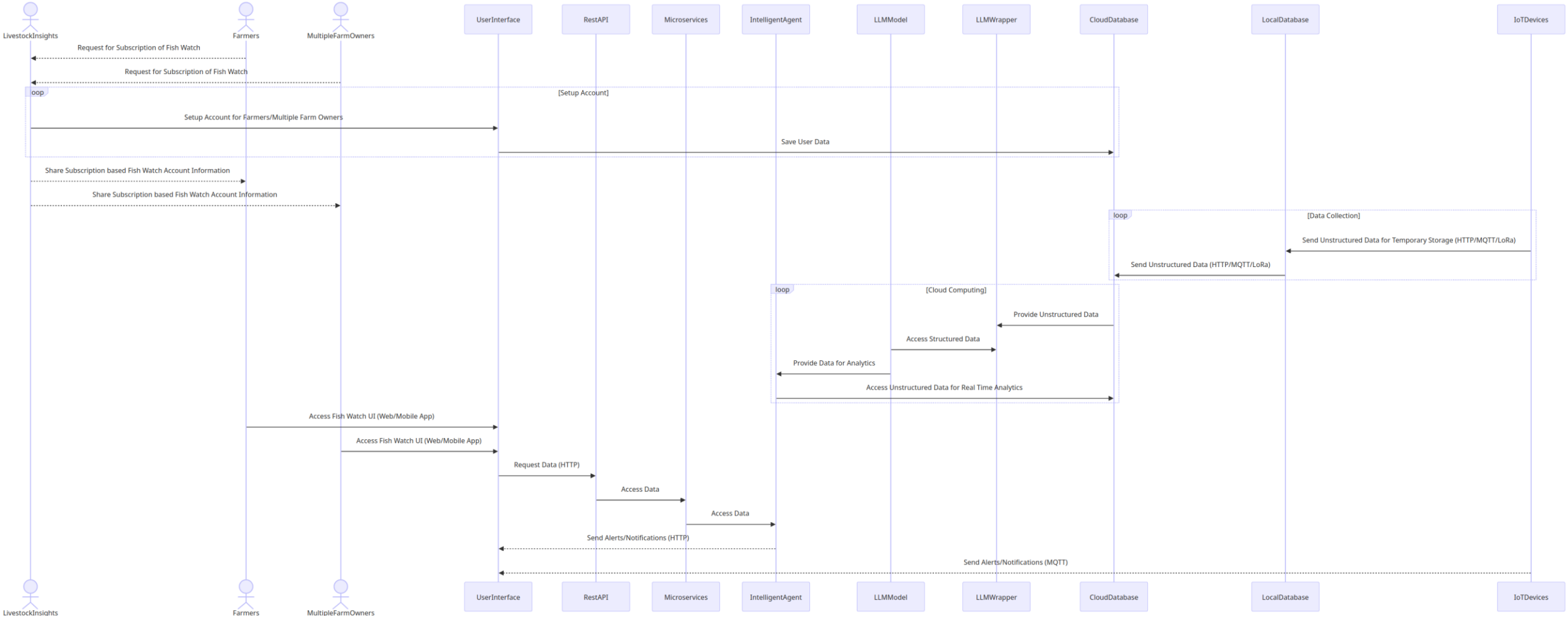
- Context
- Sequence
- Component

Context Diagram

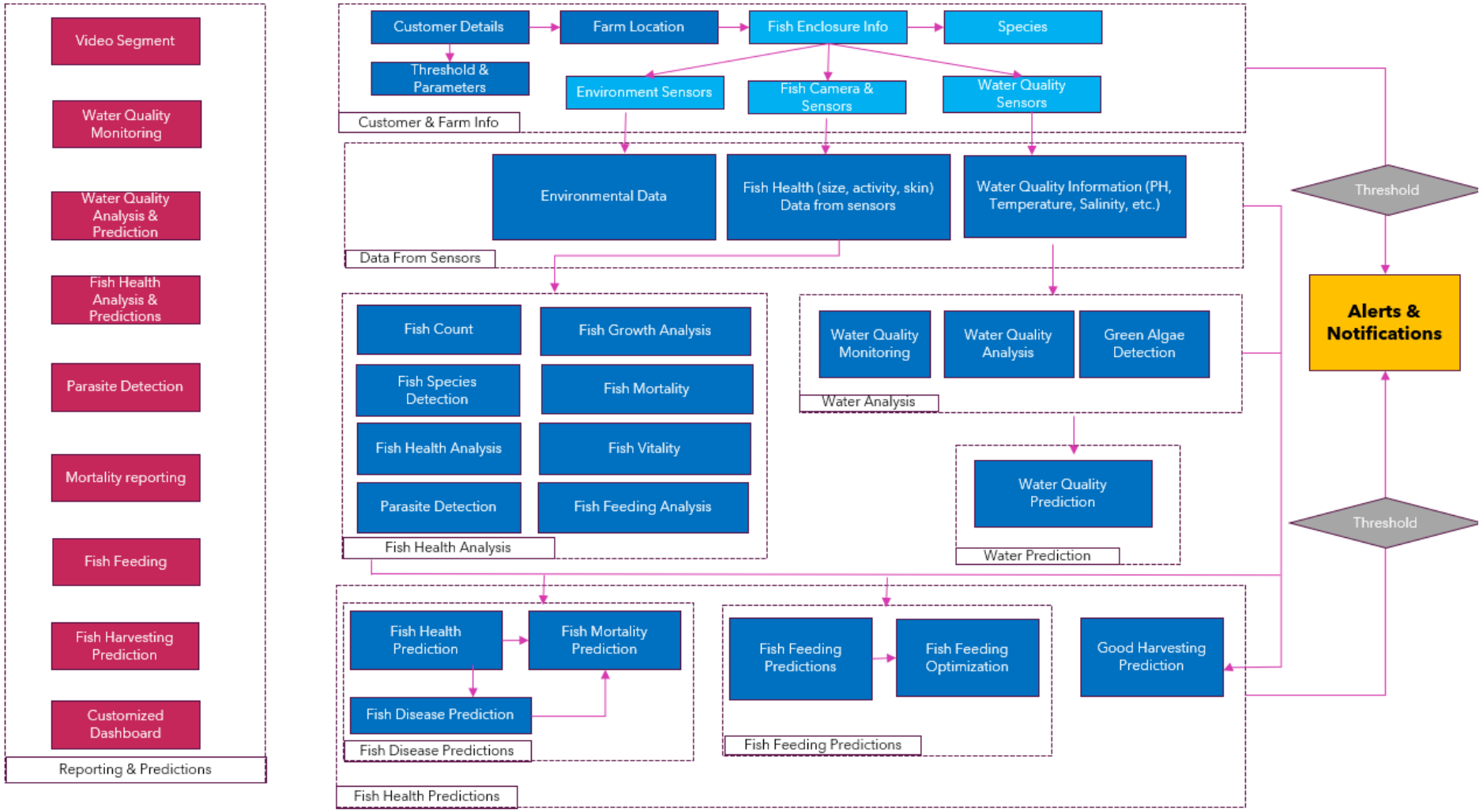


sopra steria

Sequence Diagram



Component Diagram

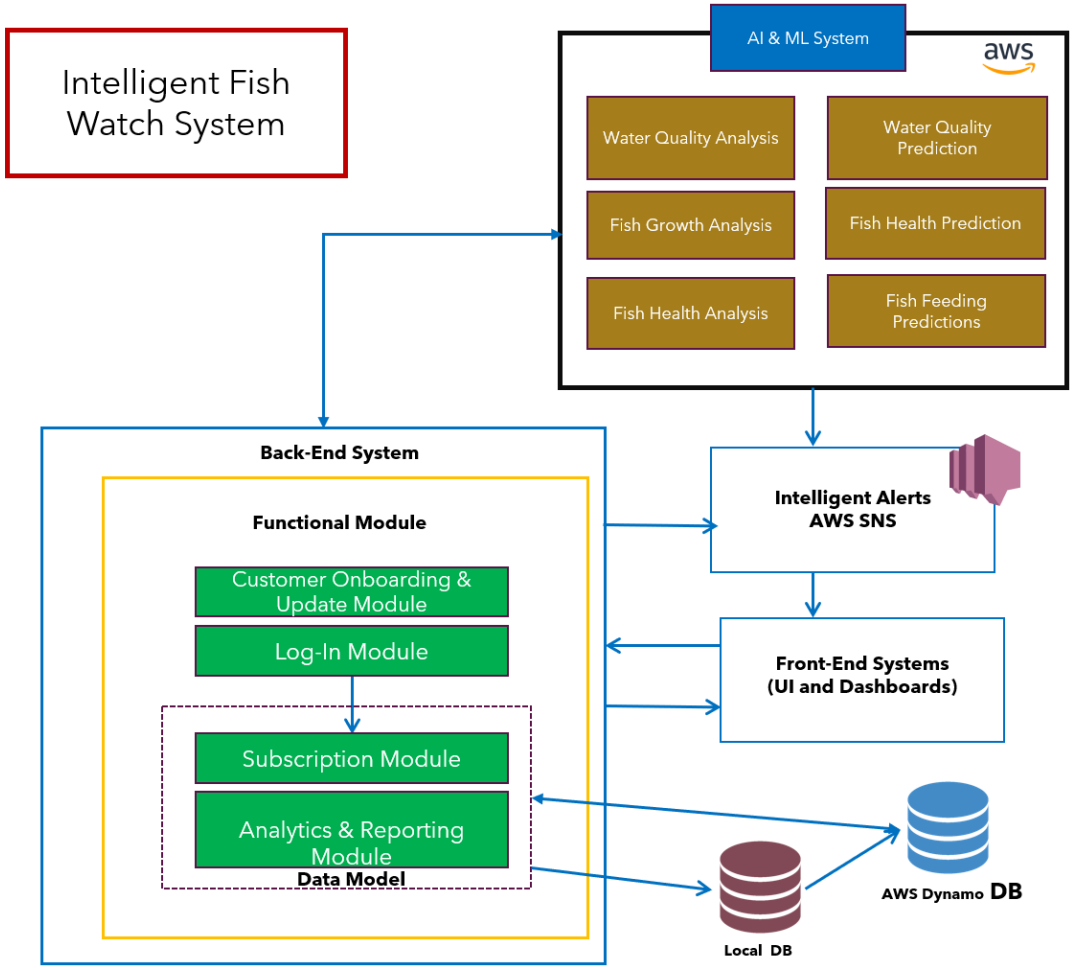


sopra steria

05

System Diagram

System Diagram



sopra steria

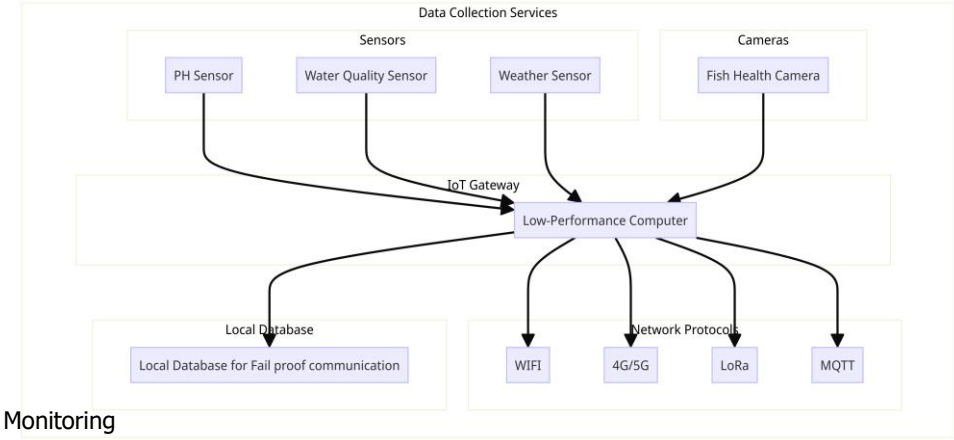
06

Services

sopra steria

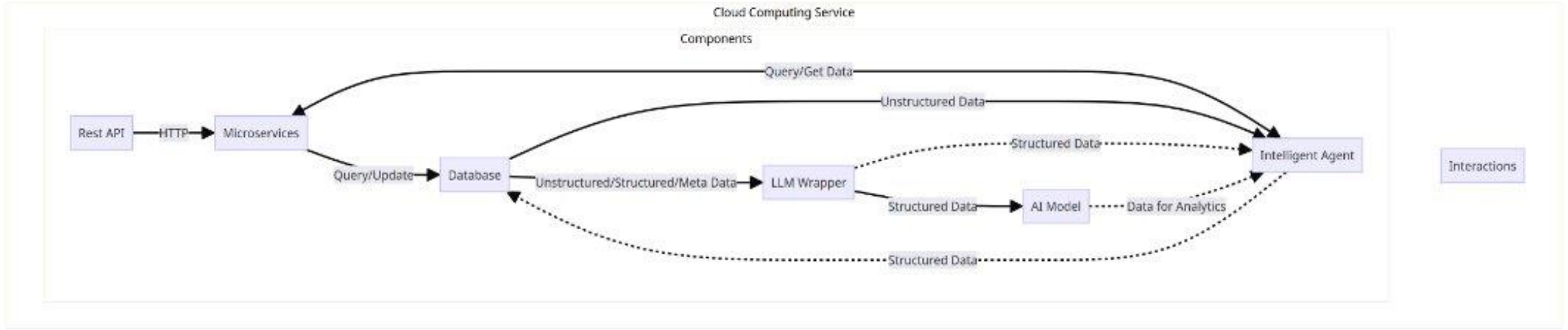
Data Collection Services

- Fish farms are outfitted with smart devices such as sensors and cameras, which collect and transmit large volumes of data to the cloud using wireless communication networks. This setup enables real-time and remote monitoring of the farm operations.
- Sensors in enclosures collect data for pH monitoring, water quality, and weather, while cameras gather information on fish health.
- Low-performance computer devices with wireless adaptors act as IoT gateways, collecting sensor data and transmitting it to the cloud for further processing and analytics.
- Local Database is available to store temporary data which in-turns save the data on Cloud Data Base, it is proposed to archive the local database at regular interval.
- Smart devices utilize Wi-Fi, 4G/5G, and LoRa for network connectivity, ensuring seamless communication with the cloud server.
- MQTT protocol ensures reliable message delivery, enabling direct communication between sensor devices and bidirectional message exchange between clients and servers. Alerts for adverse fish health conditions and environmental parameters are promptly transmitted via MQTT protocol to users and the cloud computing service.
- Data Collection Service includes sensors and cameras connected to a gateway/IoT device, which then sends the data to the Local Database which ultimately sends data to Cloud for further processing and to user Devices for Alerts.
- Cloud Computing Service processes the collected data and performs big data analytics.
- Network Protocols represent the various communication protocols used to connect the smart devices to the gateway/IoT device, including WIFI, 4G/5G, MQTT and LoRa.



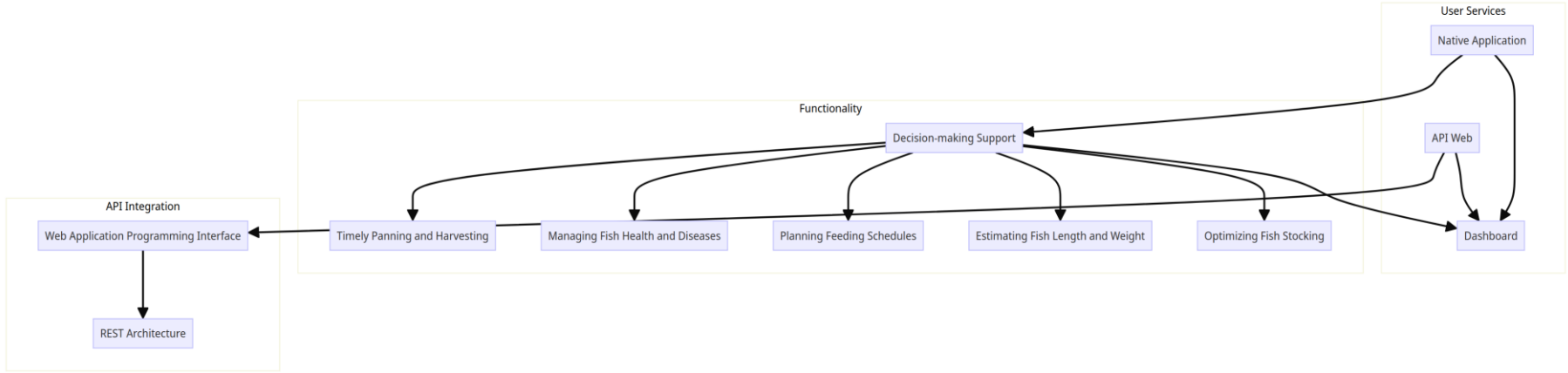
Cloud Computing Services

- Cloud computing services support data storage, analytics, IoT applications, and AI services, processing data collected from sensors.
- Big data analytics digitizes and automates farm monitoring, aiding intelligent decision-making.
- Visual representations of processed data aid farmers in understanding insights derived from analytics.
- Microservices deploy and manage various data, analytics, and decision-making services in the cloud.
- Notification Services transmit alerts based on user-defined thresholds for adverse conditions.
- Alerts are sent directly to user devices and routed through the Intelligent Agent for analytics.
- The Intelligent Agent accesses data from the AI model and Cloud Database for real-time analytics.



Analytical Services

- The user service encompasses a native application, API web, and dashboard, offering a user-friendly interface for farmers, workers, and owners to manage and access information effortlessly.
- It aids farmers in decision-making by facilitating timely panning and harvesting of fish, managing fish health and diseases, planning feeding schedules, estimating fish length and weight, and optimizing fish stocking based on time and production requirements.
- The web application programming interface (API) fosters interactive and reliable interaction among smart devices, networks, and software/applications.
- Representational state transfer (REST) software architecture (RESTful) will be integrated to manage IoT device data via HTTP, ensuring real-time data access for users.
- Native Application and API Web interfaces connected to the Dashboard for user interaction.
- Decision Support functionalities aiding farmers in various decision-making processes.
- API Integration enabling interaction between smart devices, networks, and software/applications.
- REST Architecture facilitating the management of IoT device data via HTTP for real-time data access.



07

Architecture Decision Record

Architecture Decision Points

- During designing the architecture of Fish Watch system, following architecture points are considered.

- Regional Local Data Storage
- LoR Network & MQTT Protocol
- Choice of cloud provider - AWS
- Microservice Architecture Framework
- Archiving Local Data Storage
- Role based Access control
- Multitenancy & Subscription based SaaS model
- LLM Wrapper
- AWS AI Model Deployment

- Please refer Architecture Decision record for respective Architecture Decision points for details

08

Summary & Future work

Summary

- Our current architecture demonstrates the possibility of implementing an agile-based AIoT system using an intelligent cloud infrastructure.
- Various digital services are involved, including fish feeding, fish metric estimation, environment monitoring, and fish health monitoring, for intelligent decision-making in fish farm management and monitoring.
- The different machine learning and deep learning architectures integrated into the AI functions enable big data analytics processes to predict and optimize processes, supporting data-driven decision-making.
- The AIoT system grants farm information access to farm owners, workers, and other stakeholders, enabling remote and real-time monitoring of the fish farm.
- The farm's physical environment can collect and monitor data through the cloud.
- The SaaS model & easy set up allows aquariums to use the system to look after fish health in effective manner.

Future Work

- Incorporate complete augmented reality functionality to provide a view of the real-world environment as an imaginary object, offering a visual operation interface for manipulation.
- Integrate full autonomous digital functions where humans no longer supervise decisions and controls, ensuring fish welfare and optimized production.
- Incorporate a complete decision-support system to provide farm owners, users, and other stakeholders with more intelligent data-driven decision-making applicable to varied species.

Thanks.