(Baywatch) - SEA TURTLE HABITANT MONITORING AND TRACKING SYSTEM

(SEA TURTLE IDEFICATION AND INCREASING SURVIVABILITY OF TURTLE.)

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Project Proposal Report

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Declaration

I declare that this is my own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously publish or written by another person expect where the acknowledgement is made in the text.

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The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

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Signature of the supervisor:

Date:……..

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Signature of the Co-supervisor:

Date:……

Abstract

Conservation of sea turtles is an important environmental endeavor, especially in areas like Sri Lanka where these threatened species are subject to several threats. The goal of this research project is to create a sea turtle monitoring system that is machine learning and Internet of Things based, improving sea turtle tracking and conservation. This system provides a complete approach to habitat protection and species conservation by utilizing technologies including picture categorization, disease identification, predictive analytics, and real-time environmental monitoring.

A disease identification module to track the health of the turtles, a machine learning-based image classification tool for precise species identification, and predictive models that use historical data and environmental factors to predict sightings of sea turtles are some of the system's key components. Furthermore, the system keeps an eye on the hatchery environment to guarantee ideal circumstances for. Furthermore, the system keeps an eye on the hatchery environment to guarantee ideal circumstances for a successful hatch and high survival rates.

In addition to helping conservationists with accurate, data-driven insights, this creative solution will engage eco-tourists with real-time monitoring experiences. In order to ensure a sustainable future for these endangered species, the integration of these technologies aims to address the issues of habitat degradation, illegal poaching, and the effects of climate change on sea turtles.

Keywords: Image classification, disease detection, predictive analytics, IoT, machine learning, sea turtle conservation, and environmental monitoring

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List of Abbreviations

MS	Microsoft
CNN	Convolutional Neural Network
ML	Machine Learning
SVM	Support Vector Machines
RNN	Recurrent Neural Networks
DB	Database
API	Application Framework Interface
VS CODE	Visual Studio Code
VCS	Version Control System

List of

1.0 INTRODUCTION

1.1 Background and Literature

Since turtles maintain coral reefs and seagrass beds, sea turtles are essential to marine ecosystems. They are threatened by several factors, such as poaching, habitat degradation, and climate change. For conservation efforts to be successful, accurate species identification is essential.

New developments in machine learning and image processing offer creative approaches to enhance this process. The monitoring and protection of these endangered species depends on the precision and efficiency of sea turtle classification, which may be greatly improved by utilizing these technologies.

The use of machine learning methods, in particular Convolutional Neural Networks (CNNs), in the classification of animal species is being highlighted by current research. Based on pictures, these models have demonstrated potential in the identification of a variety of animal species, including marine life.

For instance,[1] provided evidence of the efficacy of machine learning models in the classification of species of sea turtles based on aerial and underwater data. Nonetheless, numerous current methods continue to encounter obstacles associated with image quality, fluctuations in the environment, and restricted datasets.

The goal of this project is to create a reliable machine learning model for classifying sea turtles that can manage a range of environmental factors and image quality variations to overcome these restrictions. A sizable, annotated collection of photos of sea turtles will be used to train the model, with particular attention paid to important characteristics including flipper structure, head shape, and shell patterns. CNNs will be used in conjunction with feature extraction methods like Histogram of Orientated Gradients (HOG) and Local Binary Patterns (LBP) to enhance the model's performance.

The system seeks to improve these methods to attain greater accuracy in practical situations, which will help environmentalists monitor and safeguard sea turtle populations more effectively.

This classification method will aid in larger conservation efforts by providing information that guides protection plans, in addition to aiding in the identification of species. Precise categorization will enable the observation of diverse marine turtle species in diverse environments, assisting conservationists in prioritizing regions most in need of safeguarding and reducing hazards unique to certain species.

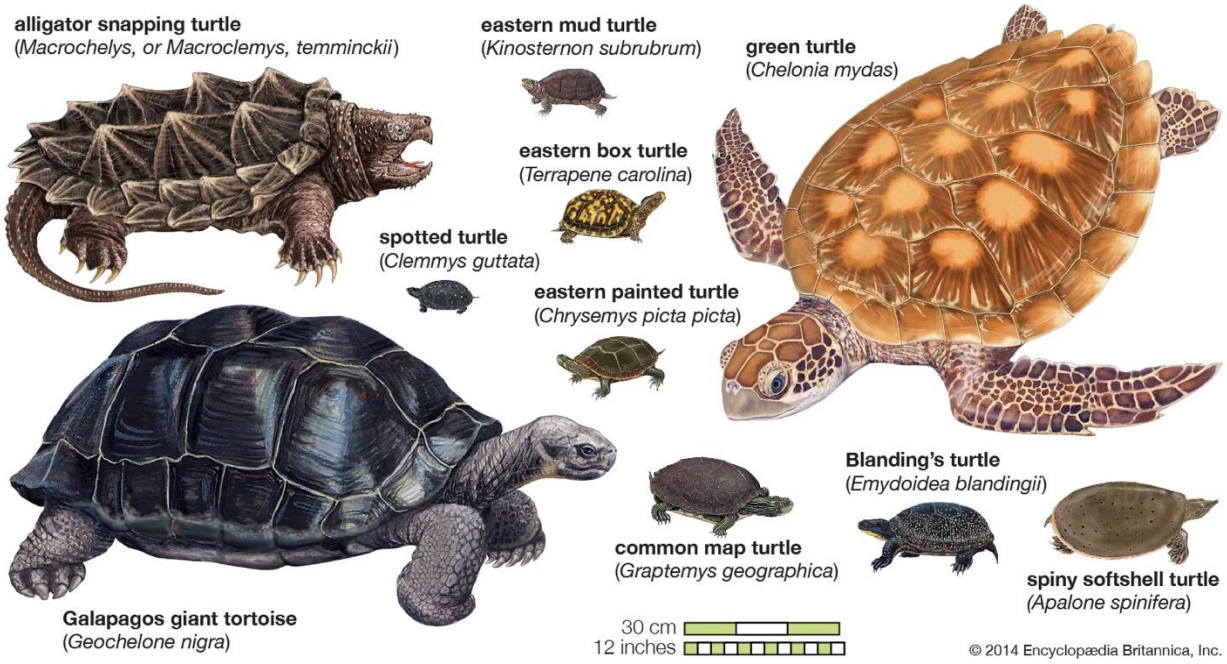

Figure 1: Classification of Sea Turtles.

1.2 Research Gap

Sea turtle conservation is an essential endeavor for maintaining marine biodiversity, yet there are significant research gaps that hinder the effective implementation of modern technologies in this area. One critical gap lies in the application of machine learning for sea turtle classification. While machine learning models, particularly Convolutional Neural Networks (CNNs), have shown promise in classifying species based on images, current approaches often struggle with limited, inconsistent datasets and environmental variability. Additionally, many studies focus primarily on the classification of common species, with less attention given to rare or endangered species of sea turtles. This limitation affects the accuracy of species identification, especially in diverse habitats such as those found in Sri Lanka.

Another research gap is the integration of health monitoring within the classification systems. Most current research separates species identification from health assessments, which are crucial for conservation efforts. While there is significant progress in using IoT and sensor-based technologies to monitor environmental conditions, there is a lack of research that combines real-time environmental data with machine learning-based classification to provide a holistic view of sea turtle health and habitat suitability. This gap limits the ability of conservationists to make informed, data-driven decisions for protecting and rehabilitating sea turtle populations.

Furthermore, there is a need for more region-specific studies, particularly in countries like Sri Lanka, where local environmental conditions and threats vary from those studied in more developed regions. The lack of localized data hinders the development of targeted conservation strategies that consider the unique challenges faced by sea turtles in these areas.

By addressing these research gaps—improving dataset quality and consistency, integrating health monitoring with classification systems, and focusing on region-specific studies—this research aims to advance the field of sea turtle conservation and contribute to the creation of more effective, real-time monitoring systems that can be deployed in diverse and challenging environments.

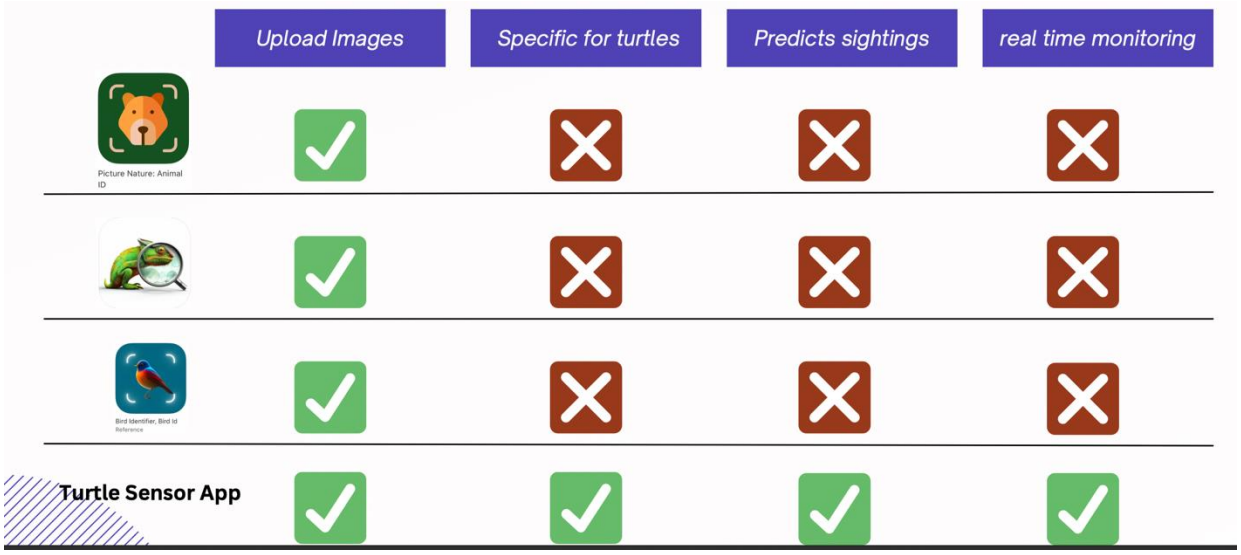

Figure 2: Competitive Analysis

1.3 Research Problem

The need for sea turtle conservation is growing due to the increasing risks posed by human activities and environmental changes to these endangered animals. In many regions, including Sri Lanka, sea turtles are threatened by habitat degradation caused by pollution, coastal development, and the aftermath of natural disasters. As a result, these already vulnerable populations are facing even greater risks as critical breeding habitats are being lost. Human activities, such as illegal poaching, fishing bycatch, and disturbances caused by tourists, further exacerbate these threats, leading to a decline in sea turtle populations.

Additionally, climate change presents new challenges. Rising sea levels and increasing temperatures affect nesting sites and hatchling sex ratios, potentially causing long-term population imbalances. Pollution, particularly plastic debris in the oceans, causes physical harm to sea turtles and disrupts their food sources. Moreover, sea turtles are vulnerable to a variety of diseases, many of which are worsened by the deteriorating conditions of their habitats and the stress caused by human interference.

Traditional methods of tracking sea turtle populations, such as manual surveys and tagging, are labor-intensive, less accurate, and often slow in producing actionable data. These methods also fail to provide real-time information, which is crucial for effective conservation efforts. Therefore, it is imperative to adopt cutting-edge technologies like IoT, machine learning, and big data analytics to enhance the accuracy, speed, and efficiency of sea turtle monitoring systems.

By utilizing these technologies, conservationists can gain more accurate insights into sea turtles' behaviors, health, and habitat conditions, allowing for better decision-making and more targeted conservation strategies. This research aims to address these challenges by developing an advanced system that integrates species classification, real-time environmental monitoring, and predictive analytics, ultimately contributing to the long-term preservation of sea turtle populations in Sri Lanka and beyond.

2.0 Objectives

2.1 Main Objective

Create an accurate and efficient image- based classification system to identify different species of sea turtles. (Sea turtle identification)

2.2 Specific Objectives

The following are the sub-objectives of conducting this research.

- Provide Develop a system that provides real-time data on sea turtle activities,
- Improved According to Sri Lankan context.
- Early Intervention
- Increased Engagement
- Non-Invasive

3.0 METHODOLOGY

3.1 Requirement Gathering

Requirement gathering was through performing an extensive analysis of past research conducted throughout recent years, identification and analysis of the existing systems, as well as reading through a variety of online resources. Also, some real-world scenarios were used to figure out this research problem and requirement gathering.

3.1.1 Past Research Analysis

When it comes to Past Research Analysis, there are quite a lot of research papers and publications under the topic of Emotion detection. However, there was a smaller number of publications considering the Stress detection. Key topics of interest included CNN, Image processing and Face recognition.

During the past research analysis, the main focus was to identify the methodologies and the tools used to build all existing tools and platforms. Moreover, it helped to identify the problems that the past researchers faced.

3.1.2 Identifying Existing Systems

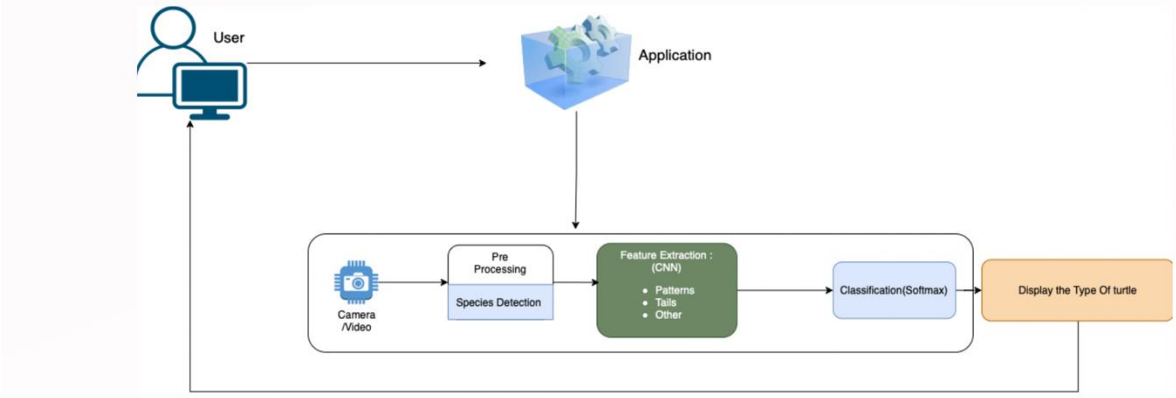

Figure 3: System Diagram

3.2 Feasibility Study

3.2.1 Technical Feasibility

3.2.1.1 Knowledge on Technologies

In order to develop the proposed solution, the knowledge in below mentioned technologies should be wanted.

 Convolutional Neural Networks (CNNs): CNNs will be utilized for image classification to accurately identify sea turtle species from images, as they excel in recognizing patterns in visual data.

 Deep Learning Algorithms: These algorithms will be applied to analyze environmental data and make predictions about sea turtle behavior and habitat preferences based on various factors.

 Internet of Things (IoT) Devices: IoT-enabled sensors will be deployed for real-time environmental monitoring, collecting data on factors such as temperature, humidity, and human disturbances in sea turtle habitats.

3.2.1.2 Knowledge on Tools

To develop the proposed optimization model, all members should have quite an in-depth understanding of the development tools and project management, other supportive tools. The figure 4 shows the current MS planner bord about the project management plans.

3.2.1.3 Data collection Knowledge

Data collection and preprocessing are essential steps in any data analysis task.

1. Data Collection.: Survey , site visits
2. Data-Preprocessing: It includes the procedures of data cleaning, data transformation, data reduction, and data integration.

3.2.2 Schedule Feasibility

This is an independent solution as a part of our project. This will be developed according to the timeline. Figure 6 and Table 2 illustrates the schedule management plan clearly.

3.2.3 Economic Feasibility

This system focuses the solution with the minimal cost. Also, the cost is very low comparing to the other solution model. However, the cost will be differed according to the economic crisis. The draft estimation is in table 4 under budget.

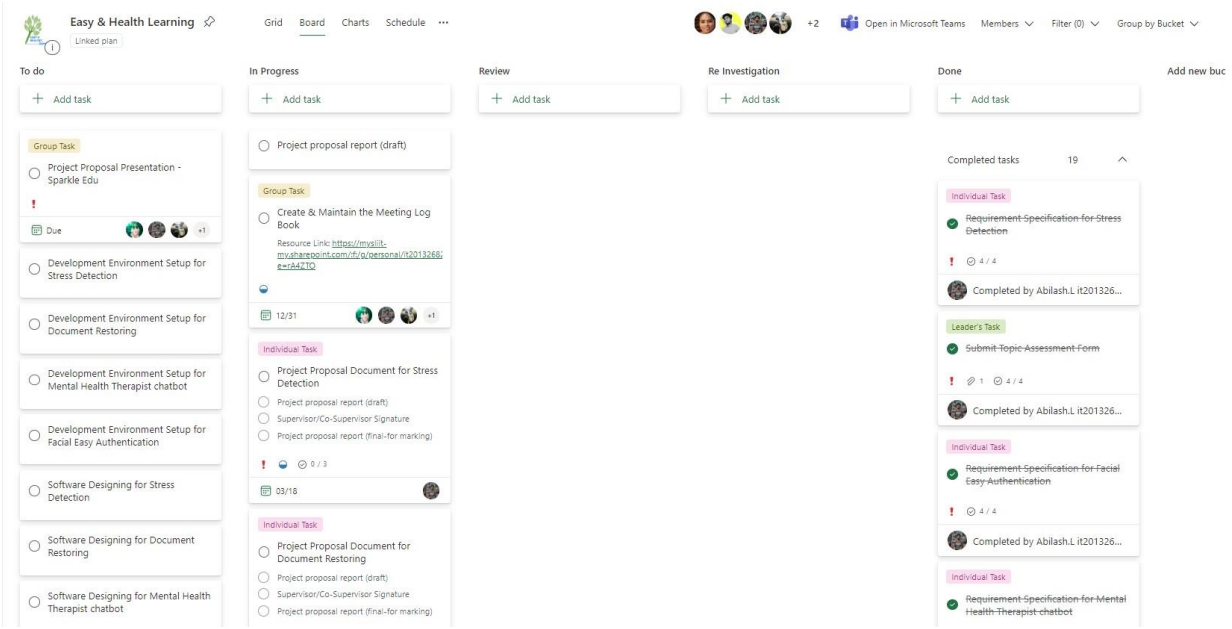

Figure 4: Ms Planner-Project Management Tool

3.3 System Analysis

3.3.1 Software Solution Approach

Below mentioned are the approach of the solution development, and figure 5 shows the flow of the solution.

1. **Data Collection**: Gather data through field observations, GPS tracking, environmental sensors, and historical records of sea turtle sightings and nesting activities.
2. **Image Acquisition**: Capture images of sea turtles in their natural habitats using cameras and IoT devices installed at strategic locations such as beaches and hatcheries.
3. **Preprocessing**: Perform preprocessing tasks such as image enhancement, noise reduction, and alignment to ensure the data is ready for analysis.
4. **Feature Extraction**: Extract relevant features from the images, such as shell patterns, flipper shapes, and size measurements, which are crucial for accurate sea turtle classification.
5. **Species Identification**: Apply image classification techniques using either all image pixels or specific features like flipper patterns, using landmarks for further time-series analysis to monitor growth and health.

6. **Model Training**: Train machine learning models, particularly CNNs, to accurately classify sea turtles based on the extracted features.
7. **Model Evaluation**: Assess the performance of the classification models using metrics like accuracy, precision, recall, and F1 score to ensure high reliability in identifying different sea turtle species.Model Evaluation: Evaluate the performance of the model using metrics such as accuracy and precision.

3.3.2 Tools & Technology

- Programming Languages – Python
- Frameworks – Keras, TensorFlow, Viola Jones, OpenCV, OpenFace, EmoPy
- Database Systems – MongoDB
- Web Development Frameworks
    - ✦ React JS – Front End Development
    - ✦ MUI – UI components design and development.
- UI Design Implementation – Figma
- Diagramming Tool – Draw.io
- Integrated Development Environment (IDE) – VS Code
- Version Control System (VCS) – Git (GitHub or GitLab)
- Collaboration Tools – Microsoft Teams or WhatsApp.
- Testing Tools ○ Jest - JavaScript Unit Testing ○ Postman – API Testing ○ Unit test – Unit Testing tool for Python
- Deployment Tools
    - ✦ Docker - Containerization
- Kubernetes - Orchestration
- Jenkins - Automation
- Ansible - Configuration
- Chef - Infrastructure ○ Code Quality Assurance tool – SonarQube
- Project Management ○ MS Planner

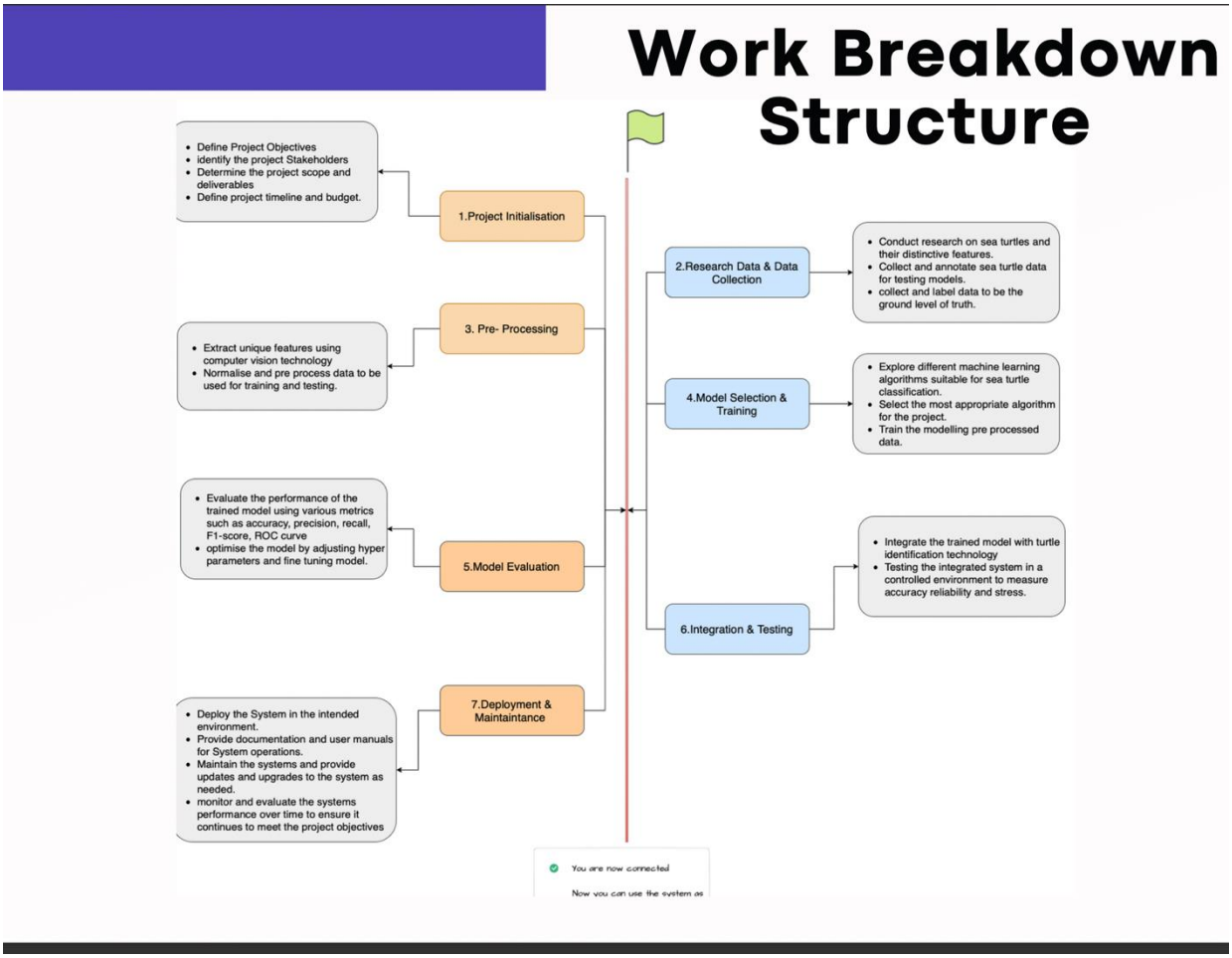

Figure 6: Work breakdown Structure

3.4 Project Requirements

3.4.1 Functional Requirements

The functional requirements for the proposed model are as follows:

- Collect and analyze data specific to the Sri Lankan coastal regions and sea turtle habitats.
- Accurately classify sea turtles based on images, identifying species and other distinguishing features.
- Monitor the environmental conditions of nesting and hatchery sites in real-time.
- Provide alerts and recommendations to conservationists regarding the health of turtles, potential threats, and necessary interventions.

3.4.2 Non-Functional Requirements

The non-functional needs that were prioritized throughout the creation of the suggested model are listed below.

- Usability
- Reliability
- Availability
- Accuracy
- Performance

3.5 Testing

When it comes to testing the research outcome, it plays a crucial role in the success of this research. In order to test the functionality of the proposed solution, the initial plan is testing the solution among the team members and friends. This will act like a unit or system testing.

However, in the final part of the research, this solution will be tested with the selected number of students in the local environment and the deployed environment. This will act like Acceptance testing (Alpha, Beta Testing).

Mostly the testing will be manual testing and sometimes internal functions and some assert functions will be used to check.

3.6 Timeline

The proposed timeline for the project is as follows.

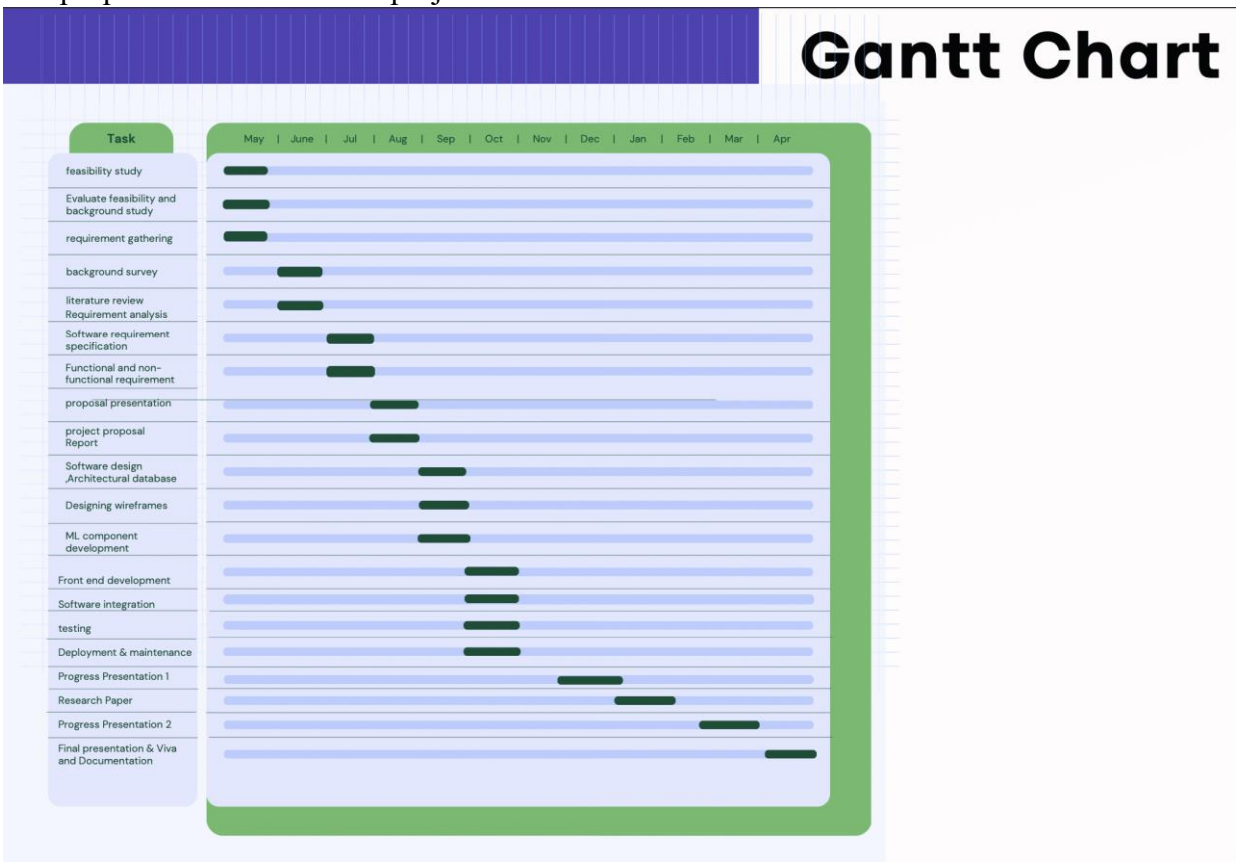

Figure 7: Gantt Chart for Project Schedule Management

3.7 Risk Management Plan

The alternative plans and their specifics are described in the risk management plan mentioned above. The development team will complete its task without interruptions using this strategy. These are the typical threats that a project team encounter.

Risk	Trigger	Owner	Response	Resource Required
Risk with respect to the Project Team				

Illness or sudden absence of the project team	Illness / Other personal emergencies	Project Leader member(s)	* Inform to the supervisor and co-supervisor. * Backup team divides the scope.	* Project Schedule Plan/Gantt Chart resources * Development functions with equal
Risk with respect to the Panel/ Supervisor(s)				
Panel Requests changes	Not satisfied with the product/presentation /outcome	Project Leader	* Do the necessary changes immediately. * Update the changes in all required documents. * Update the changes to the required persons.	* Project Schedule Plan/Gantt Chart * Product Backlog * Meeting Log
Supervisor(s) Request changes	Not satisfied with the product/presentation /outcome	Project Leader		
Panel/Supervisor(s) is not at the scheduled meetings	Illness / Other personal emergencies	Project Leader	* Inform it to the required persons immediately. * Reschedule the meeting/ do necessary alternatives	* Meeting Log * Proper Email

Table 2: Risk Management Plan

3.8 Communication Management Plan

The Communications Management Plan helps to ensure that all team members, supervisor and co-supervisor have the information they need to perform their roles throughout the project. Project success depends on the planning and execution of communication efforts.

How to communicate with different stakeholders most effectively and efficiently is decided by the communications management plan. It outlines and documents the audience, communication items'

content, format, frequency, and anticipated outcomes. Also, it specifies the various stakeholders' roles in the project, how to assign tasks to them, and the communication strategy for each of them based on their influence on the project, interests, and expectations.

3.8.1 Communication Objectives:

Proactive communication is important on all projects. Communication needs to be:

- Adequate: in the right format and right content.
- Specific: for the targeted audience.
- Sufficient: providing all the necessary information.
- Concise: brief, avoiding repetition and non-important information.
- Timely: addressing points at the right time.

3.8.2 Communication Media:

The communication media that will be used for the project are:

1. Email
2. Document (MS Word and/ PowerPoint)
3. Phone call
4. Meetings (using, meeting rooms, conference phones, Ms Teams) 5. Chats (WhatsApp)

Meeting Type	Attendees	Purpose	Frequency	Agenda Items

Planning Kick-off Meeting	Supervisor, Co-supervisor, All Team Members	* The project's planning phase was formally launched. Following this meeting, the project's scope and governance structure must be defined, the expectations of all significant project stakeholders must be established, along with their respective roles and duties, and all current hazards must be identified. * The elements will be finished in their entirety and novelty.	Once at Project Level.	* Describe the planning timetable and describe the aims, expectations, and activities of the planning phase. * State the project scope in your introduction. * Go over the key points of the project charter. * Go over the project's overall schedule. * Discuss the overall approach of the project. * Talk about the project's necessary project plans. * Explain assumptions, limitations, and hazards. * Talk about or show off any project-supporting tools. * Recap the conversation (decisions, actions, and risk).

Executing Kick-off Meeting	Supervisor, Co-supervisor, All Team Members	* The project's execution phase was formally launched. Following this meeting, the team, supervisor, and co-supervisor are aware of the project's scope, its governance structure, the duties and responsibilities of its participants, and its rules.	Once at Project Level or for each major project phase. (Before Proposal, PP1, PP2, Final)	* Provide the Project Work Plan and the Meeting Log. * The Communications Management Plan should be presented.

Meeting Type	Attendees	Purpose	Frequency	Agenda Items
				* Agree on the process for resolving disputes and propose the escalation method. * Outline the Quality Assurance & Control procedures, Issue Management, and Project Change Management processes. * Agree on the team's guiding principles (communication via email, meetings, phone, meeting minutes to be produced, availability, etc.). * Talk about the upcoming evaluations. * Recap the conversation (decisions, actions, and risk).
Internal Project Status Meeting	All Team Members	* Go over the project's status. Discuss ongoing projects and assess development.	*Once a week*	Progress status review

Actual Project Status Meeting	Supervisor, Co-supervisor, All Team Members	* Discuss new risks or/and issues and define action points. * Examine and discuss modification requests, and if necessary, accept or reject them. * Talk about the upcoming evaluations.	*Twice a week*	(presentation of periodic Project Status report). *Accomplishments (Current and Planned actions). * Actual work vs Planned. * Milestones status. * Current deliverables status:

Meeting Type	Attendees	Purpose	Frequency	Agenda Items
				-Indicators, Existing change requests (current progress), New change requests (input from Research Panel) * Next deliverables status: -Existing change requests (Current progress), New change requests * Risks & Issues

Project Review Meeting	Supervisor, Co-supervisor, All Team Members	* A meeting discussing the status of the project. * Major scope adjustments, a significant re-baselining of the project work plan (PWP), ensuring alignment with portfolio goals and objectives, and business strategies are among the subjects that will be covered.	Quarterly of the project. (Before Proposal, PP1, PP2, Final)	* The completion of required documentation. - Review of significant milestones. - Testing advancement. - Budget, resource, and other risks; issue, and action monitoring. - Panel comments. - Other: People, Resources, and Panel.
Project Steering Committee (PSC) Meeting	All Team Members	* Meeting with the supervisor(s) about the status and follow-up of the project. * This meeting is also necessary at this time because: -Official project permissions are required. - Promises made.	Once a month or at the time a significant project milestone is accomplished, the supervisor must provide their approval (s).	Project debriefing: * Results during the time period. * Issues encountered and solutions found. * Important issues deserving of management's attention. * Items that won't be completed until the following milestone or meeting.
Meeting Type	**Attendees**	**Purpose**	**Frequency**	**Agenda Items**
				*Assessment of the existing situation in relation to the project's objectives, spending plan, and completion date. *Official endorsements, commitments, and contractual details.

Change Control Meeting	Supervisor, Co-supervisor, All Team Members	* Discuss and prioritize change requests or panel inquiries.	There is an important requirement change after the panel discussion.	* Discuss the panel comments and accept the change requests and start development.
Project-End Review Meeting	Supervisor, Co-supervisor, All Team Members	The objectives for the Project-End Review meeting are: * Examine the key accomplishments and project performance. * Talk about how the project went overall. * Talk about if the goals have been attained and, if not, why. * Go over the issues and difficulties that were encountered during the project and how they were handled. * Talk about best practices and lessons learned that might be used to next initiatives.	Once per project or major project phase. (End of the Project)	* Evaluate the results and accomplishments of the project. * Consider projectrelated information (budget & work history, milestones & timing history, technical & methodological approaches used). * List the lessons that were learned. * Plam to implement your business (change management, how to achieve desired outcomes and benefits)

Table 3: Communication Management Plan

4.0 COMMERCIALIZATION

This sea turtle monitoring and classification system targets conservationists, environmental organizations, eco-tourism businesses, and government authorities in Sri Lanka. The solution is essential for those focused on addressing the challenges sea turtles face due to habitat degradation, poaching, and environmental changes.

Initially, this system will be deployed at key conservation sites and hatcheries across Sri Lanka. The proposed solution will be integrated into existing conservation platforms, offering unique

features not currently available in the market. These components, such as real-time monitoring, disease detection, and predictive analytics, will be provided through a subscription-based model for conservation authorities, eco-tourism businesses, and NGOs. By leveraging partnerships with marine research organizations, the system could also be extended to broader conservation networks, enhancing collaborative efforts across regions.

For high-end users, such as large-scale conservation projects and tourism operators, premium features like real-time environmental alerts and advanced data analytics could be offered. Additionally, the system could be integrated into eco-tourism apps, providing tourists with real-time updates on sea turtle activities as part of an exclusive eco-tourism experience.

5.0 BUDGET

Since the outcome of the proposed model is a software-based solution, there are no hardware components connected to the implementation. The primary source of the cost will be the subscription fees to the cloud provider for the computing power of the virtual machines. However, there will be some other costs expected to as be given in the table below.

Type	Cost
Internet use and web hosting	5000 LKR
Publication costs	12110 LKR
Stationary	5500 LKR
TOTAL	***22610 LKR***

Table 4: Cost Management Plan

This amount may differ according to the economic crisis.

6.0 SUMMARY

The research on sea turtle monitoring and conservation through advanced technologies like machine learning, IoT, and predictive analytics aims to address critical environmental challenges. This project focuses on the classification of sea turtles using image recognition techniques, real-time habitat monitoring, disease detection, and predictive modeling to improve conservation efforts. By implementing these technologies, the research seeks to enhance the accuracy, speed, and effectiveness of conservation practices in Sri Lanka and beyond.

This study has significant implications for wildlife conservation, particularly in the protection of endangered sea turtle species. The ability to classify turtles, monitor their health, and predict their movements in real-time will empower conservationists with actionable insights. This will not only support the preservation of habitats but also mitigate threats posed by climate change, pollution, and illegal activities. Additionally, eco-tourism industries can benefit from these technologies by engaging tourists with real-time wildlife tracking experiences, thereby promoting responsible tourism practices.

Ultimately, this research aims to contribute to the long-term sustainability of sea turtle populations by combining cutting-edge technology with conservation strategies, ensuring a balanced ecosystem for future generations.

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