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Aquatech: Inventory and Work Maintenance Management System for FRI Malaysia

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Abstract— Aquatech: Inventory and Work Maintenance Management System is built purposely for the AquaTAR (Aquarium Tunku Abdul Rahman) of Fishery Research Institute of Malaysia (FRI). FRI is an agency under the Research Department of Fisheries Malaysia that researches fish, aquaculture resources, and ecology. The system hybrids of three different system concepts, i.e., information system, task management system and inventory management system, in one responsive web application system. Studies have justified that information management helps to increase the productivity of the organisation. However, storing, maintaining, and tracking the essential resources, work tasks, and asset information can be challenging if not done correctly. Relatively, few systems in the market are available to manage the work maintenance of an extensive fishery collection, such as in AquaTAR. Therefore, this study is to design and implement a web-based application for FRI AquaTAR to help organise and manage fish information assets, track the aquarium facilities' work maintenance, and efficiently supervise the work maintenance. Three users are designed for the system: the administrator, supervisor, and workers. This system was developed using PHP programming language and MySQL database to maintain the data storage. The project has successfully developed and satisfied all the intended objectives. A questionnaire distributed to 25 participants (6 administrators, 8 supervisors and 11 workers) shows that more than 88% of the participants are satisfied with the functions explicitly provided to their role and more than 80% are satisfied with the system's user interface (UI).

Keywords—Information Management, Inventory management, Task Management, QR code, web application

I. INTRODUCTION

Managing an extensive dataset can be difficult for some research institutes. It needs to constantly preserve all recorded information in a highly secure platform, well-managed and organised and sufficient to store essential details of the research items. A collection management system involves organising, taking appropriate control, and managing the collection items that track and maintain the items' status to an excellent condition. The strength of the collection management system is determined by the database structure and the essential features involved in maintaining the collected items.

Maintaining the preservation of an item is a difficult task for the institute as constant inspection is required to maintain the great state of the items. The preservation process of collected items is determined by the requirements given by the institute so that important details can be highlighted and prioritise accordingly. Also, a proper solution to solve the specific problems related to the collections and the organisation's business flow can be resolved.

This research emphasizes developing a web-based system that can help the institute efficiently manage fishery information, work maintenance to maintain fishery collection, and inventory of the collections and maintain the collection in the FRI. The system will be developed as a reactive web-based application that enables the users to manage their data efficiently without worrying on preserving the fish specimens.

II. LITERATURE REVIEW

A. Overview of Fisheries Research Institute Malaysia

FRI is an agency under the Research Department of Fisheries Malaysia, focusing on fish and aquaculture resources and ecology research. The institute's research emphasises fishery resources, aquaculture, aquatic ecology, biotechnology, fisheries product development, and fish health. The agency also provides a comprehensive range of fishes collected in the institute to be displayed in their facility called AquaTAR (Aquarium Tunku Abdul Rahman). It is open to the public for a visit. Moreover, the responsibilities of the marine species are not restricted to just conducting research but also to providing information to be exposed to the public for educational purposes. Its goals as an agency are to excel in researching tropical fisheries, provide scientific knowledge and expertise for sustainable development of the fisheries sector, and be presented to the public view of existing fishes collected by the agency.

B. *Concept of Information Management*

The overall process of managing information, which can also be considered an asset, requires depth planning that includes developing a framework, initiating systems, and making control changes on the quality of the information to be presented as a piece of precious information[1]. However, initiating and planning information is needed to recognise the crucial information that needs to be kept in the system. According to [2], it is vital to establish a well-defined role of technology and its environment and the developers and users who will be dealing with the changes of maintaining the information, in the planning phase. This process includes prioritising each piece of data according to its value and urgent matters. Hence, maintaining information needs to be planned in a structure to preserve the quality of the information.

FRI holds many types of fishery collections that link to its aquaculture and aquatic ecology, and biotechnology. Thus, it is vital to understand the adequate and suitable information for their datasets. Based on the National Research Council of National Academies in 2004, essential criteria for implementing information management are accuracy, accessibility and usefulness. These criteria are crucial as they reflect the value of the information, resulting in the system's effectiveness, thus bringing the system to be valuable and beneficial to the institute.

C. *Concept of Inventory Management*

Stock or collection management is not an easy job for any organisation as it requires much effort, time, and energy to ensure the stocks are constantly updated and managed efficiently. According to [3], inventory management can be defined as a business process responsible for developing and managing inventory works. In addition, [3] also stated that the goal of providing inventory management is to ensure the stocks are always sufficient and avoid any excessive amount or too low of stock, thus helping an organisation to manage and organise their stocks and supplies efficiently. Thus, implementing an inventory management concept in the system allows FRI to maintain and monitor the supplies for their fishery collections in the AquTAR. This is important in preserving a healthy environment and providing good care of their fishery collections.

D. *Concept of Task Management*

Task management can be defined as managing a task through its life cycle, which involves planning, task execution, tracking and reporting [4]. Task management helps individuals achieve their task goals and share each other knowledge for the achievement of the common goals. Each of the goals needs to be stated alongside with problem and its solution or method. Apart from that, distribution of tasks is required to achieve a great flow of work and decrease any possible cost and time-consuming. Emerging a proper approach to be carried out in delegating a task is needed and prioritise them as the adequate solution can be proposed and calculated correctly referring to an important task. Organisations that know how to organise, schedule and delegate tasks are more successful in their project's deliverables [5]. To prioritise the task effectively, a proper method is required to help evaluate the work concerning the overall importance and identify and define which tasks will help achieve the objectives most efficiently.

E. *System Review*

1) *iFish Managery System*

iFish Manager system was developed by Cyberrob Company from Tasmania. It is a web-based system using a windows-based interface that uses the cloud as a medium for storing information. The system can hold various information about the species such as the fish's year class, fish's id assignments, their multi-species, feeding schedules, mortality, site management for pond or tank intakes and assignments, control of stock, spawning, and fertilisation. The system can also hold inventory information directly linked to the suppliers to ensure all the stocks such as medicine and foods for the species are secured in place.

Below are the advantages and disadvantages of the system: -

TABLE I. THE ADVANTAGES AND DISADVANTAGES OF iFISH MANAGERY SYSTEM

Advantages	Disadvantages
Does not require any installation or upgrade required.	Internet access may be limited
Data is securely kept in a cloud-based hosting	The flow of features are not well organised
The system can be accessed anywhere in the world	Only been monitor by one user
Provides a fully traceable information	
Provide features to keep track of stocks that link to suppliers	

2) *Aquariogest - Aquarium Maintenance System*

The system was developed by BF-Info Company from France. The system mainly focuses on aquarium management with two different versions to support either Freshwater aquarium or Saltwater aquarium. The system's main features are managing data of the aquarium, keeping track of all fish events, and keeping information on aquatic plants in the aquarium. Furthermore, the system also help to monitor the Aquarium water level, schedule maintenance tasks, record events like a logbook, record the breeding of fishes, and manage expenses and incomes related to the aquarium. Overall, the software system covers all activities needed in monitoring and maintaining the aquarium.

Below are the advantages and disadvantages of the system: -

TABLE II.   The advantages and disadvantages of Aquariogest - Aquarium Maintenance System

Advantages	Disadvantages
Does not require any installation or upgrade required.	Internet access may be limited
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F. Implementation of Aquarium Management

Since the FRI provides aquarium facilities, there are a lot of crucial activities needed to be carried out to maintain the facilities are in good condition and to ensure all the work maintenance of the facilities is in place. Most of the aquarium management in the existing market provides features that focus on monitoring aquarium and stocks for the aquarium. However, there are a lot of other aspects that need to be taken in the monitoring tank or aquarium. Aquaculturist needs to monitor the aquarium in a specific time and takes necessary action like feeding which can be done 3-4 times a day, draining and refilling water based on the state of water and monitoring water temperature level. Thus, maintaining an aquarium centre requires close attention, and immediate action needs to be taken. For that, AquaTAR needs to adapt these essential functions to ensure the efficiency and accuracy of the institute's business operations, increasing their productivity by managing and maintaining their fishery collections more efficiently and effectively.

G. G. QR Code

In today's IT phases, wireless technology has expanded and comes in different varieties throughout the world, and one of the wireless technologies is wireless sensors. There are many purposes that wireless can do in solving many kinds of problems faced by an organisation. For this project, a QR Code is embedded into the system to ensure the effectiveness of tracking maintenance work. QR Code (Quick Response) can be defined as a two-dimensional matrix code often mentioned as barcodes [6]. QR Code can restore an error correction for which that information can be restored even if a QR Code is damaged by up to 30% [7]. This has been proven by [8] in his study. The study has proven that even though the QR Code image is contaminated or disfigurement, the error detection still functions and can focus on the place of correct data [8]. The study also stated that QR Code has a high capacity in encoding data as it can store various types of data in one place. With this attribute of QR Code, tracking any necessary information is more effective and secure.

III. METHODOLOGY

Aquatech: Inventory and Work Maintenance Management System uses a methodology known as Rapid Application Development (RAD). The method is part of the agile software development methodology that prioritises the rapid prototype release and iteration in each phase. This methodology highlights the importance of user feedback to achieve the requirements sets by the user. Furthermore, using this methodology will reduce time in planning and focus on the prototype iterations, allowing the project managers and stakeholders to measure accuracy and communicate in enhancing or fixing issues of the progress of the development. This methodology is suitable for the prototype project as the scale is small and requires major code implementation and testing.

A. Development Phases
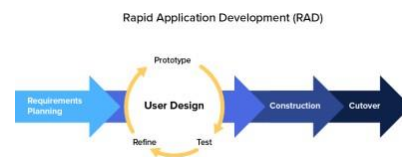
1) Requirement Planning

Fig. 1.   Rapid Application Development (RAD) Model

The first phase is identifying sufficient requirements to be implemented for the prototype project. Beforehand, the objectives and scope of the prototype must be defined to ensure the accuracy of the requirements to be captured. For each requirement identified, it will further be breakdown into a smaller module to further define the activities involved for each requirement.

Besides gathering the requirement from the user perspective, a review of related systems will also be conducted. An informal site observation, such as browsing information through FRI's website and an informal interview, has been carried out to understand work maintenance and how they manage their fish information and monitor inventory work in AquaTAR. This phase focuses more on understanding the problem faced by the user and exploring the best and most appropriate solution. A document known as Software Requirement Specification (SRS) will be developed to record all the systems' final requirements. Further, the SRS will be the primary reference for the project planning in supporting the subsequent implementation activities.

2) User Design

The next phase of RAD is User Design which structures the flow of the modules and designs the user design interface. This phase aims to propose a partial working design that can be demonstrated to the user to ensure the requirements are feasible for implementation. In this project, an initial mock-up has been designed and presented to the user for review. This phase will usually iterate as often as possible as it involves feedback on the demonstration of the user design prototype. Consistent feedback from the user enables the developer to understand and capture

what the user wants fully and does not want. With constant communication between clients, the developer will

learn through experience, resulting in a quick and easy adaptation to the user's needs. Hence, in developing a prototype, the developer will be able to evaluate the feasibility of the proposed features.

3) Construction

In the Construction phase, the activities are more focused on implementing the system, testing the modules and system, conversion of the prototype to the working system, and occurrence of unit integration. Iteration will occur as often as possible to ensure all supporting modules and components are compatible and functional. Most of the problems should have been identified and rectified through iterations of user feedback, thus resulting in a low chance of major problems.

4) Cutover

The final phase of the RAD is Cutover, which is finalising the system and deploying the final system to be used in the live production environment. Full-scale testing will be executed before the deployment to acknowledge and/or rectify system bugs. User training will also be carried out at this phase. Documentation of all the input received from this phase is crucial, leading to necessary maintenance tasks. Software Testing Plan (STP) will record all the occurrences of all proposed feature testing.

B. Hardware and Software Specification

TABLE III. SOFTWARE AND HARDWARE SPECIFICATION

Software	Hardware
Windows 10Professional	ASUS Vivobook
Internet Browser –Google Chrome	Intel ® Core™ i5-1035G1 CPU 1.00Ghz 1.19Ghz
Visual Studio Code	RAM
Xampp	NVIDIA GraphicCard
PhpMyAdmin	
Bootstrap	

IV. RESULT AND DISCUSSION

A. Functional Requirements

Functional requirements represent the functions or feature of a system that describes how the function will work and what it is supposed to do. Use case diagram illustrates how the system will be utilised from the end user's experiences. It summarises the relationship between the behaviour and the actor (users of the system), which helps to give an overview of the context of a system and its requirements. All the functionalities presented in the use case are based on the requirements elicited thoroughly and according to the intended actors. Overall, use cases are

drawn to display the dependencies and relationships in the diagram that can be understood easily.

Fig. 2. Use case diagram for Administrator

Fig. 3. Use case diagram for Supervisor

Fig. 4. A use case diagram for Workers
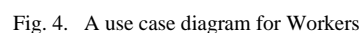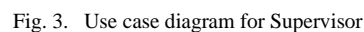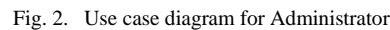
B. User Interface (Highlighted Features)

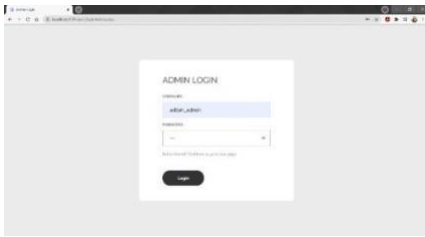#### 1) Login Interface – Administrator

Fig. 5.   Administrator login interface

Fig. 5 displays the admin login interface. Admin able to access the system through this page with the right credentials. If the admin inputs the wrong credentials, such as username or password, the system will trigger an alert message that notifies the user.
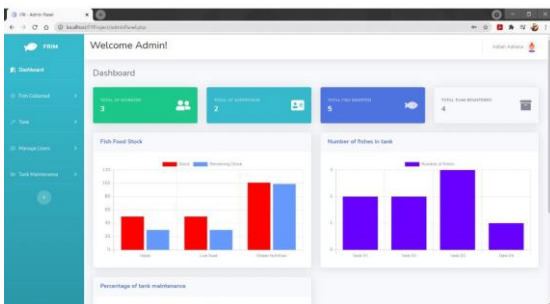
2) Dashboard Interface – Administrator

Fig. 6.   Dashboard Administrator

Fig. 6 displays the Admin dashboard interface. After the system verifies the admin credentials, the system will display an alert message that shows the admin has successfully entered the system and redirects to the first page of the Admin Panel, the dashboard
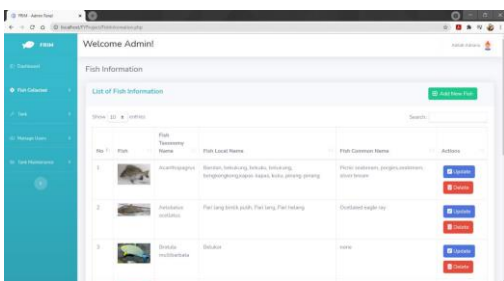

Fig. 7.   Fishery Collection Interface

Fig. 7 displays a list of fish collected in the institute. The page will display the registered fish information that is in the aquarium facility. Admin can do CRUD operations (Create, Read, Update and Delete) and search for any specific fishery information by their fish taxonomy such as name, localname or common name of fish.
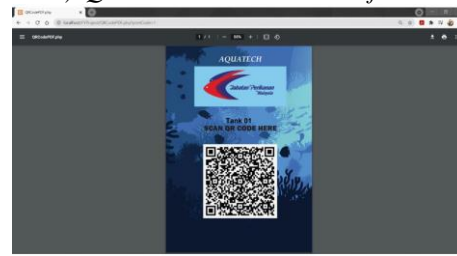
3) QR Code Generation Interface

Fig. 8.   QR Code generation for each tank

Fig. 8 displays the generated QR Code image for the selected tank. The page also provides functionality for printing. The admin can print out the image and stick the image to the intended tank for the workers to scan the details of the tank and their associated assigned tasks.

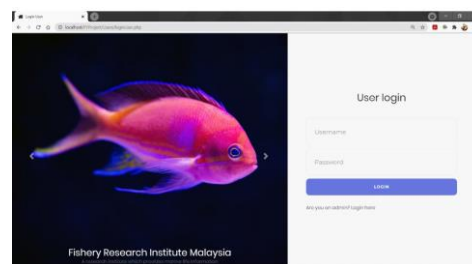#### 4) Login interface – Supervisor and Worker

Fig. 9.   Supervisor and Worker user interface

Fig. 9 displays the user login interface for both Supervisor and Worker. Supervisor or Worker can access the system through this page with the right credentials. An alert message will trigger when the user enters the wrong input or is not registered in the database.

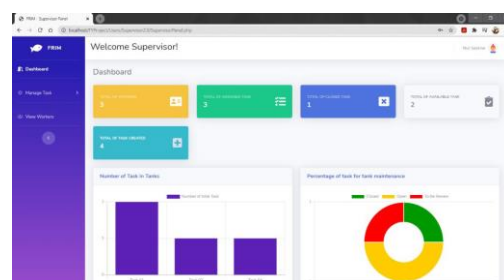#### 5) Dashboard Interface – Supervisor

Fig. 10. Dashboard interface for Supervisor

Fig. 10 displays the Supervisor dashboard interface. The page is displayed right after the Supervisor successfully login into the system. The dashboard summarises the total number of workers, number of assigned tasks, number of completed tasks, and number of tasks created. Graph view will also summarise the overview of the tasks.

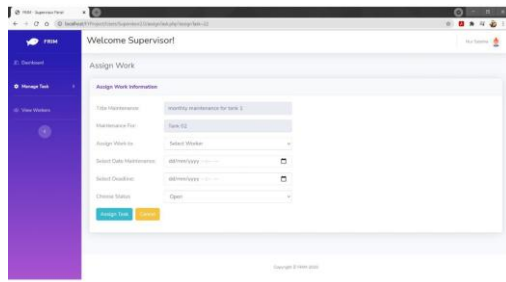### 6) *Assign Tasks Interface – Supervisor*

Fig. 11. Assign task interface

Fig. 11 displays the supervisor's function to assign a task to a specific worker on a specific day and time together with its expected completion date. The task can be selected from the pre-defined tasks as the task are mainly generic for maintenance.
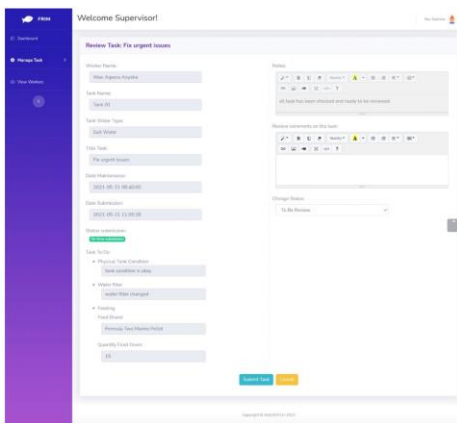
7) *Review assigned task – Supervisor*

Fig. 12. Review assigned task interface

Fig. 12 displays the function for the supervisor to review the assigned task. The supervisor will be able to review the task that the Worker has submitted to check on its completeness and compliance. The supervisor can view the details execution of the tasks and any issues raised regarding the assigned task. The task will be closed once Supervisor satisfied with the work done on the task.

8) *Scan QR Code – Worker*

Fig. 13. Scan QR code interface

Fig. 13 shows the scan QR code function. The function is for the Worker to scan the QR code that sticks on each tank. Upon completing the scanning, the system will display the details of the assigned task associated with the scanned tank. The worker may enter the details of the tasks and submit them to the Supervisor for verification.

C. *User Feedbacks*

Aquatech: Inventory and Work Maintenance Management System is a web application to resolve work maintenance issues in AquaTAR and digitally manage the information of fishery collections available in the institute. The system is mainly for the FRI workers with three different roles, i.e., the administrator, supervisors, and maintenance workers. The feedback was gathered according to these three roles. Thus, a survey was distributed to 25 participants (6 administrators, 8supervisors and 8 maintenance workers). Below are the findings from the survey on the system.

TABLE IV. USER FEEDBACKS

Features	Results
Fishery collection	88.8% of respondents say that the fish details stored in the system is sufficient
Graphical analysis (Dashboard)	About 70% of the respondents agree that the graph provide valuable summarization of information for managing works
Delegation of tasks	80% of respondents were satisfied with the task management flow in the system.
QR Code	All of the respondents

	says that the QR code scanning is functioning well.
	80% of the respondents say that the QR Code function helps increase the productivity of the task execution.
User Interface	Most of the respondents were satisfied with the user interface of the system.

The feedback from the prototype indicates that the functions provided in the system could help increase the efficiency and productivity of the work maintenance management and manage fishery collections. The inventory management feature embedded in the system also ensures the efficiency of maintaining and monitoring the supplies of fishery collections in AquaTAR. By having this function, AquaTAR can provide a better healthy environment and better care of their fishery collections.

V. CONCLUSION AND RECOMMENDATION

Aquatech: Inventory and Work Maintenance Management System has been completed. The system has been delivered with sufficient features to be used by the users. A critical review of the domain and existing systems was conducted to gather necessary evidence of features appropriate to the AquaTAR system. The system has shown its capability to help the Administrator track work maintenance tasks and store important information on the fishery collections in the facility. The system has also demonstrated its ability to provide a structured and efficient work maintenance flow for the Supervisor to delegate, track, review and check work maintenance tasks. Furthermore, workers can now retrieve a more accurate and detailed task description and update the assigned tasks efficiently through the system. The integration of QR Code scanner and scanning into the system makes the task reporting more efficient.

The implementation of the prototype system had gone through extensive testing and reviewing to ensure its quality of the prototype system. However, there is always room for improvement. Following is the list of functions that might help to further increase the value of the system to AquaTAR:-

- Fish Food Inventory can be amplified by ordering and tracking stocks from the supplier.

- An analytical tool that can intelligently mining the performance and efficiency of the work maintenance tasks. This function should have a more structured way of working maintenance reporting and printing.

- A better view for the workers to view their work maintenance task in a weekly or monthly view.

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