Sri Lanka Institute of Information Technology

Software Engineering Practices

(IT5030)

Continuous Assignment – 2025, Semester 1/2

DiveMaster – Diving Certificates Management System

Project Proposal

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Abbreviations Table

Abbreviation	Full Form	Description
DCMS	Diving Certification Management System	The digital platform proposed to streamline diving certifications, scheduling, assessments, and equipment tracking.
PADI	Professional Association of Diving Instructors	A globally recognized organization that offers diving certifications and training programs.
SSI	Scuba Schools International	A well-known diving certification agency that provides structured training for divers.
RBAC	Role-Based Access Control	A security mechanism that restricts system access based on user roles.
MFA	Multi-Factor Authentication	A security feature that requires multiple verification methods for user authentication.
AI	Artificial Intelligence	Used in the system for marine species identification and hand signal recognition.
CRUD	Create, Read, Update, Delete	The fundamental operations performed on database records.
JWT	JSON Web Token	A secure method for user authentication and authorization in the system.
UI/UX	User Interface/User Experience	Design principles for creating an intuitive and user-friendly system.
API	Application Programming Interface	Used for integrating various system functionalities and third-party services.
ORM	Object-Relational Mapping	A technique used in database management to interact with structured data.
SSL	Secure Sockets Layer	A security protocol that encrypts data communication over networks.
SQL	Structured Query Language	A language used for managing and querying databases.
MySQL	My Structured Query Language	The database management system used in the project.
Laravel	PHP Web Framework	The backend framework used to develop the system.
React.js	JavaScript Library	The frontend library used for building the system's user interface.
Flutter	Cross-Platform Mobile Framework	The framework used for developing the offline mobile app.
GitHub	Version Control System	A platform used for source code management and collaboration.
Jira	Agile Project Management Tool	Tool A tool used for tracking project tasks, sprints, and backlog items.
SLTDA	Sri Lanka Tourism Development Authority	The regulatory body for tourism development in Sri Lanka.
DFAR	Department of Fisheries and Aquatic Resources	The government agency responsible for marine conservation and diving regulations.

1. Introduction

1.1 Background

Sri Lanka, an island nation renowned for its rich marine biodiversity and clear waters, has established itself as a premier destination for scuba diving. The country offers diverse diving experiences, ranging from vibrant coral reefs to historic shipwrecks, attracting both recreational and professional divers. To ensure safe and standardized diving practices, internationally recognized certification agencies, such as the Professional Association of Diving Instructors (PADI) and Scuba Schools International (SSI), provide structured training programs in Sri Lanka.

Source

Source

Figure 1 : Scuba Diving and Open Water Divers

Diving Certification and Methodologies

Diving certifications are essential for equipping divers with the necessary skills, safety measures, and technical knowledge required for underwater exploration. These certifications follow structured methodologies combining theoretical education, confined water training, and open water dives.

1. **PADI (Professional Association of Diving Instructors):**
    - **Overview:** The world's leading scuba diving training organization, offering a progressive learning path from beginner to professional levels.

Figure 2 : Logo of PADI

    - **Courses Offered:**
        - *Beginner Courses:*
            - **Discover Scuba Diving:** An introductory experience for those new to diving.
            - **Open Water Diver:** The most popular entry-level certification, enabling divers to explore up to 18 meters.

- *Advanced Courses:*
    - **Advanced Open Water Diver:** Focuses on enhancing diving skills and includes deep and navigation dives.
    - **Rescue Diver:** Teaches techniques to prevent and manage diving emergencies.
- *Specialty Courses:*
    - Courses such as Deep Diving, Wreck Diving, and Underwater Photography allow divers to specialize in areas of interest.

- **Methodology:** PADI courses combine theoretical knowledge with practical training, including confined water sessions and open water dives. The organization emphasizes safety, environmental awareness, and skill development.

2. **SSI (Scuba Schools International):**

    - **Overview:** SSI is another prominent global diving agency offering a structured training system.

Figure 3: Logo of SSI

    - **Courses Offered:**
        - *Entry-Level Courses:*
            - **Basic Diver:** For those new to diving, focusing on essential skills.
            - **Open Water Diver:** Enables divers to explore up to 18 meters.
        - *Advanced Courses:*
            - **Advanced Adventurer:** Allows drivers to experience different specialties.
            - **Stress & Rescue Diver:** Focuses on managing stress and emergency situations.
        - *Specialty Courses:*
            - Includes specialties like Deep Diving, Wreck Diving, and Underwater Photography.

    - **Methodology:** SSI emphasizes a holistic approach to diving education, integrating theory with practical experience. The training includes confined water sessions, open water dives, and theoretical lessons.

Diving centers in Sri Lanka adhere to the training standards set by their respective certification agencies. The general methodology includes:

- **Theory Sessions:** Covering topics such as diving physics, physiology, equipment usage, and safety procedures.
- **Confined Water Training:** Conducted in controlled environments like pools, where students practice essential skills.
- **Open Water Dives:** Real-world dives in natural settings, allowing students to apply learned skills under instructor supervision.

These methodologies ensure that divers are well-prepared to handle various underwater scenarios safely and competently.

1.2 The Need for a Digital Diving Certification Management System

With digital transformation revolutionizing various industries, scuba diving education and certification management must also adapt to modern technology. Currently, many diving centers rely on paper-based records, manual scheduling, and in-person assessments, resulting in operational inefficiencies, miscommunication, and delays in certification issuance.

The Diving Certification Management System (DCMS) aims to streamline these processes by providing a centralized, automated, and user-friendly platform for diving centers, instructors, and students. Key enhancements include:

- Automated Scheduling & Resource Allocation: Efficient assignment of instructors, dive sessions, and equipment.
- Digital Dive Logs: A cloud-based platform for divers to log, retrieve, and analyze dive records.
- Online Learning & Assessment: Integration of theoretical modules with automated evaluation tools.
- Certification Issuance & Verification: Instant digital certification upon course completion.
- Equipment Tracking & Maintenance: Real-time monitoring of diving gear and scheduled maintenance alerts.
- Advanced Reporting & Analytics: Data-driven insights into operational improvements.

1.3 Evolution of Diving Certifications

Diving certifications have evolved significantly, transitioning from informal training methods to globally recognized, standardized programs. Organizations like PADI and SSI have set international standards that blend theoretical knowledge, hands-on training, and open water experience.

Traditionally, scuba training relied on physical classrooms, paper-based assessments, and manual record-keeping. However, the increasing demand for flexible learning and digital accessibility has led to innovations such as e-learning platforms, virtual assessments, and automated certification tracking.

The DCMS will integrate these advancements to modernize the certification process for diving centers in Sri Lanka, ensuring compliance with global best practices while enhancing operational efficiency.

1.4 Benefits of Implementing DCMS

A well-designed Diving Certification Management System will provide substantial benefits to all stakeholders:

1. For Diving Centers:
    - Reduced administrative workload with automated scheduling and reporting.
    - Centralized student progress tracking and instructor assignment.
    - Efficient resource management through real-time equipment tracking.
    - Compliance with international certification standards.
2. For Instructors:
    - Simplified scheduling of training sessions and dive reservations.
    - Digital tracking of student progress, assessments, and dive logs.
    - Faster certification approvals through direct integration with certification authorities.
3. For Students & Recreational Divers:
    - Flexible learning options with online theoretical modules and progress tracking.
    - Access to personalized dive logs, certification records, and performance analytics.
    - Improved communication with instructors and dive center management.
4. For Certification Authorities:
    - Real-time verification of certification authenticity.
    - Seamless integration with dive center records for compliance tracking.
    - Reduced processing time for certification issuance and renewal.

1.5 Growth and Digital Trends

The global scuba diving industry is rapidly expanding, fueled by advancements in digital education, virtual training, and AI-driven safety protocols.

- Market Expansion: The global scuba diving market is projected to reach $5.6 billion by 2030, driven by increasing tourism, technological innovations, and environmental awareness.
- Digital Learning Adoption: Over 60% of divers prefer online learning modules before engaging in practical sessions.
- Sustainability Efforts: Many dive centers are adopting paperless systems to reduce environmental impact and align with global sustainability goals.

The Diving Certification Management System (DCMS) represents a forward-thinking approach to scuba diving certification management. By transitioning from manual to digital processes, diving centres in Sri Lanka can significantly improve efficiency, accuracy, and overall diver experience.

This proposal aims to establish a scalable, future-ready system that aligns with the evolving needs of the diving industry, ensuring compliance with international standards while leveraging cutting-edge technology for improved operational efficiency.

2. Existing Process

2.1 Overview of the Current Certification Process

The current process for obtaining a diving certification in Sri Lanka involves multiple manual steps, which introduce inefficiencies at various stages. This system relies heavily on paper-based documentation, in-person coordination, and manual scheduling, making it prone to delays, miscommunication, and operational bottlenecks.

The key stages in the current certification process include:

- **Course Enrollment** – Students register for courses manually through direct interactions with dive centers or via phone/email.
- **Knowledge Development** – Theoretical learning is conducted through in-person classroom sessions, requiring physical attendance and printed materials.
- **Confined Water Training** – Students practice diving skills in controlled environments, with scheduling managed manually.
- **Open Water Training** – Real-world dives are arranged via phone calls and paperwork, often leading to scheduling conflicts and mismanagement of resources.
- **Performance Assessment** – Instructors evaluate students through manual grading systems, delaying assessment results.
- **Certification Issuance** – Certificates are manually processed and issued as physical documents, causing delays in verification and retrieval.

2.2 Challenges in the Existing System

The traditional system presents several limitations:

- **Inefficient Scheduling:** Manual coordination of dive sessions leads to overbooking, scheduling errors, and lack of real-time updates.
- **Paper-Based Records:** Physical dive logs, student records, and assessment sheets are prone to damage, loss, and data inconsistencies.
- **Slow Certification Processing:** Manual verification and approval processes delay the issuance of certifications.
- **Limited Data Insights:** Lack of centralized reporting tools prevents dive centers from tracking trends, student progress, and operational efficiency.
- **Equipment Mismanagement:** Lack of automated tracking leads to underutilization or overuse of diving gear, increasing maintenance costs.

The current certification process is outdated and lacks the efficiency needed for modern diving operations. By replacing manual processes with a digital system, dive centers can significantly enhance workflow automation, resource utilization, and user experience, paving the way for a more efficient and scalable certification model.

3. Problem Statement

The current system for managing diving certifications in Sri Lanka is outdated, inefficient, and highly manual, leading to delays, miscommunication, and administrative burdens for all stakeholders. The lack of automation in key processes such as scheduling, dive log management, certification issuance, and resource allocation results in operational bottlenecks and an overall poor user experience for diving centers, instructors, and students.

Additionally, paper-based record-keeping increases the risk of data loss, errors, and inefficiencies in tracking student progress, equipment maintenance, and certification validity. To remain competitive in the rapidly evolving diving industry, diving centers require a modern, digital solution that streamlines these operations and enhances efficiency.

3.1 Identified Problems

1. Manual Scheduling and Resource Allocation

    - Time-consuming coordination between instructors, students, and dive centers leads to inefficiencies.
    - Double-booking and scheduling conflicts occur due to the lack of a centralized system.
    - Instructors have limited visibility on their assigned schedules and availability.

2. Inefficient Dive Log Management

    - Dive logs are still paper based, leading to data loss, errors, and difficulty in tracking student progress.
    - Instructors have to manually verify and sign off dive logs, causing delays.
    - Divers face difficulty accessing past dive records and logs.

3. Delayed Certification Processing

    - Manual assessment and certification issuance result in long waiting times for divers.
    - Certification approvals require physical documentation and verification, delaying diver qualification.
    - No real-time tracking for divers to check the status of their certification.

4. Lack of Equipment Tracking and Maintenance

    - Equipment is not digitally tracked, leading to misuse, overuse, or improper maintenance.
    - No automated reminders for maintenance, inspections, or replacements.
    - Dive centers lack insights into equipment usage, resulting in increased costs.

5. Poor Communication and Accessibility

- No centralized platform for instructors, students, and managers to communicate efficiently.
- Last-minute schedule changes are not instantly communicated, causing confusion.
- Students face difficulty accessing learning materials, assessment results, and certification status.

6. Limited Data Analytics and Reporting
    - No structured reporting tools for tracking student progress, certification trends, or operational efficiency.
    - Managers cannot generate automated reports on performance metrics, student certifications, or dive logs.
    - Inconsistent data storage results in difficulties for compliance tracking with certification bodies.

3.2 Stakeholders

The Diving Certification Management System (DCMS) will benefit various stakeholders involved in the diving certification process:

1. Diving Center Managers
    - Oversee course enrollments, scheduling, and resource allocation.
    - Approve or modify instructor and student schedules.
    - Monitor equipment inventory and maintenance status.
    - Generate reports on certification completion and operational efficiency.
2. Instructors
    - Conduct theoretical and practical training sessions for students.
    - Approve and assess dive logs and certification eligibility.
    - Receive automated notifications about assigned sessions.
    - Request schedule modifications if conflicts arise.
3. Certification Authorities (PADI, SSI, etc.)
    - Verify assessment records and compliance with certification standards.
    - Issue digital diving certifications based on course completion.
    - Maintain global certification records for divers.
4. Recreational and Professional Divers (Students)
    - Register for courses and track personal progress.
    - Log dives digitally and receive instant instructor feedback.
    - View and download certifications in a digital format.

- Access learning materials and online assessments.

5. Research Divers and Marine Conservationists

   - Log marine life observations and track dive site conditions.
   - Store scientific dive data for future analysis.
   - Collaborate with certification authorities for advanced diving programs.

3.3 Users and Responsibilities

Table 1 - User Responsibilities

	USERS					
	Guest User	**Recreational/ license-seeking diver**	**Research Diver**	**Manager**	**Instructor**	**Certification Authority**
RESPONSIBILITIES	**User Management**					
	Create Account/Login	Login	Login	Login	Login	Login
	-	Request Account Password Reset	Request Account Password Reset	Update profile details	Request Account Password Reset	Request Account Password Reset
	-	Update Profile Details	Update Profile Details	Create user accounts	Update Profile Details	Update Profile Details
	-	View Activity Logs	View Activity Logs	Reset and deactivate user accounts	View Activity Logs	View Activity Logs
	-	-	-	View activity logs	-	-
	Booking Service					
	-	Book a training or recreational dive session	Book a diving session with specific instructors	Accept reservations	-	-
	-	Choose the dive site, date, and time	Select a dive location and schedule a time slot	Decline reservations and suggest dates	-	-
	-	Modify or cancel booking	Modify or cancel booking	-	-	-
	-	View booking history and upcoming sessions	View past and upcoming dive bookings	-	-	-
	Scheduling and Resource Allocation					

RESPONSIBILITIES	-	Request and schedule diving sessions based on available slots.	Request and schedule diving sessions based on available slots.	Evaluate incoming dive reservations, check resource availability, and approve feasible bookings.	View assigned dive sessions and confirmed availability.	-
	-	Check confirmed bookings and assigned instructors.	Check confirmed bookings and assigned instructors.	Allocate an instructor to each approved reservation.	Request modifications due to conflicts or issues.	-
	-	Modify bookings if needed before the scheduled session.	Modify bookings if needed before the scheduled session.	Assign essential gear (oxygen tanks, regulators, accessories, boats) to dive sessions.	Verify allocated gear before dive sessions.	-
	-	-	-	Edit, delete, or reschedule bookings based on availability and instructor feedback.	Review and generate reports on personal dive schedules and equipment usage.	-
	-	-	-	Review modification requests from instructors and make necessary updates.	-	-
	-	-	-	Track instructor availability, equipment status, and facility usage.	-	-
	-	-	-	Produce reports on dive schedules, resource utilization, and instructor workloads (daily, weekly, monthly, yearly).	-	-
	Digital Dive Logs and Marine Life Tracking					
	-	Identifies fish species	Use the app to log essential dive details such as dive duration, depth, and environmental conditions.	View the tracking records	Record essential details about the buddy divers	-
	-	Identifies hand signal recognitions.	Capture data on marine life, including images and	Generate reports of the tracking records	Log dive-specific information, such as	-

RESPONSIBILITIES			observations, and note down any significant research findings.		the planned location, expected depth range, entry/exit points, and estimated duration.	
	-	Capture underwater images	Document environmental data, including water conditions, visibility, and other factors relevant to the research.	-	Document environmental conditions such as weather, water temperature, visibility, and potential hazards at the dive site.	-
	-	-	Take photos and log species observations for later identification and analysis.	-	Perform an equipment check (air tank levels, regulator functionality, emergency gear readiness) and record the results.	-
	-	-	Record any unusual environmental phenomena or behaviours.	-	Specify training objectives if the dive is for skill-building (e.g., navigation, buoyancy, marine species identification).	-
	Assessment and Certification					
	-	Complete assigned assessments to demonstrate knowledge and skills	-	Oversee assessment completion and maintain records	Assign and evaluate assessments	Verify assessments for compliance

RESPONSIBILITIES	-	View personal assessment records and track progress	-	Access all assessment records	View and manage student assessments	Access certification records in read-only mode
	-	Complete assigned assessments to demonstrate knowledge and skills	-	Create, read, update, and delete assessments and certifications	Assign assessments to students and evaluate performance	Verify issued certifications
	-	View personal progress reports	-	Modify and approve certification statuses	Update certification statuses for students	Generate compliance reports
	-	-	-	Generate and export reports on student performance, pass rates, and issued certifications	Generate reports on student progress	Authenticate and verify certification access
	Equipment Inventory and Maintenance System					
	-	Check equipment details (e.g., specifications and availability)	Check equipment details (e.g., specifications and availability)	Track equipment usage logs	Check available equipment and maintenance status	-
	-	Choose appropriate gear for dive sessions	Choose appropriate gear for dive sessions	Assign equipment to users and manage inventory	Update usage logs to track which equipment was used	-
	-	Restricted access to avoid accidental modifications	Restricted access to avoid accidental modifications	Add, modify, and remove equipment, track usage, and oversee automated maintenance reminders	Report maintenance issues for faulty equipment	-
	-	Get reminders about assigned equipment and return schedules	Get reminders about assigned equipment and return schedules	Generate reports on usage, maintenance, and inventory	Receive automated maintenance alerts	-
	-	Get reminders about assigned equipment and return schedules	Get reminders about assigned equipment and return schedules	Remove decommissioned or disposed equipment	-	-

4. Proposed Solution

4.1 Solution Overview

The **Diving Certification Management System (DCMS)** is a **comprehensive, digital platform** designed to **modernize, streamline, and enhance** the operational efficiency of diving centres. This system integrates **user management, online reservations, digital dive logs, automated scheduling, equipment tracking, assessments, and certification issuance** into a single, centralized platform. By eliminating **manual paperwork, inefficient scheduling, and fragmented resource management**, the system ensures a **seamless, secure, and structured** diving certification process.

The traditional approach to **managing diving courses, student records, equipment, and certifications** is heavily reliant on **paper-based documentation, manual coordination, and in-person verification**, leading to **delays, inefficiencies, and miscommunication**. The **DCMS addresses these challenges** by providing a **web-based solution** where **recreational/ license-seeking divers, research divers, instructors, managers, and certification authorities** can interact in real time, reducing administrative overhead and improving operational workflows.

At the core of the system lies **a robust user management and reservation module**, allowing students, instructors, and administrators to **seamlessly access and interact with system functionalities based on role-based permissions**. Users can **register for courses, update their profiles, manage dive schedules, and make reservations** for training sessions and guide open dives. The system ensures **data integrity and security**, allowing administrators to control user access, monitor activity logs, and generate detailed reports on registrations, certifications, and system usage.

The **scheduling and resource allocation functionality** plays a crucial role in **optimizing instructor assignments, managing equipment availability, and preventing scheduling conflicts**. When a user books a diving session, the system automatically notifies the manager, who verifies instructor availability, assigns essential resources such as **oxygen tanks, regulators, wetsuits, and dive boats**, and confirms the schedule accordingly. **Real-time notifications** are sent to instructors, allowing them to **confirm or request modifications to their schedules**. The system also enables **dive center managers to oversee the entire scheduling process, update reservations, and ensure efficient utilization of resources**.

To **enhance the learning experience**, the system incorporates **an e-learning module** where students can **access theoretical coursework, instructional videos, and interactive assessments**. Theoretical learning, which was traditionally conducted **in physical classrooms with printed materials**, is now available **digitally**, allowing students to progress at their own pace. **Automated assessments and quizzes** ensure that students grasp the necessary concepts before proceeding to practical training.

The **DCMS further enhances safety and record-keeping through digital dive logs**, eliminating the need for **paper-based dive record management**. Before a dive session, instructors can **record essential dive details**, including **planned dive depth, estimated duration, environmental conditions, and emergency protocols**. Equipment checks are also documented, including air tank levels, regulator functionality, and emergency gear readiness. If the dive is for training purposes, the instructor specifies the skills to be practiced and the dive objective (e.g., navigation, buoyancy control, or marine species identification). **Divers log their post-dive details digitally**, and instructors **validate and approve dive**

logs directly within the system. This functionality ensures **accurate record-keeping, reduces the risk of misplaced dive logs, and allows divers to access their historical dive data anytime**.

A **specialized offline mobile application** is integrated into the system for research divers and recreational license-seeking divers, enabling them to **capture marine life data, record environmental conditions, and log dive statistics even in deep-sea environments without internet access**. Once the driver returns to a connected location, the app **automatically syncs data with the main system**, ensuring seamless synchronization and long-term data storage. Advanced AI-powered features allow divers to **identify fish species and recognize underwater hand signals using machine learning models**, enhancing the overall diving experience.

One of the **most critical aspects** of diving center operations is **equipment inventory and maintenance management**, which is fully automated within DCMS. The system **tracks all equipment in real time**, ensuring that **oxygen tanks, regulators, wetsuits, and emergency gear** are properly assigned, maintained, and replaced when necessary. **Automated maintenance reminders** notify administrators when **equipment inspections or servicing are due**, ensuring compliance with safety standards and preventing the use of faulty gear. **Instructors can report maintenance issues directly**, and **managers can generate detailed reports** on equipment utilization, condition, and service history.

Another essential component of the system is **the assessment and certification process**, which ensures that students meet the necessary standards before receiving their diving certification. Instructors conduct **practical assessments**, and students complete **theoretical exams online**, eliminating the need for **manual grading and paperwork submissions**. Once an assessment is completed, **the system automatically evaluates and records the results**, allowing instructors to provide feedback and update student progress instantly. Upon successful completion, **a digital certification is issued**, which can be **downloaded, shared, and verified in real time**. This feature significantly **reduces processing delays and allows certification authorities to instantly validate credentials** without requiring physical documents.

The **reporting and analytics module** within DCMS provides **valuable insights into system usage, student performance, certification rates, and operational efficiency**. Managers and administrators can **generate automated reports on training sessions, instructor workload, dive schedules, and certification trends**, helping them make **data-driven decisions to improve service quality and optimize operations**. The system also supports **compliance tracking with international diving certification authorities**, ensuring that all processes adhere to **global training and safety standards**.

The **technical architecture** of DCMS is designed for **scalability, security, and high performance**. The **frontend** is built using **modern web technologies**, offering **a user-friendly, mobile-responsive interface** that allows students, instructors, and administrators to interact with the system from **any device, anywhere in the world**. The **backend** is powered by **a robust server infrastructure**, handling **user authentication, data storage, role-based access control, and system integrations**. The **database securely stores all dive logs, user information, equipment records, and certifications**, ensuring **long-term accessibility and data integrity**.

To **enhance security**, DCMS implements **multi-factor authentication (MFA) and encrypted communication protocols**, preventing unauthorized access and protecting sensitive information. The system also **logs all user activities**, enabling administrators to **track interactions, detect anomalies, and take corrective actions when needed**.

By integrating **all components—user management, scheduling, digital dive logs, equipment tracking, assessment and certification processing—into a unified platform**, the **DCMS significantly improves efficiency, reduces manual workloads, and enhances the overall experience for diving centres and divers alike**.

The implementation of this system will **transform the way diving centres operate**, making **scheduling effortless, certification issuance instant, equipment maintenance proactive, and user management streamlined**. It will **eliminate inefficiencies, enhance safety standards, and modernize the diving certification process** to align with the **evolving digital landscape and industry best practices**.

In conclusion, the **DCMS is a state-of-the-art IT solution** designed to **optimize the diving certification process from start to finish**. By leveraging **automation, AI-driven analytics, digital learning, and cloud-based accessibility**, the system ensures that **diving centres operate at maximum efficiency while maintaining compliance with international standards**. This **comprehensive approach** to managing training, scheduling, resource allocation, dive logs, and certifications **sets a new benchmark for diving education and operational excellence**, positioning the **DCMS as an indispensable tool** for modern diving centres.

4.2 Functional and Non-functional Requirements of the system

The functional requirements define the key operational features that the DCMS must support to ensure efficient diving certification management.

Primary Functional Requirements:

User Management & Authentication:

- The system should allow users to create accounts, log in, and manage profiles securely.
- Role-based access control (RBAC) should be implemented for guest users, students, instructors, managers, and certification authorities to restrict unauthorized access.
- Multi-factor authentication (MFA) should be integrated for additional security.

Scheduling & Resource Allocation:

- The system should enable real-time booking and scheduling of diving sessions and certification courses.
- Instructors and managers should be able to assign available resources (e.g., instructors, dive gear, boats).
- The system should support automated scheduling conflict detection and allow instructors to request schedule modifications.

Digital Dive Logs & Marine Life Tracking:

- The system should provide digital logging capabilities for divers to enter post-dive details, including depth, time, and environmental observations.
- AI-powered marine life tracking should be integrated, allowing divers to record species and environmental conditions.

- An offline dive logging feature should be included for divers operating in low-connectivity environments, with automatic sync upon reconnection.

Assessment & Certification:

- The system should allow students to complete theoretical assessments and practical evaluations online.
- Automated grading should be implemented for quizzes and exams, reducing instructor workload.
- Certification authorities should be able to review, approve, and issue digital diving certifications, which should include a QR code for instant verification.

Secondary Functional Requirements:

Equipment Inventory & Maintenance:

- The system should track dive gear allocation and maintenance schedules, ensuring all equipment is inspected and serviced periodically.
- Automated maintenance alerts should notify dive center managers when equipment requires servicing.
- Instructors should be able to report faulty equipment, prompting managers to take corrective actions.

Payment & Reservation System:

- The system should allow users to book and pay for courses and dive sessions online using integrated payment gateways.
- Refund policies and automated cancellation procedures should be in place for user flexibility and business transparency.

Reporting & Analytics:

- The system should generate real-time reports on student progress, equipment usage, dive reservations, and instructor performance.
- Administrators should be able to export reports in multiple formats (CSV, PDF, Excel) for internal audits and compliance tracking.

Non-Functional Requirements

The non-functional requirements define the system's overall quality attributes, ensuring efficiency, security, and usability.

Scalability & Performance:

- The system should be able to handle concurrent users efficiently, supporting at least 500 active users without performance degradation.

- The database should be optimized for fast query processing, ensuring that user interactions (e.g., booking a dive) occur in real-time.

Security & Compliance:

- The system should encrypt sensitive data, including user credentials, payment details, and certification records, using SSL/TLS encryption.

User Experience & Accessibility:

- The system should have an intuitive UI/UX, ensuring ease of use for users of all technical backgrounds.
- The system should be mobile-responsive and compatible with desktop, tablet, and mobile devices.

4.3 Target Audience

This proposal is directed towards key governmental stakeholders in Sri Lanka responsible for tourism development, international relations, maritime safety, and the regulation of aquatic resources. The primary audiences include:

- **Ministry of Foreign Affairs:** Oversees Sri Lanka's international relations and collaborations, playing a pivotal role in promoting the country's image abroad.
- **Sri Lanka Tourism Development Authority (SLTDA):** The apex body for Sri Lanka's tourism industry, responsible for planning, development, regulation, and policy implementation.
- **Ministry of Tourism and Lands:** Charged with formulating and executing national policies on tourism and land development, contributing to economic advancement.
- **Department of Fisheries and Aquatic Resources (DFAR):** Responsible for the management and regulation of marine fisheries, promoting sustainable practices, and conserving marine resources.
- **Sri Lanka Coast Guard:** Ensures maritime law enforcement, safety, and security within Sri Lankan waters, including oversight of diving activities.
- **Diving Certification Agencies:** International bodies like PADI and SSI that set training standards and certify divers.
- **Local Diving Centres and Operators:** Entities providing diving services and training, crucial for implementing standardized certification processes.

Engagement with these entities is crucial for the successful implementation of the Diving Certification Management System (DCMS), ensuring it aligns with national objectives, regulatory frameworks, and international standards.

4.4 System Architecture Diagram

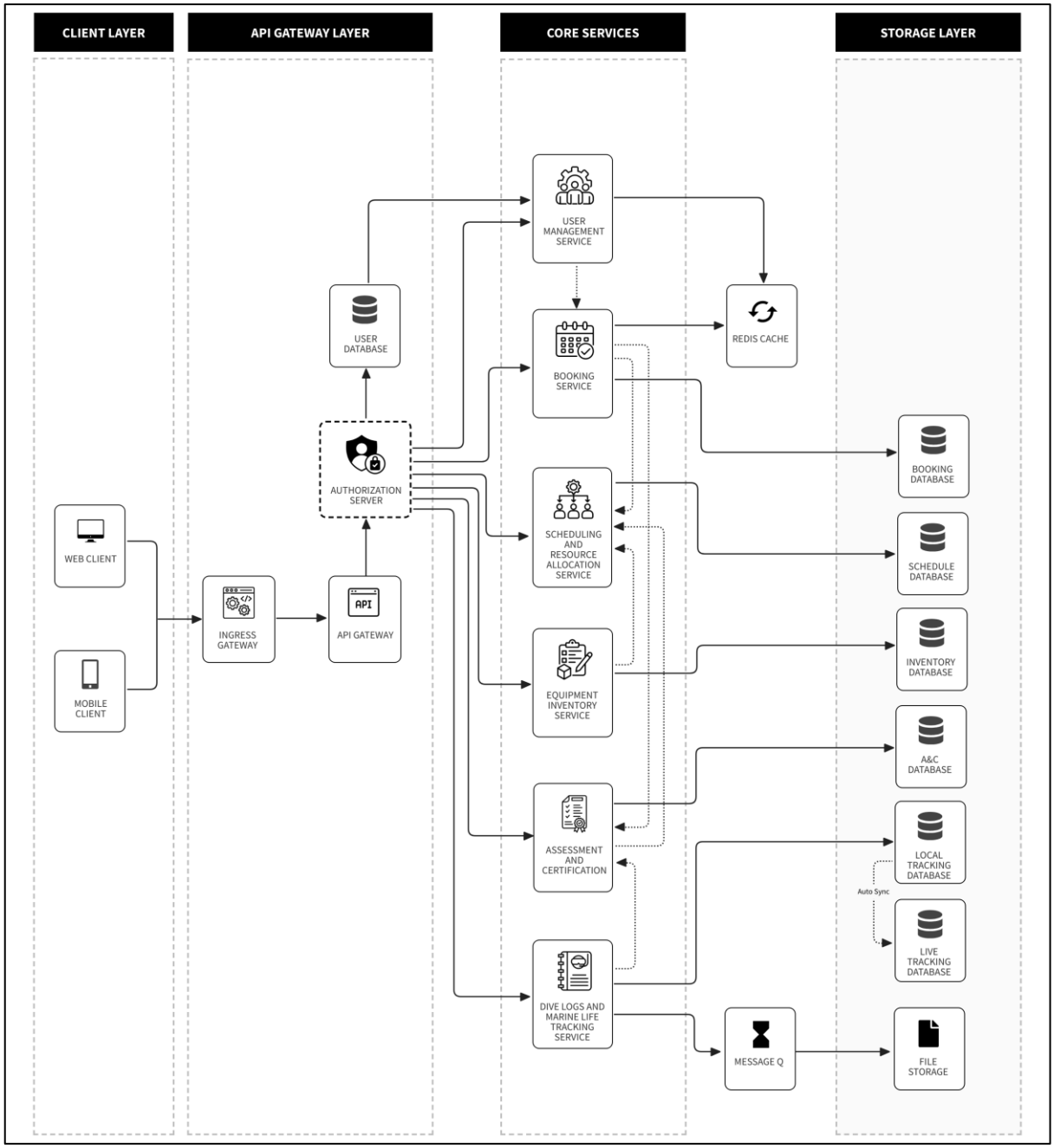

Figure 4: DiveMaster - System Architecture Diagram

4.5 Use Case Diagram

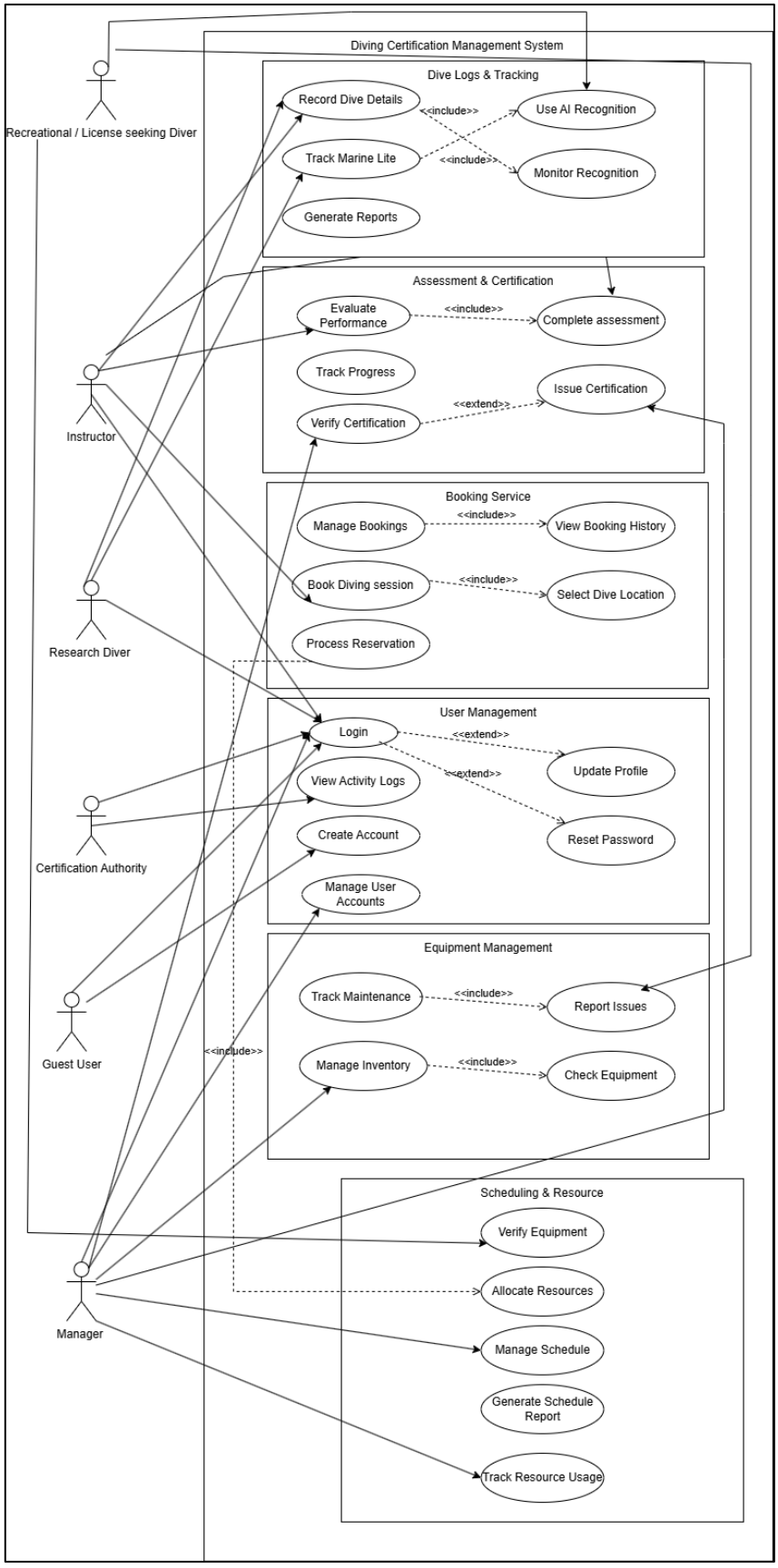

Figure 5: DiveMaster - Use Case Diagram

4.6 Activity Diagram

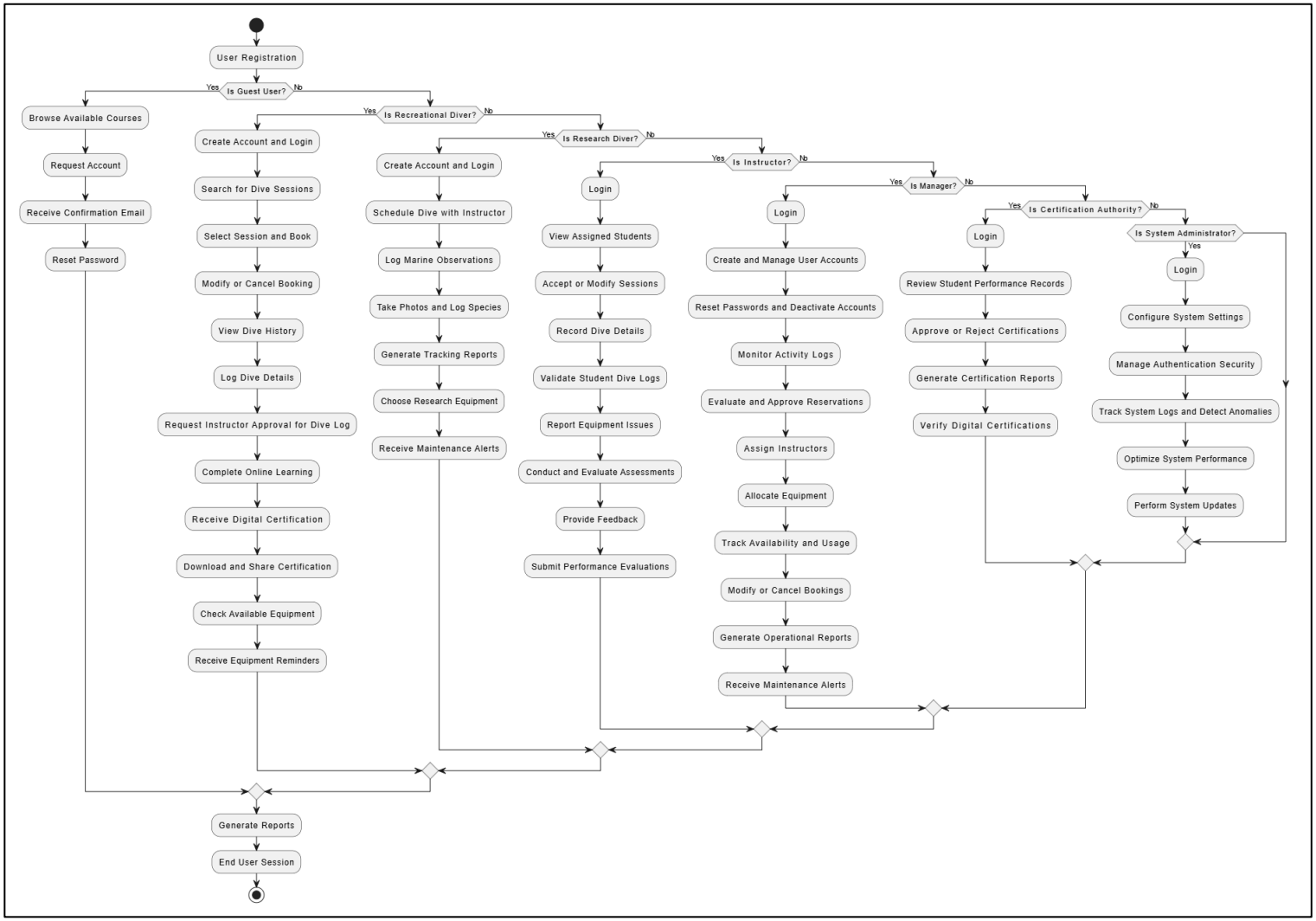

Figure 6: DiveMaster - Activity Diagram

4.7 Context Diagram

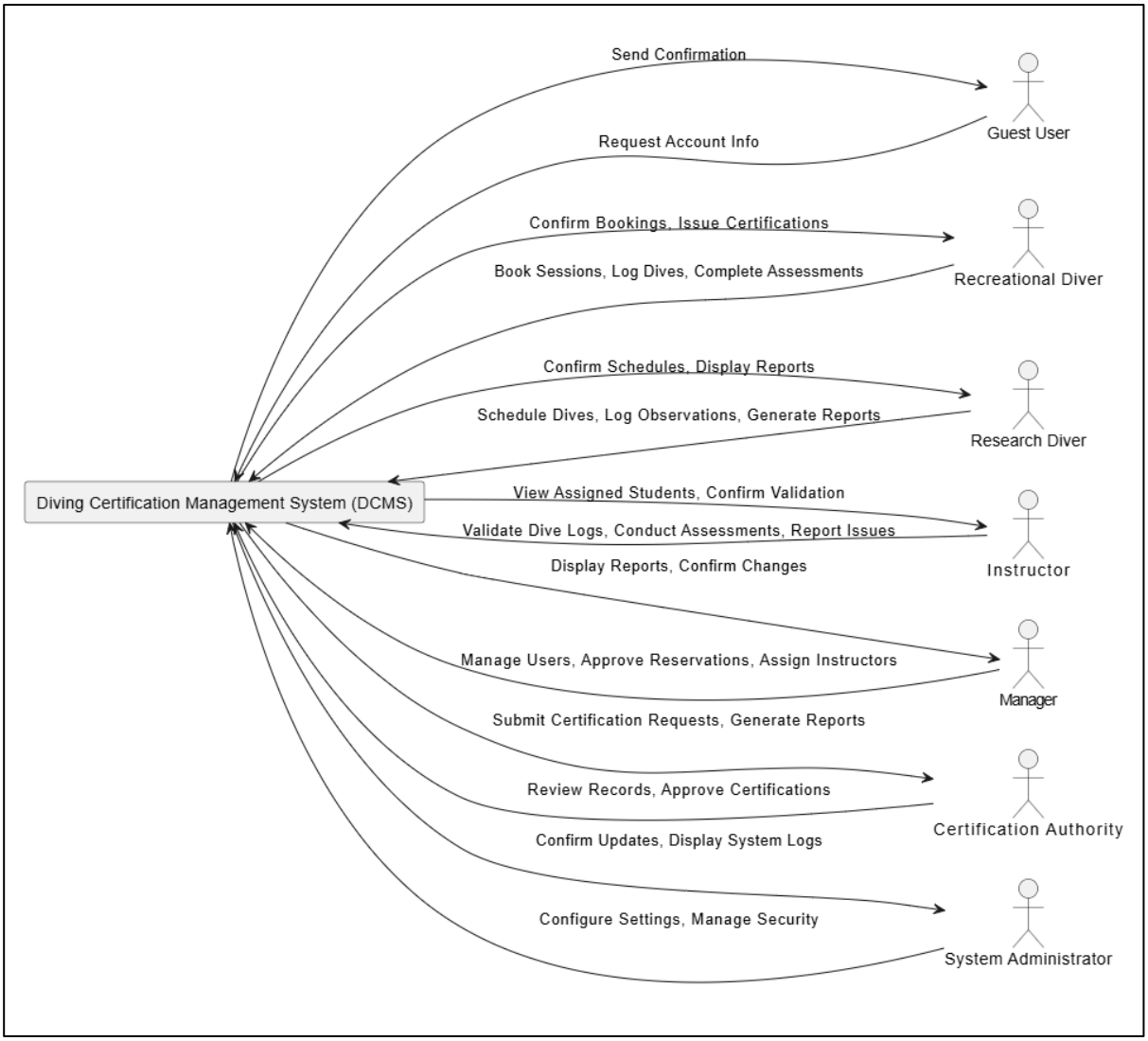

Figure 7: DiveMaster - Context Diagram

4.8 Applicable User Storie

1. Guest User

    - As a guest user, I want to browse available diving courses and sessions so that I can understand what training opportunities are available before registering.
    - As a guest user, I want to request an account so that I can enroll in a diving course or make a reservation for a dive session.
    - As a guest user, I want to reset my password in case I forget it so that I can regain access to my account.

2. Recreational/License-Seeking Diver

    - As a recreational diver, I want to create an account and log in so that I can access my diving course details, schedules, and progress.
    - As a recreational diver, I want to book a training or recreational dive session so that I can participate in a dive at my preferred location and time.
    - As a recreational diver, I want to modify or cancel my booking so that I can adjust my schedule based on availability.
    - As a recreational diver, I want to view my past and upcoming dive bookings so that I can keep track of my diving schedule.
    - As a recreational diver, I want to log my dive details, including depth, duration, and environmental conditions, so that I can maintain an accurate record of my diving experience.
    - As a recreational diver, I want my instructor to review and approve my dive log so that my training progress is validated.
    - As a recreational diver, I want to complete online learning modules and assessments so that I can prepare for my diving certification.
    - As a recreational diver, I want to receive my digital certification after completing my assessments so that I can easily verify my credentials.
    - As a recreational diver, I want to download and share my certification so that I can prove my qualifications to other dive centres.
    - As a recreational diver, I want to check available equipment before my scheduled dive so that I can ensure all necessary gear is available.
    - As a recreational diver, I want to receive automated reminders about my assigned equipment and return schedules so that I can follow proper procedures.

3. Research Diver

    - As a research diver, I want to create an account and log in so that I can book dives and access research-related features.

- As a research diver, I want to schedule a dive session with specific instructors so that I can conduct research with expert guidance.
- As a research diver, I want to log marine life observations and environmental conditions so that I can contribute to conservation research.
- As a research diver, I want to take photos and log species observations for later identification and analysis.
- As a research diver, I want to use an offline mobile app to capture dive data so that I can store and sync my logs even when underwater.
- As a research diver, I want to generate reports of my tracking records so that I can analyze trends in marine biodiversity.
- As a research diver, I want to choose specific diving equipment based on my research needs so that I can ensure all necessary gear is available.
- As a research diver, I want to receive automated maintenance alerts for assigned equipment so that I can avoid using faulty or expired gear.

4. Instructor

- As an instructor, I want to log in and view my assigned students so that I can track their training progress.
- As an instructor, I want to accept or request modifications to my assigned training sessions so that I can manage my schedule efficiently.
- As an instructor, I want to check confirmed bookings and assigned students so that I can prepare for upcoming training sessions.
- As an instructor, I want to record essential dive details, such as buddy divers, dive site conditions, and skills to be practiced, so that I can ensure a structured training session.
- As an instructor, I want to validate and approve student dive logs so that their training records are accurately maintained.
- As an instructor, I want to report equipment maintenance issues so that necessary repairs can be scheduled.
- As an instructor, I want to conduct and evaluate student assessments so that I can determine their readiness for certification.
- As an instructor, I want to provide feedback on student assessments so that they can improve their skills and knowledge.
- As an instructor, I want to submit student performance evaluations so that certification authorities can review and approve certifications.

- As an instructor, I want to access reports on student progress and certification pass rates so that I can assess overall training effectiveness.

5. Manager (Dive Centre Administrator)

    - As a manager, I want to create and manage user accounts for instructors and students so that I can control system access.
    - As a manager, I want to reset passwords and deactivate accounts so that I can maintain security and prevent unauthorized access.
    - As a manager, I want to monitor system activity logs so that I can track system usage and security compliance.
    - As a manager, I want to evaluate incoming dive reservations so that I can approve or decline bookings based on resource availability.
    - As a manager, I want to assign instructors to each approved reservation so that dive sessions are properly managed.
    - As a manager, I want to allocate essential diving equipment to each dive session so that divers have the necessary gear for their training.
    - As a manager, I want to track instructor availability, equipment status, and facility usage so that I can optimize scheduling and resource utilization.
    - As a manager, I want to modify, reschedule, or cancel bookings based on availability and instructor feedback so that scheduling remains flexible.
    - As a manager, I want to generate reports on dive schedules, equipment usage, and instructor workload so that I can analyze operational efficiency.
    - As a manager, I want to receive automated alerts for overdue equipment maintenance so that I can prevent safety hazards.

6. Certification Authority

    - As a certification authority, I want to review student performance records so that I can verify compliance with certification standards.
    - As a certification authority, I want to approve or reject submitted certifications so that only qualified divers receive credentials.
    - As a certification authority, I want to generate reports on issued certifications and pass rates so that I can track industry trends.
    - As a certification authority, I want to verify digital certifications through the system so that divers can authenticate their credentials easily.

4.9 Objectives

The primary objective of DCMS is to modernize and automate the diving certification process, ensuring a seamless, efficient, and error-free experience for students, instructors, and dive centre administrators.

By replacing manual scheduling with AI-driven automation, the system will eliminate double bookings, optimize resource allocation, and improve instructor efficiency. The digital dive log system will provide better tracking and validation of student progress, while real-time certification issuance will enable instant verification for divers worldwide.

The integration of e-learning modules will allow students to learn at their own pace, reducing the reliance on classroom-based sessions. Additionally, automated equipment tracking and maintenance scheduling will enhance safety and prolong the lifespan of diving gear.

From an administrative perspective, the ability to generate real-time reports on course enrolments, certification trends, and revenue insights will provide dive centres with valuable data for strategic decision-making. The system's compliance with international certification authorities ensures that all training and certification processes align with industry standards.

Ultimately, DCMS will transform diving centre operations, increase customer satisfaction, and set a new standard for digital diving certification management.

4.10 Production Logo

Figure 8: DiveMaster - Production Logo

Figure 9: DiveMaster - Logo Components

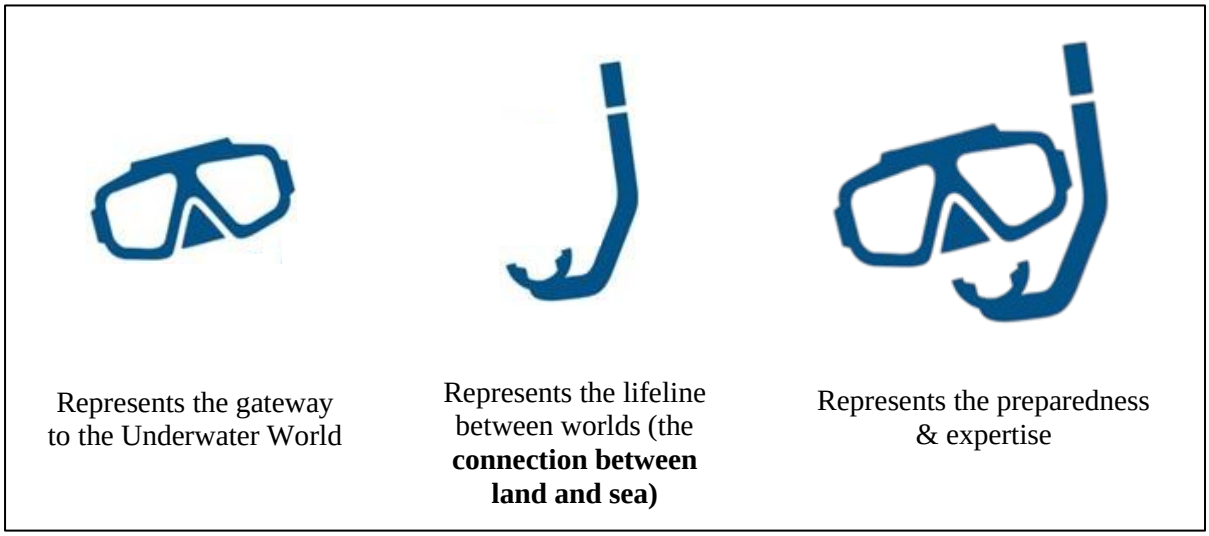

Figure 10: DiveMaster - Logo Lore/Inspiration

Logo Description for Dive Master

The **Dive Master** logo is a clean and visually engaging design that effectively represents the diving industry. Each element of the logo contributes to its meaning:

1. **Diving Mask and Snorkel**
    - The logo incorporates a stylized **diving mask and snorkel**, symbolizing underwater exploration and adventure.

- The mask has a modern and sleek design, conveying professionalism and expertise in diving.
- The snorkel is positioned upright, reinforcing the connection to the sport of snorkeling and diving.

2. **Typography**
   - The brand name **"Dive Master"** is written in a bold, rounded font, which gives a sense of friendliness, approachability, and reliability.
   - The typography is clean and modern, ensuring clear readability.

3. **Color Scheme**
   - The logo is designed in a **deep blue color**, which is strongly associated with the ocean, depth, and trust.
   - This color choice reflects the underwater theme and signifies a sense of calmness, confidence, and professionalism.

4. **Overall Meaning**
   - The combination of the diving mask, snorkel, and text conveys the brand's identity as an expert in diving.
   - It appeals to both beginner and professional divers, making it an ideal logo for a business in the diving industry.
   - The simplicity of the design ensures versatility, making it easy to use on various platforms, including digital and print media.

5. Methodology

The Diving Certification Management System (DCMS) will be developed over a five-month period using the Agile Scrum methodology, ensuring iterative development, continuous feedback, and flexibility in adapting to stakeholder requirements. By leveraging Scrum, the project will follow a structured yet adaptable workflow that promotes efficient collaboration, transparency, and high-quality deliverables.

Jira will be utilized for project management, enhancing sprint planning, task assignment, backlog management, and progress tracking. Unlike traditional waterfall methodologies, where each phase is completed before moving to the next, this approach allows multiple core system components—Course and User Management, Digital Dive Logs and Marine Life Tracking, Equipment Inventory and Maintenance, Assessment and Certification, and Scheduling and Resource Allocation—to be developed concurrently. This ensures that the entire system is integrated efficiently and no module is left behind, leading to a faster and more cohesive deployment.

5.1 Scrum Roles & Responsibilities

The development process will involve the following key Scrum roles, each with specific responsibilities:

- **Product Owner (PO):** Defines the product vision, prioritizes features, ensures alignment with business needs, and manages the Product Backlog. The PO will also gather stakeholder feedback and adjust priorities accordingly.

- **Scrum Master:** Facilitates Agile best practices, ensures adherence to Scrum principles, resolves impediments, optimizes workflow, and promotes effective communication within the team.

- **Development Team:** A cross-functional team of frontend engineers (React.js), backend specialists (Laravel), database administrators (MySQL), and testers responsible for the design, development, testing, and integration of system components.

5.2 Scrum Artifacts & Tracking Progress

To ensure transparency and structured progress, several Scrum artifacts will be used throughout the project:

- **Product Backlog:** A continuously updated list containing all features, requirements, and user stories, such as user logins, course tracking, dive logs, scheduling, equipment management, and certification issuance. The Product Owner will manage and prioritize this backlog based on stakeholder needs.

- **Sprint Backlog:** A subset of prioritized tasks from the Product Backlog, defining the specific features and functionalities to be delivered within each sprint.

- **Increment:** A working version of the system, delivered at the end of each sprint, ensuring progressive system functionality and early feedback incorporation.

- **Burndown Chart:** A visual progress tracker showing completed and remaining tasks, helping the team stay on schedule and meet deadlines.

5.3 Sprint Planning & Execution

The project will be divided into three major sprints, each focusing on different aspects of system development while ensuring parallel progress across all modules.

Table 2- Sprint Planning and Execution

Project Deliverables		
Sprint	**Focus Areas**	**Key Deliverables**
Sprint 1 (Weeks 1-6)	Laying the foundation for core functionalities and system architecture.	- Initial database schema & API design. - Frontend UI components for major modules. - Backend integration with user authentication. - Course & User Management basic setup. - Scheduling and Equipment management framework.
Sprint 1 (Weeks 7-14)	Feature expansion and system deepening.	- Role-based access control (RBAC) for security. - Automated notifications & reminders. - File uploads for assessments and dive logs. - Real-time equipment tracking & maintenance alerts. - Advanced scheduling algorithms and AI-powered optimization.
Sprint 3 (Weeks 15-20)	Final integration, testing, and deployment preparation.	- System-wide integration of all components. - Security enhancements & API optimizations. - UI/UX refinements for better usability. - Rigorous testing & debugging for system stability. - Final deployment & documentation handover.

Each sprint will conclude with a Sprint Review and Retrospective, where the team evaluates progress, gathers feedback, and identifies improvements for the next sprint.

6. Tools and Technologies

The Diving Certification Management System (DCMS) will be developed using a modern and scalable technology stack, ensuring performance, security, and maintainability. The system architecture is designed to support real-time operations, offline functionality, and seamless integration with third-party service such as payment gateway.

By leveraging a robust frontend, a powerful backend, a secure remote database, and reliable version control, the system will provide a responsive, high-performance, and user-friendly experience.

6.1 Frontend

The frontend of DCMS will be developed using React.js, a widely adopted JavaScript library known for its component-based architecture, high performance, and reusability. React enables a dynamic user interface with real-time updates, making it an ideal choice for an interactive application like DCMS.

For styling, Tailwind CSS will be used to create a responsive, visually appealing, and mobile-friendly interface. Tailwind's utility-first approach allows for fast and maintainable design development.

Client-side navigation will be handled using React Router, which provides smooth navigation between different views without requiring full-page reloads. To fetch and manage API data, Axios will be integrated, ensuring efficient communication with the backend while supporting request interception for authentication and error handling.

For authentication, JWT-based authentication (JSON Web Token) will be implemented, ensuring secure user sessions and role-based access control (RBAC). Optional UI libraries like MUI (Material UI) or Ant Design may be used to enhance UI consistency, accessibility, and design aesthetics.

The Offline Diving Research & AI Learning App will be built using Flutter, a cross-platform mobile framework that ensures a high-performance and seamless UI experience on both Android and iOS devices. The app will be optimized for low-power AI processing, considering its usage on specialized underwater tablets such as Duslate Aquatab X, Shark Marine Dive Tablet, and Innovasub's DPX-1 Shield.

For offline data storage, SQLite (via the SQLite package) will be used to store dive logs, research data, and AI-driven insights locally, allowing users to sync their data once network connectivity is restored.

To ensure efficient state management, Provider, River pod, or Bloc will be used, enabling seamless UI updates and data flow management within the app. Additionally, path provider will be integrated to handle local file storage for images, videos, and research notes captured during dives.

6.2 Backend

The backend will be built using Laravel, a PHP framework known for its security, scalability, and developer-friendly features. Laravel will handle API development, authentication, data management, and business logic processing, ensuring a structured and maintainable backend system.

For secure authentication, Laravel Sanctum will be implemented, enabling JWT-based authentication for secure user access and API communication. Laravel's built-in routing and middleware will ensure structured access control, request validation, and security enhancements.

The Eloquent ORM (Object-Relational Mapping) will be used for efficient database interactions, allowing seamless CRUD (Create, Read, Update, Delete) operations for users, courses, dive logs, equipment, and certification data. Form validation will be handled using Laravel Form Requests, ensuring data integrity, and preventing invalid user inputs.

To support real-time notifications, Laravel's event broadcasting system will be integrated with API, allowing instant updates on schedule changes, certification approvals, and reservation confirmations.

Database:

- Hosted MySQL Database
- SQLite DB for Flutter Application

6.3 Integration / Version Control

To ensure efficient collaboration, version tracking, and source code management, GitHub will be used for version control. The development team will follow Git best practices, including

- **Feature branching:** Each new feature will be developed in a separate branch to maintain code stability.
- **Pull requests & code reviews:** All changes will go through a review process before being merged into the main branch.

The database will be a hosted MySQL instance on cPanel or hPanel, providing secure and scalable data storage for user accounts, course enrolments, dive logs, equipment tracking, and certifications.

For third-party integrations, the system will connect with,

- Payment Gateway (e.g., pay here) for course registration payments.

6.4 Project Management and Communication

The development process will be managed using Jira, ensuring efficient sprint planning, task tracking, and agile workflow management.

Jira will be used for,

- Creating and managing the Product Backlog (list of features, bug fixes, and enhancements).
- Sprint planning and tracking (assigning tasks, monitoring progress, and meeting deadlines).
- Collaboration and real-time updates (ensuring all team members stay informed on development progress).

For communication, the team will use Microsoft Teams for daily discussions, issue resolution, and real-time collaboration. Google Meet or Zoom will be used for weekly sprint reviews and team meetings.

7. Schedule

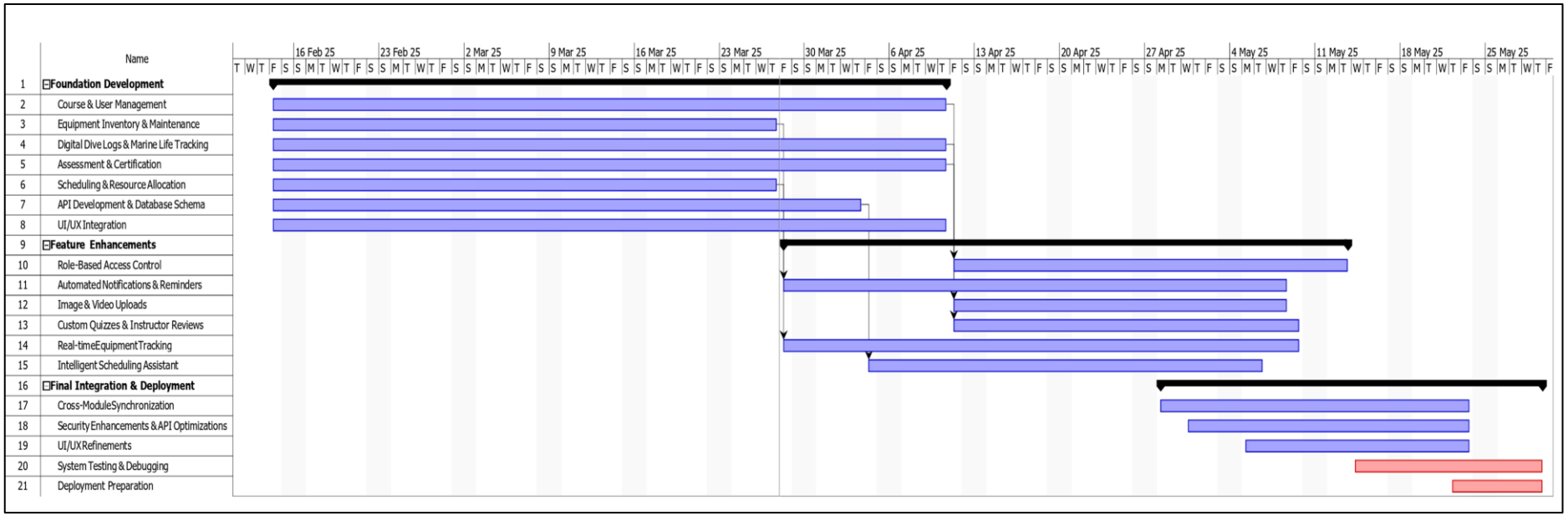

Figure 11: DiveMaster - Gantt Chart

8. Workload Distribution

Table 3- Workload Distribution

Student ID	Name	Component	Tasks
MS24905336	Singh W.M.T.R	Dive Logs and Marine Life Tracking Service	Develop the digital dive log system.
			Implement dive session logging (depth, duration, location, conditions).
			Design the marine life tracking interface.
			Implement AI-based species identification.
			Develop offline dive log functionality with automatic sync.
			Ensure instructor review and approval functionality for logs.
			Integrate reporting tools for divers and researchers.
MS25914078	Premarathne H.M.P.D	Scheduling and Resource Allocation Service	Develop automated scheduling logic.
			Implement instructor and resource allocation features.
			Manage booking validation and conflict resolution.
			Enable schedule modification and real-time updates.
			Integrate instructor notifications and responses.
			Generate scheduling reports and analytics.
MS24905954	Kaushalya M.K.B	Assessment and Certification	Develop online learning and assessment modules.
			Implement automated grading and feedback mechanisms.
			Ensure compliance with diving certification authorities.

			Generate digital certifications upon course completion.
			Implement QR-code-based certification verification.
			Develop analytics for student performance tracking.
MS24912570	Weerapana W.M.G.D	Equipment Inventory Service	Develop an equipment management module.
			Implement equipment tracking and assignment.
			Create automated maintenance reminders.
			Ensure integration with the scheduling system.
			Enable reporting for equipment usage and maintenance history.
MS25913774	Gamlath M.G.H.C	User Management & Booking Service	Develop user registration, authentication, and role management.
			Implement profile management and account security features.
			Develop the online booking system for courses and dive sessions.
			Integrate payment and reservation management.
			Ensure seamless interaction between bookings, schedules, and user roles.
			Generate reports on user activity and bookings.

9. Appendix

9.1 Annex I – Identified Features and Details

User Management	Guest User	Course and session browsing	Should be able to view available courses.
			Should be able to view upcoming dive sessions.
		Account request	Should be able to request an account for course enrollment.
			Should be able to submit necessary details for approval.
		Password reset	Should be able to request a password reset.
			Should receive an email with a reset link.
	Recreational/License-Seeking Diver	User account creation	Should be able to register using an online form.
			Should provide personal details, emergency contacts, and experience level.
		Profile management	Should be able to update personal details (name, email, phone number).
			Should be able to update emergency contact information.
			Should be able to update certifications and training records.
		Course and session booking	Should be able to reserve training courses.
			Should be able to book guided open dives.
			Should be able to book refresher training sessions.
		Booking modification and cancellation	Should be able to reschedule a booked session.
			Should be able to cancel a booked session before a deadline.
		Dive log entry	Should be able to enter dive records (depth, duration, environmental conditions).
			Should be able to log the type of equipment used.
			Should be able to submit dive logs for instructor review.
		Certification access	Should be able to view earned certifications.
			Should be able to download and print certifications.

			Should be able to share certifications with dive centers.
	Research Diver	Dive session booking	Should be able to schedule research-focused dive sessions.
			Should be able to select specific instructors for research guidance.
		Marine life tracking	Should be able to log observed marine species.
			Should be able to upload images for species identification.
			Should be able to use AI-powered species recognition.
		Offline dive logging	Should be able to record dive data without an internet connection.
			Should be able to sync offline logs once online.
		Reporting	Should be able to generate reports on recorded species.
			Should be able to analyze environmental trends over multiple dives.
Scheduling & Reservations	Instructor	Schedule management	Should be able to view assigned training sessions.
			Should be able to accept or request modifications to assigned sessions.
			Should receive notifications for schedule changes.
		Student management	Should be able to view assigned students.
			Should be able to track student progress and training history.
		Dive log validation	Should be able to review student-submitted dive logs.
			Should be able to approve or request changes to logs.
		Reporting	Should be able to generate reports on student progress.
			Should be able to generate performance analytics on training sessions.
Scheduling & Resource Allocation	Manager (Dive Center Admin)	User account management	Should be able to create, modify, and deactivate accounts for students and instructors.
		Scheduling	Should be able to approve or reject dive reservations.
			Should be able to assign instructors to sessions.
			Should be able to allocate equipment to dive sessions.

		Equipment availability tracking	Should be able to view real-time equipment availability.
		Reporting	Should be able to generate reports on equipment usage.
			Should be able to track instructor workload.
Equipment Management	All Users (Based on Role)	Equipment tracking	Should be able to check available equipment before a dive.
			Should be able to view assigned equipment details.
		Maintenance management	Should be able to receive automated maintenance reminders.
			Should be able to report issues with equipment.
			Should be able to track maintenance history for assigned equipment.
Assessments & Certification	Student	Online learning	Should be able to access digital learning modules.
			Should be able to take quizzes and exams.
		Certification issuance	Should be able to receive certification upon course completion.
			Should be able to verify certification validity through a QR code.
	Certification Authority	Certification review	Should be able to review student assessments.
			Should be able to approve or reject certifications.
		Reporting	Should be able to generate compliance reports on issued certifications.
Security & Compliance	Manager (Dive Center Admin)	Access control	Should be able to configure user roles and permissions.
		Authentication security	Should be able to enable multi-factor authentication (MFA).
		Audit logs	Should be able to track user activity logs.
		Data security	Should ensure encryption of sensitive data.