DEVELOP AN AUGMENTED REALITY MEASURING TOOL FOR MARINE LIFE

By

Yong Chung Wei

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF INFORMATION SYSTEMS (HONOURS)

INFORMATION SYSTEMS ENGINEERINNG

Faculty of Information and Communication Technology

(Kampar Campus)

MAY 2023

UNIVERSITI TUNKU ABDUL RAHMAN

REPORT STATUS DECLARATION FORM

Title: DEVELOP AN AUGMENTED REALITY MEASURING TOOL FOR MARINE LIFE

Academic Session: May 2023

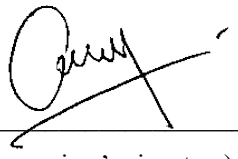
I YONG CHUNG WEI

(CAPITAL LETTER)

declare that I allow this Final Year Project Report to be kept in
Universiti Tunku Abdul Rahman Library subject to the regulations as follows:

1. The dissertation is a property of the Library.
2. The Library is allowed to make copies of this dissertation for academic purposes.

Verified by,



(Author's signature) (Supervisor's signature)

Address:
133, Taman Tun Sambanthan,
31100 Sungai Siput (U),
Perak

Ts Dr Cheng Wai Khuen
Supervisor's name

Date: 13 September 2023 **Date**: 13 September 2023

FACULTY/INSTITUTE* OF INFORMATION AND COMMUNICATION TECHNOLOGY

UNIVERSITI TUNKU ABDUL RAHMAN

Date: 13 September 2023

SUBMISSION OF FINAL YEAR PROJECT /DISSERTATION/THESIS

It is hereby certified that _____***Yong Chung Wei***_____ (ID No: __***19ACB06074***___) has completed this final year project/ dissertation/ thesis* entitled "_*Develop an Augmented Reality Measuring Tool*_____" under the supervision of ___Ts Dr Cheng Wai Khuen __ (Supervisor) from the Department of ___INFORMATION SYSTEM___, Faculty/Institute* of _INFORMATION AND COMMUNICATION TECHNOLOGY__ , and ____Ts Dr Khor Siak Wang___ (Moderator)* from the Department of __ INFORMATION SYSTEMS___, Faculty/Institute* of _INFORMATION AND COMMUNICATION TECHNOLOGY__.

I understand that University will upload softcopy of my final year project / dissertation/ thesis* in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,

YONG CHUNG WEI

DECLARATION OF ORIGINALITY

I declare that this report entitled **Develop an Augmented Reality Measuring Tool for Marine Life** is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature : 

Name : Yong Chung Wei

Date : 13 September 2023

ACKNOWLEDGEMENTS

I would like to express my appreciation and thankful to my supervisor, Ts Dr Cheng Wai Khuen. Dr Cheng provide me a bright way and also support me in my Final Year Project. Your useful advice and suggestion were very helpful and guided me to the correct way in my Final Year Project. All of the advice and suggestion will be a very useful knowledge to me, not only in the project.

To a very special person in my life, Chew Xin Ru who very supportive, caring and standing by my side during hard times. Lastly, I would like to express my appreciation to my family who are love me and unconditional support me in my course.

ABSTRACT

This is the student Final Year Project to develop an augmented reality measuring tool for marine life. The project will involve several techniques and open-source such as OpenCV, AR Core, and machine learning. The main purpose of this project is able to measure multiple type of marine life such as fish, prawn and crab. The application of this project able to estimate the length and weight of marine life while performing measuring. First of all, it requires a machine learning to train a pre-trained object detection module to determine the object is what type of marine life. So that, the application only will measure marine life object that detected by the pre-trained module. After that, it will estimate the size and type of the marine life. OpenCV will be used in input processing for the input of pre-trained module. Other than that, the output of the result will display in augmented reality with AR Core technique. After that, it also can estimate the type of fish, prawn and crab such as mud crab, flower crab, black tiger prawn, fresh water prawn, grouper fish and pomfret fish. It also can be achieve using machine learning with mobilenet machine learning module. It requires to collect huge among of image data for machine learning training purpose in order to achieve wanted accuracy. Moreover, the application also able to estimate the freshness of the marine life. It will achieve through image processing to estimate the freshness of marine life such as fish, prawn and crab.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AR	Augmented Reality
AI	Artificial Intelligence
RAD	Rapid Application Development

CHAPTER 1 Introduction

In this chapter, I would like to present the problem statement and motivation of my project. After that, it proceeds with the main objective of the project that ensure my work is directed in the way of the project. Other than that, it proceeds with project scope and direction of the project. Lastly, it will be the last few part which is contribution of the project and report organization in this report.

1.1 Problem Statement and Motivation

Total fishery production of Malaysia by value (US$ 1,000)

	2019	2018	2017	2016	2015
Total	**3,612,486**	**3,588,104**	**3,586,643**	**3,181,205**	**3,205,698**
Capture Fisheries	2,792,056	2,812,260	2,797,988	2,468,899	2,400,783
Marine Capture	2,770,023	2,781,682	2,774,062	2,447,329	2,382,430
Inland Capture	22,033	30,578	23,926	21,570	18,353
Aquaculture	820,430	775,844	788,655	712,306	804,915

Figure 1.1 Total Fishery Production of Malaysia by Value

Seafood products become very important food to human since human need to consume large number of seafood to absorb nutrient from seafood especially fish. In Figure 1.1 show that, the fishery product keeps increasing from year 2015 to 2019. It already increased 12.69% from year 2015 to 2019 [1]. It has a high increment of fishery production in Malaysia. Some people want to earn more profit on that since the fishery production got increment and increased market of fishery production. So that, people will implement illegal activities on that such as seafood fraud to earn more profit. There is some news about seafood fraud in below.

Figure 1.2 Seafood Fraud News

There are some investigations exposing seafood fraud activities in global area and found that 9000 seafood samples from restaurant, fishmongers and supermarkets in 30 countries, 36% of seafood has mislabeled. There is one example in Germany, 48% of king scallops are tested is less coveted Japanese scallop. Another example in Italian fish markets and fishmongers, there are 45% of 130 shark fillets from Italian fish markets and fishmongers are mislabeling. They use cheaper shark pretend the most prized shark by Italian buyers. Because of seafood business is involving international trade, it causes the seafood supply chains become complex and highly vulnerable to mislabeling. Vice-president of Oceana USA said that, mislabeling is common everywhere after study and study [1]. There are also some investigations to expose short-weight seafood. Consumers are getting fraud by seller that pay more than the real price because of the ice when consumers purchasing frozen seafood product [2]. The seafood often has a layer of ice to keep their freshness and it is a legal and normal practice in seafood industry. However, some of the seafood industry overglazing and soaking and include the weight into the seafood net weight to achieve seafood fraud to make more profit [3]. So that, the motivation of my project is develop an augmented reality

measuring tool to measure marine life that can avoid seafood fraud. One of the features of the measuring tool is able to detect the species of seafood. The measuring tool can detect some of the species of seafood such as mud crab, grouper fish, black tiger prawn and others. Consumer able to use the application to ensure the species of seafood in order to avoid seafood fraud from seafood seller. In the other word, the application can assist consumer to detect the real species of seafood to avoid seafood fraud which is mislabeling. After that, the measuring feature can assist consumer measure the size of seafood without any physical measuring tool. So that, it can avoid the problem of overglazing and soaking that include the weight of ice into seafood net weight to increase the profit. The augmented reality measuring tool is using AR technique to estimate the length and weight of seafood. So that, it will avoid the weight of ice to measure the correct net weight of seafood.

Figure 1.3 Forced Labor and Seafood Supply Chain News

From figure 1.2 that's show forced labor and seafood supply chain news occurs in worldwide. Since the seafood industry is making much profit while the demand of seafood production is increasing, seafood industries are focusing in their labor to achieve production effective and efficiency. However, some industry involves in forced labor that cause emotional and physical abusing to achieve production and cost effective and efficiency. Other than that, it will result death, excessive overtime, poor living condition, deceptive or coercive recruiting and non-payment or underpayment of wages in forced labor. In the news state that, it already detected forced labor activities by some of the agencies and department of commerce [4]. It is a very serious problem in seafood industry that will result a lot of bad effect. Some of the people will make money without their ethics and it cause harming some people. However, it is essential to recognize that this is only the tip of the iceberg, and more needs to be done to address the issue fully. So that, the motivation of this project is the application able to replace the some of the workforce possible to decrease forced labor cases. Measuring size of seafood is one of the jobs in seafood supply chain, the application able to replace the job to decrease the forced labor cases. It can lower the expenses of seafood industries and also able to decrease the cases of forced labor. It is a good possible solution to attract seafood industries and government to implement this solution which can decrease the expenses of seafood supply chain and lower forced labor.

1.2 Research Objective

- **Provide an augmented reality measuring tools for marine life**

  The main objective of augmented reality measure tool for marine life is provide a tool to let human can estimate the length and weight of marine life. The measuring target that I plan is fish, crab and prawn. So that, it can lower seafood fraud while using this application. For example, everyone can use this application to ensure the accuracy of seafood weight and length that measured by seller to avoid seafood fraud.

- **Use Artificial Intelligence to analyze the species of marine life and freshness of fish**

  The second objective is providing an AI service to recognize marine life species in order to provide more informative details to user and avoid mislabeling while user buying seafood without any knowledge of seafood. The application also able estimate freshness of fish in order to guide user how to determine the fish is fresh or stale. For example, user able to determine freshness of fish while detecting the species of fish.

1.3 Project Scope and Direction

At the end of the project, it will contribute an augmented reality measuring tool to measure marine life. The measure target that I plan is fish, crab and prawn. The application able to estimate length and weight of seafood. The information of length and weight will use Augmented Reality (AR) technology to present it in user device. The way to measure the length also will use Augmented Reality to measure the distance between the start point and end point of the object.

Moreover, the application also able to detect the type of marine life using Artificial Intelligence (AI) to train a pre-trained model to implement object detection. The object that application able to detect is fish, crab and prawn that same with the measure target that I mentioned above. So that, the application will detect type of marine life, then only can estimate the size of marine life.

After that, the application able to estimate the species of marine life and estimate the freshness of marine based on the species of marine life. Because of different species of marine life has different characteristic to determine the freshness of marine life. For example, the application detected the fish is grouper fish, the application will estimate the freshness of grouper fish based on the characteristic of the fish. In addition, the application also able to estimate the freshness of fish only. It will based on the fish eye to determine the freshness of fish.

1.4 Contribution

In this project will be developed an Augmented Reality measuring tool for marine life. The tool is designed to assist users in estimating the length and weight of fish, crab, and prawn, and to provide information about the species and freshness of the seafood. The main responsibilities included developing the AI models for object detection and species recognition, as well as implementing the AR technology for measuring length and weight.

To develop the AI models, I used a combination of deep learning and machine learning techniques to train the models on a large dataset of fish, crab, and prawn images. The main challenge of developing these models was to ensure high accuracy in detecting and recognizing the different species of marine life, even in different lighting and environmental conditions. First of all, I will do data collection to collection needed image data for the model training. It requires the image data set capture in different kind of environmental condition in order to achieve high accuracy. After collected dataset, it will proceed to train the model and do some testing.

The augmented reality measuring tool for marine life has the potential to benefit a wide range of users, including fishermen, seafood buyers, and consumers who are concerned about the quality and freshness of the seafood they consume. By providing accurate measurements and information about the species and freshness of the seafood, the tool can help to ensure that users are consuming high-quality, fresh seafood.

Through my work on the project, I gained valuable experience in AI development and AR technology, as well as user interface design and optimization. My contributions helped to improve the accuracy and functionality of the tool, which has the potential to provide valuable information to users about the seafood they consume.

1.5 Report Organization

This report will be organized into 7 chapters which is Chapter 1 Introduction, Chapter 2 Literature Review, Chapter 3 Proposed Method/Approach, Chapter 4 System Design, Chapter 5 System Implementation, Chapter 6 System Evaluation and Discussion and Chapter 7 Conclusion and Discussion. In Chapter 1 Introduction will be explained the problem statement and motivation of this project and also the main objective, contribution and report organization. In Chapter 2 literature review will be compare the previous work and proposed system. In Chapter 3 proposed method/approach will be presented methodology and timeline. In Chapter 4, it will be presented block diagram, use-case diagram and description and activity diagram. In Chapter 5, it will be presented hardware and software setup, setting and configuration of the project, overall system operation with screenshot and implementation issues and challenge. In Chapter 6, it will be presented system testing and performance metrics, project challenges and objectives evaluation. Lastly, the conclusion and recommendation will be in the last chapter which is Chapter 7.

CHAPTER 2 Literature Reviews

2.1 System Review

2.1.1 Fish Ruler [5]

https://play.google.com/store/apps/details?id=com.maruar.fishruler&hl=en_US&gl=US

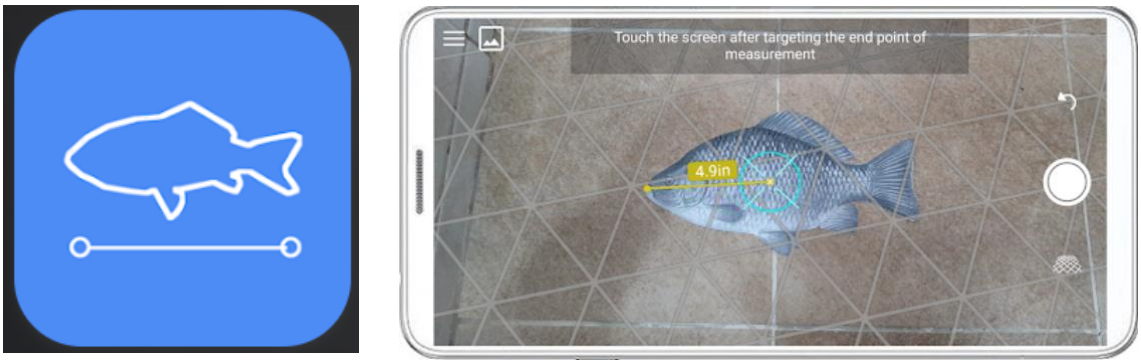


Figure 2.1 Fish Ruler

Fish Ruler [5] is a mobile application download from Google Play App Store. It can measure the length of fish on our smartphone without any measurement tools required. Fish Ruler implement Augmented Reality to interact with the fish to recognize the fish object and perform measuring of fish length. There are some steps to implement the Fish Ruler which is user need to find a horizontal surface for a measurement to let the system can recognize the object. After that, user require to move their smartphone around the space over a surface of the object to discover flat surface. After the system successful recognize the surface of the object, user need to target a starting point and ending point of the fish. After targeting, the system will come out a ruler and result of length.

Strength

Fish Ruler **implement Augmented Reality technique to let user can easily measure a fish length**. The system does not require any tools such as ruler to measure the length of fish. Fish Ruler only require download the application in user smartphone to perform measuring. It is an **offline application** and user does not need Internet to implement the application. So that, user still

can use the application when Internet connection is unstable. The application will show a virtual ruler on user interface around the fish. User can take a picture of the result and save in the application. User can review it all the time if user need to compare with multiple fish. For example, there are multiple fish need to measured by user, they can measure it one by one and capture a picture in order to able to review all the fish length.

Weakness

Fish Ruler require user to **a lot of step to implement measuring**. For example, user need to move the smartphone camera to recognize the surface of the object and target the starting point and ending point of the object. That's mean fish ruler cannot auto measure the fish and require user measure it manually. Although it can measure the length of fish, but it is also an inconvenience way to let user measure fish manually. Besides that, Fish Ruler **not able to measure multiple fish in one time**. The application only able user measure one fish per time and save in the gallery in order to review all the measure history. The gallery is the only way that let user review the measure history. User measure multiple fish but require capture the result multiple time. It is such an inconvenience way to user also.

Figure 2.2 Fish Ruler Testing Example

Other than that, Fish Ruler will not recognize the measure object is fish. That's mean the application will measure all the object, not only fish. Although the name of the application is Fish Ruler, but the technique of recognize fish is not available. For example, with Figure 2.2, Fish Ruler able to measure the mouse at the same time the application will not acknowledge the object is a

fish. This is a mistake of the application if user only need to measure fish, but the application will measure others object.

2.1.2 Fisherman's Mobile Weigh Station [6]

https://play.google.com/store/apps/details?id=com.mobileweighstation.android&hl=zh&gl=US

Figure 2.3 Fisherman's Mobile Weigh Station

Fisher's Mobile Weigh Station [6] is a mobile application that store multiple result of fish length and weight. The application is using a picture to measure the length and estimate the weight of fish. There are some steps to measure the fish length and weight. First of all, user can input a picture or snap a picture of fish as an input. After that, the application can let user select species of fish in order to future measure or estimate fish weight. The application require user to create a custom reference in order to have a reference to measure the fish. The reference is a guide to let application acknowledge the size of picture environment. So that, the application will provide a ruler that based on the reference to measure the length of fish. After that, the application will let user select the body type of the fish in order to have more accurate measuring. Then, the application will generate all the result including species, length, and estimated weight to user.

Strength

Fisher's Mobile Weigh Station able to **measure the length of fish** and **estimate weight of fish** based on the length, body type and species. The application provides a reference type of measuring to measure the length of fish. For example, user must provide a sample length object

such as a ruler is 15cm. After that, the application will measure the length of fish based on the reference with a ruler. After measured fish, the application able to estimate the weight of fish with the length of fish, species and body type. It is very useful for user to measure weight and length of fish without any measuring tools.

Weakness

Fisher's Mobile Weigh Station **not using augmented reality technique to measure fish length**. So that, it will cause there are a lot of step to measure fish of length. For example, the application needs a reference to measure fish of length. The measurement of the application requires user to target the starting point and ending point of the fish in order to measure fish length. At the same time, the reference also require user target the starting point and ending point of sample target object.

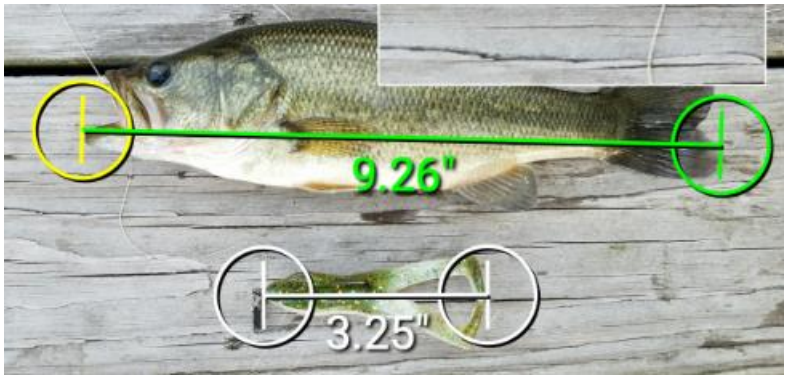


Figure 2.4 Fisherman's Mobile Weigh Station Testing Example

For example, with Figure 2.4, the white color ruler is the reference of target object and green color ruler will be based on the white color ruler to measure the fish. That's mean, user require have a acknowledged length of object to create the reference in order to the green color ruler can refer. Since it is involving a lot of step, it will affect inconvenience to user.

2.1.3 AR Fishing Measure, fish ruler [7]

https://apps.apple.com/us/app/ar-fishing-measure-fish-ruler/id1549776641

Figure 2.5 AR Fishing Measure, fish ruler

AR Fishing Measure [7] is a mobile application that can download from App Store. It is an Augmented Reality application to measure the fish length. It is an easy application to user use. The application require user to target the object to measure which is the fish. After that, the application will pop out a virtual ruler to measure the fish. User can adjust the position of ruler if the ruler position does not fit with the fish. User able to take a picture and save it in smartphone in order to review next time.

Strength

AR Fishing Measure **provide a virtual ruler** to let customer use the virtual ruler measure the fish with their own. The ruler will clearly show the index of length and easily measure the length of fish. For example, user can use their smartphone to download AR Fishing Measure to measure a fish without any tools. The application does not require any tools to measure the fish, only need the application because it will provide a virtual ruler to measure fish. After user measured a fish, user can take a picture and save it in their phone. So that, the application also able user to save the result in order user can review next time.

Weakness

Although AR Fishing Measure provide a virtual ruler to let customer measure fish, but it is quite **not efficiency to user measure large number of fish**. It is because, the virtual ruler is same like a physical ruler require user to measure fish with themselves. The only difference is one is virtual ruler that generate in smartphone and another is physical ruler that need to bring with their own. Although it will let user have a convenience way to bring a ruler, but the function is still same with the physical and virtual ruler. The application should help user generate the result for user instead of measure fish with user themselves. The virtual ruler is still the strength of AR Fishing Measure application, but it can be better to help user measure fish and come out a result to user. Although it is a fish measuring tools, but the application will not recognize fish and it can measure anything

2.1.4 WetRuler

https://apps.apple.com/au/app/wetruler/id1445381420

Figure 2.6 WetRuler

WetRuler is an application that download from App Store. It is an Augmented Reality fish measuring tool to measure the fish length and estimate the weight of fish. The application involves only few steps to measure fish. First of all, user can choose a type of fish to measure. After that, user can start to measure the fish. User require to target 2 point which is the starting and ending point of fish. After targeted both of the point, the application will automatically come out the length of fish and estimate the weight of fish based on fish type that user selected before.

Strength

WetRuler is using **Augmented Reality to measure length of fish**. The application use camera to detect the object and let user target starting and ending point of fish. For example, the user only need to use the application that involves with camera to target the fish of starting and ending point of fish. After that, the application will calculate the length of fish. Other than that, the application able to estimate the weight of fish based on the length and type of fish. It will estimate the weight after user measure a fish.

Weakness

The weakness of the WetRuler is the application **cannot capture or snap a picture** to store in user smartphone in order to review after measured. WetRuler only able to measure one fish in one time without saving the measure result. For example, user not able to review back the result of fish after they measured. It is only able to measure a fish in one time. After that, WetRuler require user to target the ending point and starting point of fish with 2 red dots, but it is very **difficult to let user target the point in the screen**. Sometime it will not response when clicked so many times. Although the application is an Augmented Reality measuring tool, but the application will **not recognize the measure object is fish**. It is able user to measure all the things that user wants to measure. For example, user can measure the length of car instead of fish with WetRuler application.

2.2 Comparison between existing system and proposed system

	Fish Ruler	Fisherman's Mobile Weigh Station	AR Fishing Measure	WetRuler	Proposed System
Augmented Reality Length Measuring	Yes	No	Yes	Yes	Yes
Support Automatic Measuring	No	No	No	No	Yes
Recognize Different Type of Marine Life (fish, crab)	No	No	No	No	Yes
Estimate Freshness of Marine Life	No	No	No	No	Yes
Able to Estimate Species of Marine Life (Mud Crab, Flower Crab)	No	No	No	No	Yes
Able to Measure Length Manually	Yes	Yes	Yes	Yes	No
Able to Select Multiple Species of Fish Before Measure	No	Yes	No	Yes	No
Obtain Reference to Measure Fish	No	Yes	Yes	No	No

Table 2.1 Comparison between existing system and proposed system

Table 2.1 show that the comparison between existing system and proposed system. The existing system is Fish Ruler, Fisherman's Mobile Weigh Station, AR Fishing Measure and WetRuler. The main purpose for all of the existing system is about measuring size of marine life but there are some different way and feature to measure the size of marine life. The existing system provided a very good concept to us in measuring the size of marine life. The most important thing is able to measure length of marine life. Based on the table above, all of the existing system able to measure length manually except proposed system. It is a very good practice and idea from existing system to measure marine life length. So that, the proposed system has a improve feature which is support automatic measuring to measure the length of marine life. It modifies from the existing system which measure length manually from existing system to proposed system which

able to measure marine life length automatic which mean the proposed system only need to scan through the marine life, then able to get the length of marine life.

After that, some of the existing system such as Fisherman's Mobile Weigh Station and WetRuler able to select multiple species of fish before measure to achieve high accuracy measuring. It is a very good concept to let user choose the species that user want to measure. From this concept, the proposed system will be modified to able to recognize different type of marine life such as fish, crab and prawn. So that, user do not require to choose what species is that before measure. It will be difficult to some user if they not acknowledge the species of marine life, so user will randomly choose it. With the new feature in proposed system, user no longer require to choose it, the application will recognize the type of marine life.

After recognize type of marine life, there is a feature to estimate the species of marine life such as mud crab, flower crab and others. For example, the application detected the marine life is crab, then the feature of estimate the species of marine life will estimate the crab is mud crab. So that, it is more convenient to user who do not acknowledge the species of marine life, it can also provide new knowledge to user learn how to recognize the species of marine life.

After estimate the species of marine life, it able to estimate the freshness of marine life. It is the new feature from all of the existing feature. This feature able to assist user whether the marine life is stale or fresh. It also can assist some of the users who do not know how to determine the freshness of marine life. So that, the system able to assist them and teach them how to determine whether the marine life is fresh or stale.

In conclusion, the existing systems provide a lot of useful concept in order to have a good improvement idea to improve marine life measuring tool. The system has new features such as automatic measuring, species recognition, and freshness estimation. The system can also increase users' knowledge and understanding of marine life. Therefore, the proposed system can be a valuable tool for fishermen, researchers, and marine life enthusiasts who want to measure, identify, and learn more about marine life.

CHAPTER 3 Proposed Method/ Approach

This chapter will be presented the method and approach that I used in this project. It will separate in different part which is used tool specification to develop the system and system architectural diagram such as use case diagram, activity diagram and sequence diagram.

3.1 Methodology

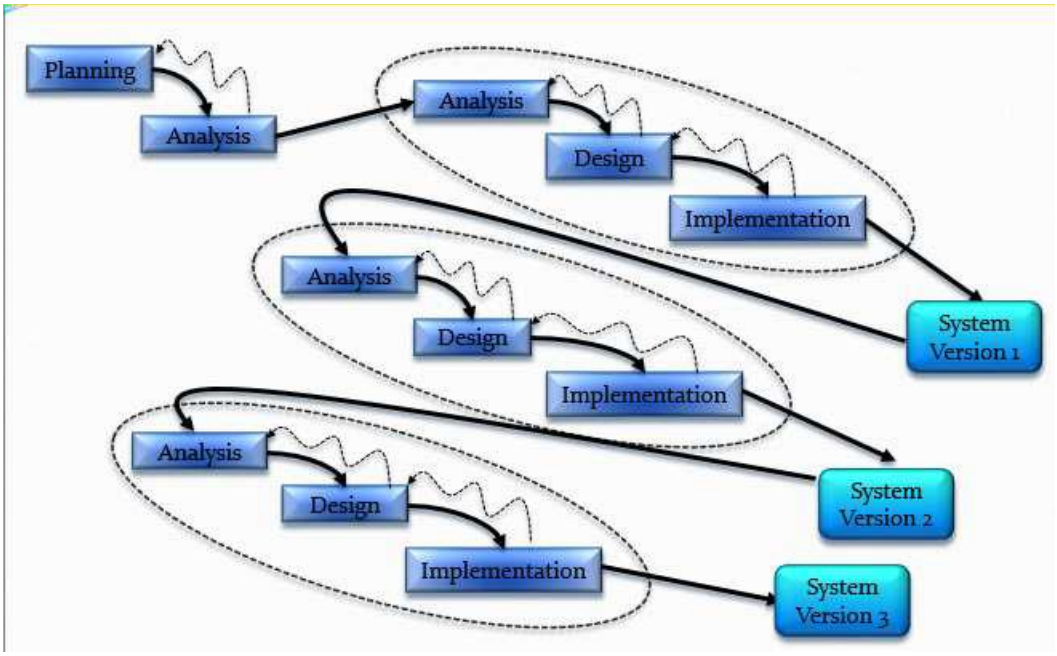


Figure 3.1 Phased Development Methodology

The Augmented Reality measuring tool for marine life is an innovative and exciting project that requires a structured approach to its development. In order to ensure that the project is completed successfully, a methodology needs to be employed that can provide a clear path to the completion of the project. For this project, the Rapid Application Development (RAD) phased development model has been chosen as the project methodology. The RAD phased development model is a popular methodology that involves the project being divided into four distinct phases: planning, analysis, design, and implementation. The model is characterized by its iterative and incremental approach to development, which means that each phase of the project is completed before moving on to the next phase.

The first phase of the RAD model is planning, which involves defining the project objectives, requirements, and scope. During this phase, the project team will also define the project timeline, budget, and resources needed to complete the project. This phase is crucial as it lays the foundation for the entire project and ensures that everyone is on the same page. Once the planning phase is complete, the project team will move on to the analysis phase. This phase involves gathering and analyzing data to identify the project's requirements and specifications. This phase is critical to the success of the project as it helps to ensure that the system is designed to meet the needs of the end-users. After the analysis phase, the project team will move on to the design phase. During this phase, the system architecture and user interface are designed. This phase is also critical as it helps to ensure that the system is designed to be easy to use and understand. Finally, the implementation phase is where the system is built, tested, and deployed. This phase involves the actual coding and development of the system. Once the system is built, it is tested to ensure that it meets the requirements and specifications identified in the analysis phase. Once the first version of the system is completed, the project team will move on to the next version of the system and continue with the same iterative process until all the required features and functionality have been developed [8].

In conclusion, the RAD phased development model is an effective methodology for the development of the Augmented Reality measuring tool for marine life. By using this methodology, the project team can ensure that the project is completed on time, within budget, and to the satisfaction of the end-users.

3.2 Timeline

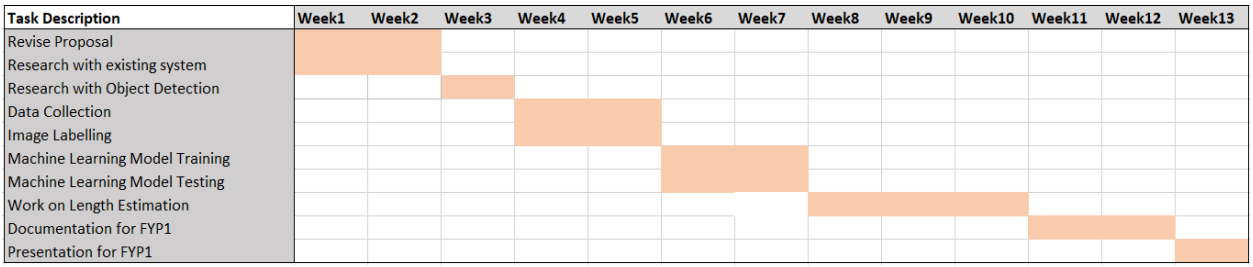


Figure 3.2 Timeline of FYP1

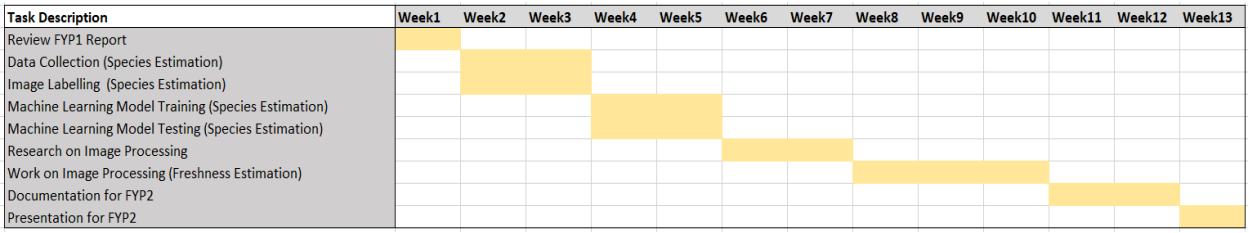


Figure 3.3 Timeline of FYP2

CHAPTER 4 SYSTEM DESIGN

4.1 System Architecture Diagram

4.1.1 Block Diagram

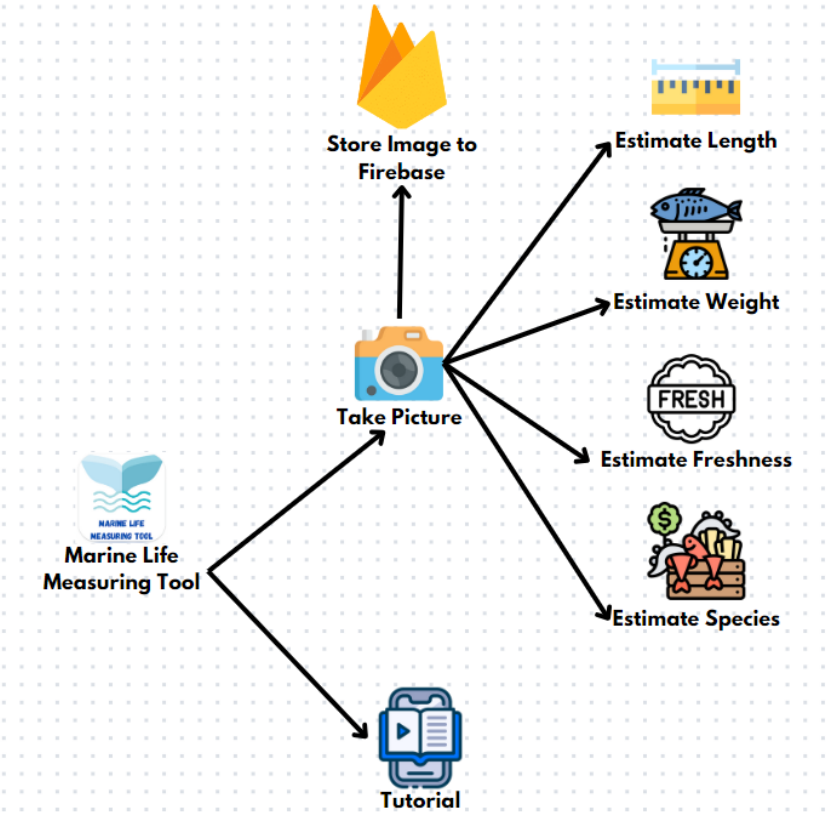


Figure 4.1 Block Diagram of Marine Life Measuring Tool

From figure 4.1, it shows the block diagram of Marine Life Measuring Tool. In Marine Life Measuring Tool, the main function of the application is estimate length, weight, freshness and species and also provided an application tutorial to user learn how to use the measuring tool. In the diagram shows that marine life measuring tool able to let user take a picture of marine life. After that, the application will process some of the function to perform length, weight, freshness and species estimation. The process includes some calculation to estimate length and weight and object detection to estimate freshness and species of marine life. After the estimation, the estimation result will be presented in Augmented Reality with ARCore. There is one more important thing for the measuring tool is it will store the image in Firebase after user take a picture

of marine life. The purpose of storing the image is the images can be use in future work. Measuring tool involved machine learning and object detection technique, the images are needed to improve the accuracy of detection model. The marine life detection of measuring tool may not provide desired result to user since there are a lot of marine life species in the world. So that, it can use the images that detected unseen species of marine life from the model to train a better model. The main purpose to storing the images is able to scale up the application and able to recognize more marine life in future. Other than that, an application tutorial will be presented to user in order to let user learn how to use the measuring tools.

4.1.2 Use-Case Diagram

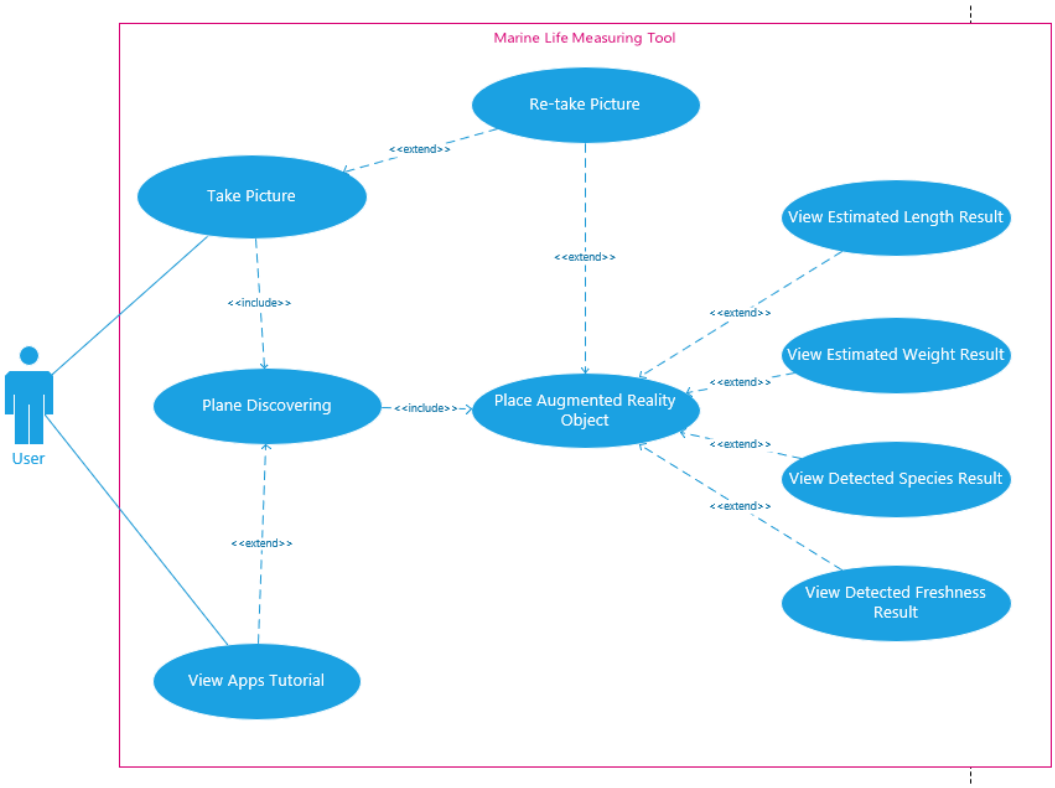


Figure 4.2 Use Case Diagram of Marine Life Measuring Tool

From figure 4.2, it shows the use-case diagram of Marine Life Measuring Tool. The main actor of the use-case diagram is user and it is the only one actor for this diagram. There are 2 main use-cases which is take picture and view apps tutorial. The first use-case take picture is let user take a picture of marine life that user want to measure. If the picture took by user is not detected any marine life, the system will ask user to re-take the picture one more time until it detects marine life. Then only the system will proceed to next step which is plane discovering in order to place Augmented Reality object that contain the result of estimation such as length, weight, species and freshness. If user failed to discover a plane, the system will pop up the apps tutorial to user in order to let user know how to correctly discover the plane. After plane discovered, user able to place the Augmented Reality Object that contain 4 buttons that will display different result with different button. After placed Augmented Reality object, user able to view wanted result with different button such as view detected freshness result, view detected species result, view estimated weight result and view estimated length result. User also able to re-take picture if user willing to measure another marine life.

4.1.3 Use-Case Description

Use-Case Name: Estimate length, weight, species and freshness of marine life	**Importance Level:** High
Primary Actor: User	
Stakeholder and Interest: Users estimate length, weight, species and freshness of marine life and display the result in Augmented Reality Object	
Brief Description: This use case describes how user estimate length, weight, species and freshness of marine life and display the result in Augmented Reality Object	
Trigger: User click on the "START MEASURE" button	
Normal Flow of Events: 1. User click on "START MEASURE" button 2. User require to take a picture of marine life that want to measure 3. System will store the picture to Firebase 4. System will execute marine life detection model to estimate species of marine life 5. User require to discover plane in order to place the Augmented Reality object 6. User click on "SCAN" button 7. System will estimate the length and weight of marine life 8. System will place the Augmented Reality object with 4 buttons 9. User clicks on respective button 10. System will display desired result to user such as length, weight, species and freshness	
Sub Flows:	
Alternate/Exception Flows: 3a. User click "SCAN AGAIN" button to take one more picture 3b. System will execute Freshness detection model to estimate freshness of fish 5a. User fail to discover plane, system pop up App Tutorial to guide the user.	

Use-Case Name: View Apps Tutorial	**Important Level:** High
Primary Actor: User	
Stakeholder and Interest: User click a button to display the application tutorial for user	
Brief Description: This use case describe how user can interact and learn from the tutorial	
Trigger: User click on “TUTORIAL” button	
Normal Flow of Events: 1. User click on “TUTORIAL” button 2. System pops up a window of tutorial 3. User able to view and learn with the tutorial 4. User decide want to close or continue to view the tutorial 5. User decide want to go next or previous page	
Sub Flows:	
Alternate/Exception Flows:	

4.1.4 Activity Diagram

Estimate Length, Weight, Species and Freshness of Marine Life

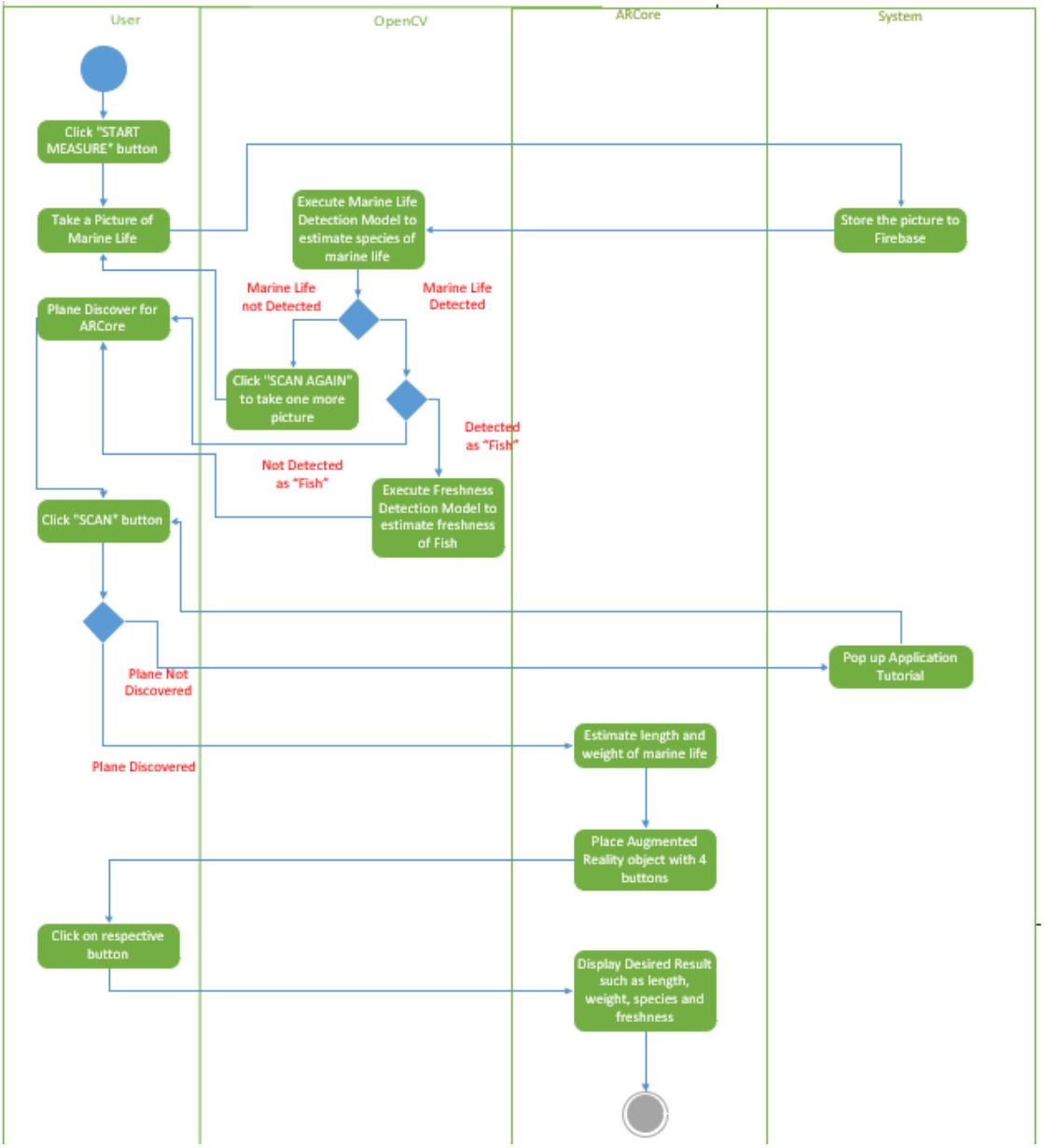


Figure 4.3 Activity Diagram of Estimate Length, Weight, Species and Freshness of Marine Life

Based on Figure 3.3, it shows activity diagram of estimate length, weight, species and freshness of marine life. There are 4 swimlane which is user, OpenCV, ARCore and system to execute the activity in a process. From the activity start, user require to click “START MEASURE” button to take a picture of marine life that user willing to measure. After user took a picture, system

will store the picture into Firebase for future work to scale up the detection model. After stored the picture, OpenCV will execute the marine life detection model to estimate the species of marine life. If the marine life detection model detected nothing, it requires user click “SCAN AGAIN” button to take one more picture. So that, it will go back to the take picture activity until marine life detection model detected a marine life. If the detection result is Fish, OpenCV will execute one more detection model which is Freshness Detection model to estimate the freshness of fish. The Freshness Detection model only for fish type only. If the detection result not Fish, it will skip the Freshness Detection activity and proceed to plane discover for ARCore. User require to discover the horizontal plane in order to ARCore able to place an Augmented Reality object on the plane. After user discover plane, user require to click “SCAN” button. If user fail to discover plane, it will pop up application tutorial to let user know how to properly discover a plane. If user discover plane successfully, ARCore will estimate the length and weight of marine life and place Augmented Reality object on the discovered plane with 4 buttons. After that, user able to click the 4 buttons that will come out different result such as length, weight, species and freshness for fish. For example, if user click on length button, it will display length result.

View Apps Tutorial

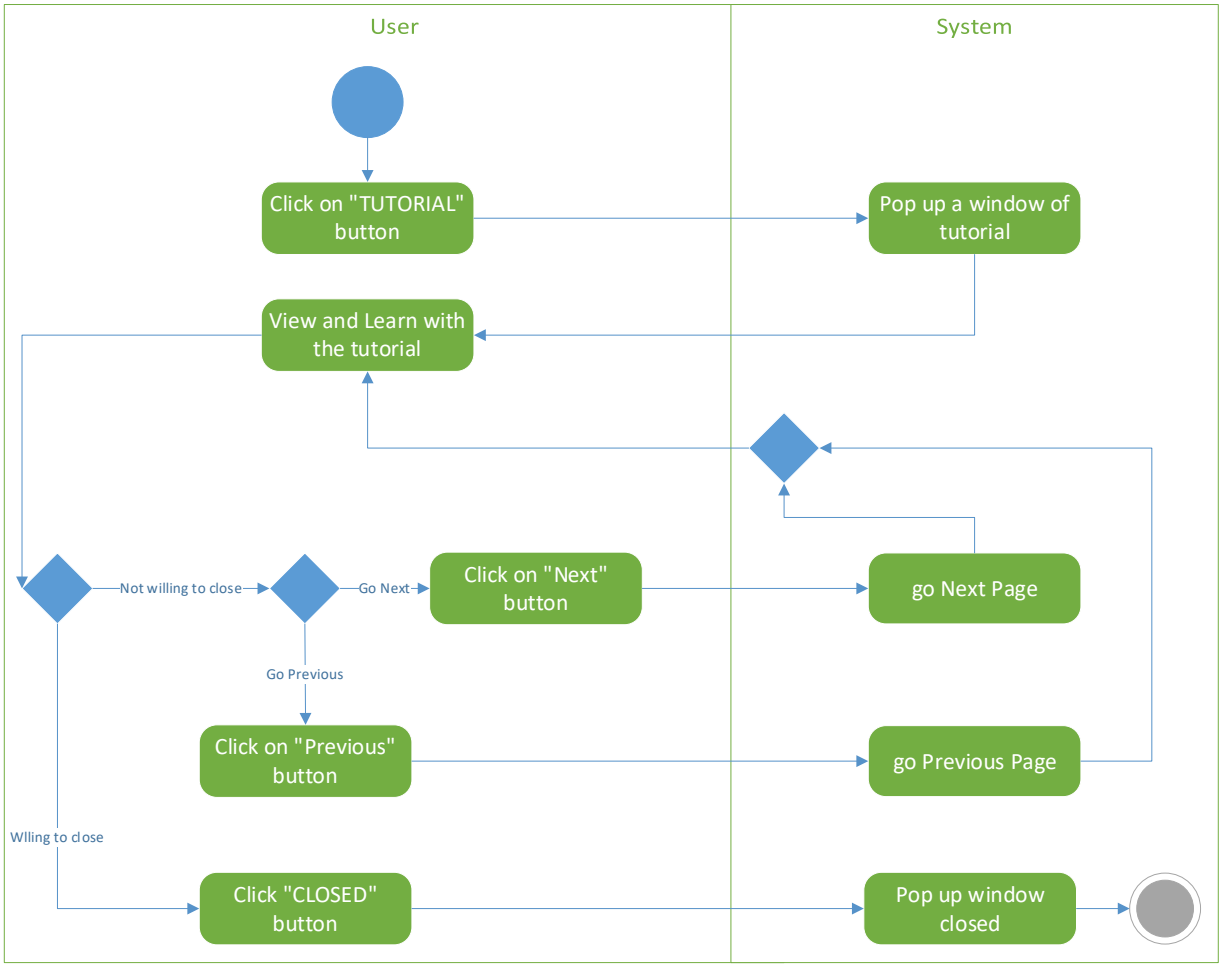


Figure 4.4 Activity Diagram of View Apps Tutorial

Based on figure 3.4, it shows activity diagram of View Apps Tutorial. There are 2 swimlane which is user and system. From start of activity, user require to click on “TUTORIAL” button to start the tutorial session. After click on the button, system will pop up a window of tutorial. User able to view and learn with the tutorial. In the tutorial pop up window, if user not willing to close the window, user can choose they want to go next or previous page with next button and previous button. If user click on next button, it will go next page and view able to view the next page. If user click on previous button, system will back to previous button and user able to view back the previous tutorial page. If user willing to close the tutorial window, user able to click on “CLOSE” button, then the tutorial window will be close and it goes to the end of activity.

CHAPTER 5 System Implementation

5.1 Hardware Setup

Model	ASUS TUF FX505G
System Type	x64-based PC
Processor	Intel(R) Core(TM) i5-8300H CPU @ 2.30GHz, 2304 Mhz, 4 Core(s), 8 Logical Processor(s)
Graphic Processor	Intel® UHD Graphics 630
Graphic Card	NVIDIA GeForce GTX1050
RAM	12 GB
Operating System	Microsoft Windows 10 Home

Model	Samsung Galaxy Note 20
Processor	Exynos 990 (7 nm+)
Graphic Processor	Mali-G77 MP11
RAM	8GB
Storage	256GB
Operating System	Android 10, upgradable to Android 13, One UI 5
Rear Camera	Main camera: 12 MP (OIS, PDAF) Second camera: 64 MP (Telephoto, OIS, PDAF) Third camera: 12 MP (Ultra-wide, Autofocus) Video recording: 7680x4320 (8K UHD) (24 fps), 3840x2160 (4K UHD) (60 fps), 1920x1080 (Full HD) (240 fps), 1280x720 (HD) (960 fps) Front: 10 MP (PDAF, HDR)

Table 5.1 List of Hardware

5.2 Software Setup

Software	Description
Android Studio	- Android Studio is an IDE for Android app development - Will integrate ARCore and OpenCV in Android Studio to develop application - Using Java Programming Language while develop the application
ARCore	- ARCore is augmented reality SDK from Google - Using ARCore to present the result of information - Using ARCore technique to estimate the size of object
OpenCV	- OpenCV's Java API to perform image processing operations such as flipping, scaling, drawing rectangles and text, and applying filters.
Google Colab	- a cloud-based development environment to write and run Jupyter Notebook that containing Python code. - Using this platform to do machine learning training
Teachable Machine	- a web-based machine learning platform created by Google. It enable users to quickly train a machine learning models without having any knowledge of programming and data science. It was developed as a part of Google's initiatives to increase machine learning's usability for a wider range of users.
Firebase Storage	- a cloud-based storage service from Google's Firebase platform. Firebase storage was created with the express purpose of storing and serving user-generated content for Firebase-powered applications, such as photos, videos, and other files.

Table 5.2 List of Software

Android Studio

Figure 5.2.1 Android Studio

Android Studio is an Integrated Development Environment (IDE) that develop Android app. It is also an official IDE for developer to develop Android app. In Android Studio, it provides developer several features that increase developer productivity to develop Android apps. There are several features include versatile Gradle-based build system, powerful and quick emulator that support user can test their apps in Android Studio when developing their apps, a single environment where you can work on Android projects for all devices, Firebase integration and others [13]. In FYP2, it uses Android Studio with Java programming language to build Augmented Reality Measuring Tool for Marine Life. In the measuring tool, it requires to import and execute Tensorflow Lite detection model with OpenCV, Firebase to store images, integrate ARCore to perform Augmented Reality function and others feature. All the feature that mentions above, Android Studio can be achieved during developing the measuring tool. So that, Android Studio is the IDE that I choose to develop the measuring tool. The version to be used for the project is Android Studio Arctic Fox | 2020.3.1 Patch 4. The reason that I use this old version of Android Studio because the latest version of Android Studio no longer supports ARCore sceneform SDK. So that, it requires use older version of Android Studio to match the version of ARCore sceneform since ARCore sceneform SDK is stop the maintenance and update by Google start from 1.16.0 version [14].

OpenCV

Figure 5.2.2 OpenCV

The vast open-source library known as OpenCV is used for computer vision, machine learning, and image processing. It currently plays a significant part in real-time operation, which is crucial in modern systems. Using it, one may process pictures and videos to find faces, objects, and even type of marine life. We use vector space and apply mathematical operations to these features to identify visual patterns and their various features [15]. In this project, we integrate OpenCV SDK into Android Studio in order to use OpenCV library function to execute Tensorflow Lite in order to perform marine life detection and freshness detection for fish.

ARCore

Figure 5.2.3 ARCore

A Google's framework for creating augmented reality experiences is called ARCore. Your phone can perceive its surroundings, comprehend the outside world, and interact with information through ARCore, which makes use of many different APIs. To enable shared AR experiences, some APIs are accessible on iOS and Android. To combine virtual material with the real world as seen through your phone's camera, ARCore makes use of three crucial capabilities which is the phone is able to understand and track its position in relation to the outside world through motion tracking, the phone can determine the size and placement of any kind of surface, including horizontal, and vertical surfaces like walls, coffee tables, and the ground through environmental knowledge and the phone can assess the amount of light present in the surrounding area [16]. In this project, it use ARCore to estimate the length of marine life through environmental understanding that allow to detect the size of surface. It helps the project to estimate the length of marine life. Other than that, the result of length, weight, species and freshness estimation will be presented in Augmented Reality object. So that, this project use ARCore to achieve Augmented Reality.

Google Colab

Figure 5.2.4 Google Colab

A product of Google Research called Colaboratory, or "Colab" for short is particularly well suited to machine learning, data analysis, and education. It enables anyone to create and execute arbitrary Python code through the browser. Technically speaking, Colab is a hosted Jupyter notebook service that offers free access to computer resources, including GPUs, and requires no setup to use [17]. In this project, it uses Google Colab to train the freshness detection model. Google Colab able to create a jupyter notebook and write python code to perform the training of detection model. There is free GPU resource but limited time for the project to train the model. So that, Google Colab help the project in the training of freshness detection model.

Teachable Machine

Figure 5.2.5 Teachable Machine

Teachable Machine is a web platform that enables quick and simple machine learning model creation for your projects without the need for coding. It able to export a model for use on websites, applications, and more after training a model to recognize your sights, sounds, and poses [18]. Teachable Machine is a user-friendly machine learning platform for developers who do not familiar with data science and coding. In Teachable Machine, it requires user collect images and import these images to Teachable Machine, it will start to train the model with one click of button. After the training, user able to download training model in Tensorflow Lite form. User also able test the accuracy of model through the webcam. In this project, it uses Teachable Machine to train 2 model which is type of marine life detection model and species of marine life detection model. After the training, it able to download the models in Tensorflow Lite form that fit and able to import into Android Studio to do further work in there.

Firebase

Figure 5.2.6 Firebase

A platform for building and growing popular apps and games is called Firebase. It supported by Google and relied upon by millions of companies worldwide. Backend-as-a-Service (Baas) is what Firebase does. It offers a range of tools and services to developers so they can create high-quality apps, expand their user base, and make money. It is built using Google's technical framework [19]. In short, it is a cloud service that contain several services that include authentication, Cloud Firestore Database (Realtime Database), Storage, Hosting, Notification and others. In this project, it uses Firebase storage to store the images from user. The purpose of storing these images is use to scale up and enhance the performance of detection model. It can use the images from user to train a more stronger detection model in order to increase the usability of apps.

5.3 Setting and Configuration

a) Android Studio Configuration and Setting

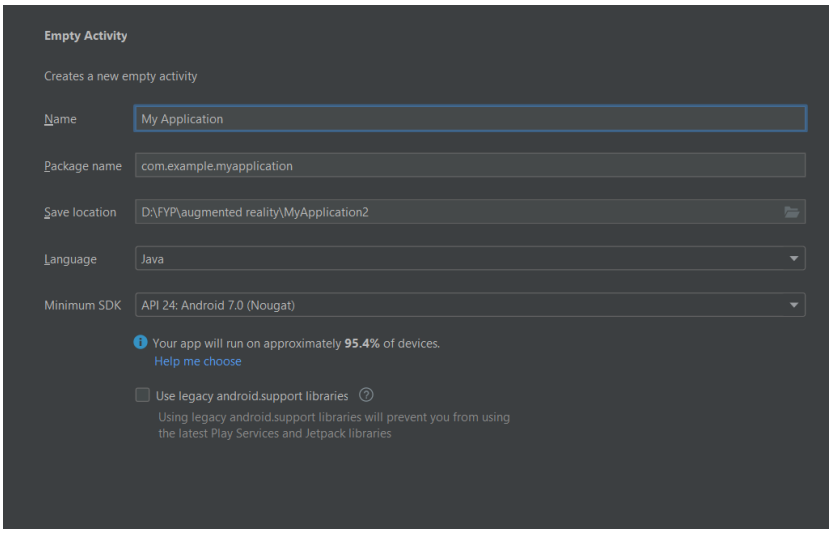


Figure 5.3.1 Android Studio Configuration and Setting

It requires to download Android Studio archives in Android Developers website. The version that downloaded for this project is Android Studio Arctic Fox | 2020.3.1 Patch 4. The language to be used in this project is Java programming language and minimum SDK is API 24: Android 7.0 (Nougat).

b) ARCore Configuration and Setting

```
dependencies {

    implementation 'com.google.ar:core:1.35.0'
    implementation 'com.google.ar.sceneform.ux:sceneform-ux:1.15.0'
```

```
private float calculateDistance(Vector3 objectPose0, Vector3 objectPose1) {
    return calculateDistance(
            x: objectPose0.x - objectPose1.x,
            y: objectPose0.y - objectPose1.y,
            z: objectPose0.z - objectPose1.z
    );
}

private float calculateDistance(float x, float y, float z) {
    return (float) Math.sqrt(Math.pow(x, 2) + Math.pow(y, 2) + Math.pow(z, 2));
}
```

Figure 5.3.2 ARCore Configuration and Setting

It requires to add dependencies of ARCore and AR sceneform to implement several classes of function from ARCore and sceneform such as Anchor, HitResult, Plane, AnchorNode, Vector3 and others. Vector3 class act an important role in this project to estimate the real world in order to estimate the length of marine life. There are 3 field in Vector3 which is float x, float y, and float z. It collects two Vector3 point from the starting point to ending point of marine life. So that, it uses these two Vector3 point to estimate the length of marine life with the function float calculateDistance(Vector3 objectPose0, Vector3 objectPose1) and float calculateDistance(float x, float y, float z). The function will get two Vector3 points and subtract x, y and z between the 2 points to calculate the length of marine life.

c) OpenCV Setting and Configuration

It requires to download OpenCV SDK from OpenCV official website. After downloaded the SDK, it requires to import the SDK to Android Studio. There are several steps to import SDK to Android Studio.

Step 1: Point to File > New > Import Module and click Import Module

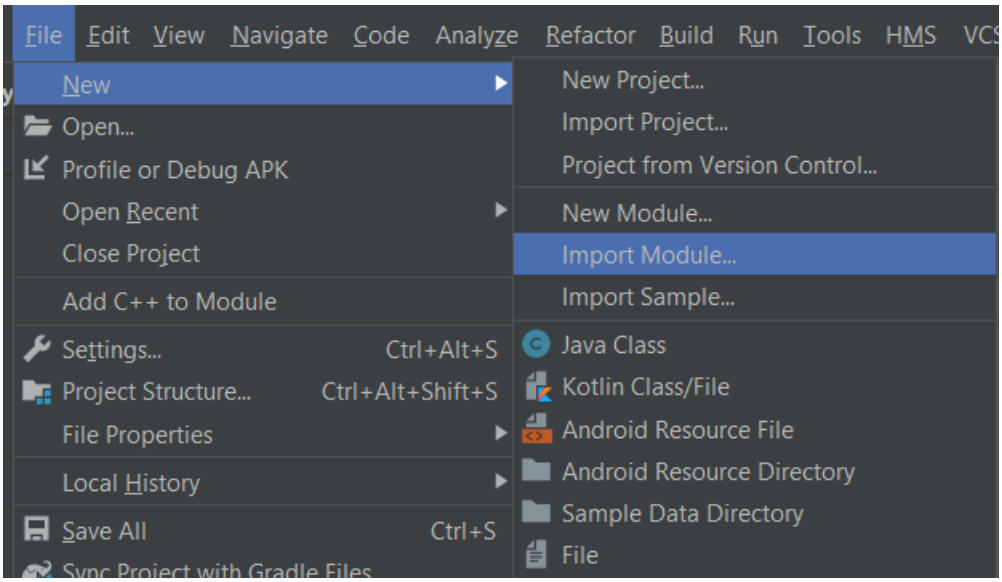


Figure 5.3.3 OpenCV Setting and Configuration 1

Step 2: Find the downloaded SDK folder and import sdk folder. After that, provide a name for the SDK.

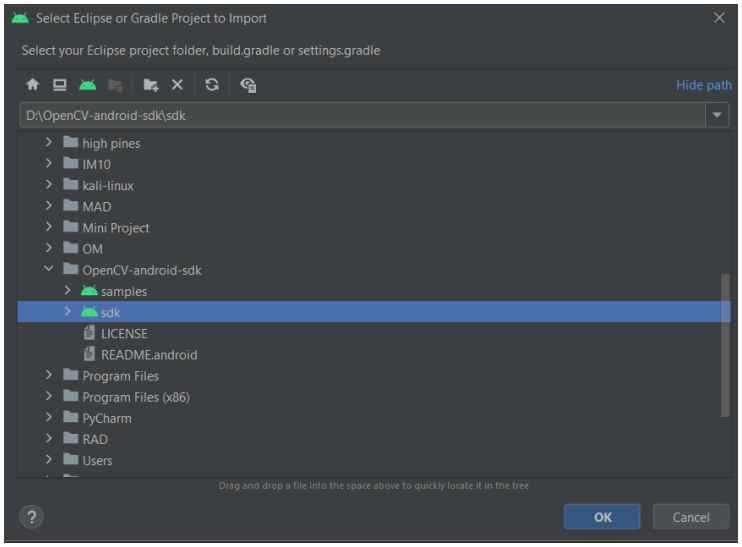


Figure 5.3.4 OpenCV Setting and Configuration 2

Step 3: It might prompt out an error message “Plugin with id ‘kotlin-android’ not found. So that, we need to add a plugin into OpenCV Gradle File.

```
plugins {
    id 'org.jetbrains.kotlin.android' version '1.7.10' apply false
}
```

Figure 5.3.5 OpenCV Setting and Configuration 3

Step 4: Go to File > Project Structure.

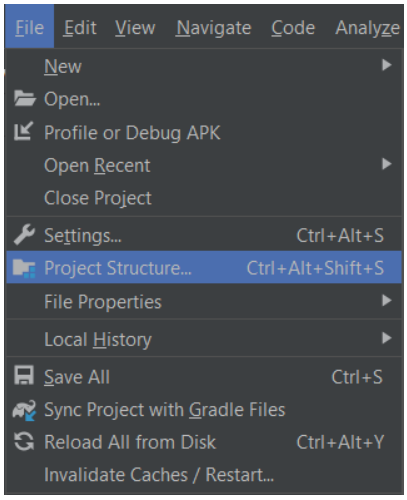


Figure 5.3.6 OpenCV Setting and Configuration 4

Step 5: In the window find ‘Dependencies’ and click <All Modules> to add Module Dependency and click on ‘app’.

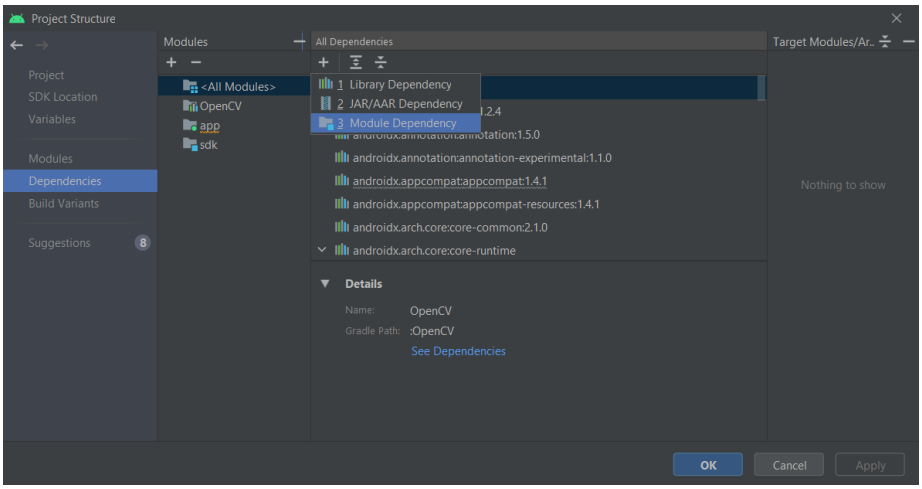


Figure 5.3.7 OpenCV Setting and Configuration 5

Step 6: Choose openCV SDK and click OK. (the sdk file name might be different from here because it set by your own in step 2)

Figure 5.3.8 OpenCV Setting and Configuration 6

Step 7: Import some classes from OpenCV that shows no error that's mean OpenCV SDK imported successful

```
import org.opencv.android.Utils;
import org.opencv.core.Mat;
```

Figure 5.3.9 OpenCV Setting and Configuration 7

d) Firebase Storage

In Android Studio, there is a Firebase Assistant for developers connect with Firebase. It only requires some steps to connect a Firebase Project to Android Studio Project.

Step 1: Open Firebase console in Google Browser. Create a new project and provide a project name.

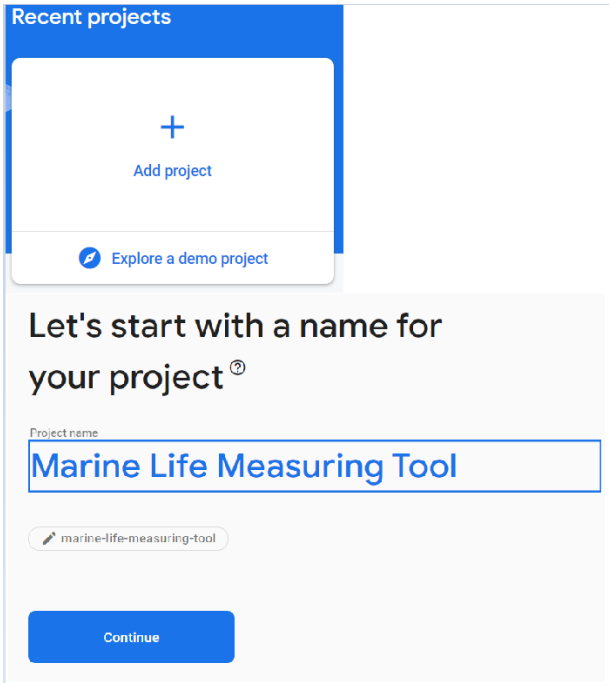


Figure 5.3.10 Firebase Setting and Configuration 1

Step 2: Register apps to created Firebase Project. Insert Android package name that find from Module Gradle file and Debug signing certificate SHA-1 can find from the result of signingReport in Android Studio.

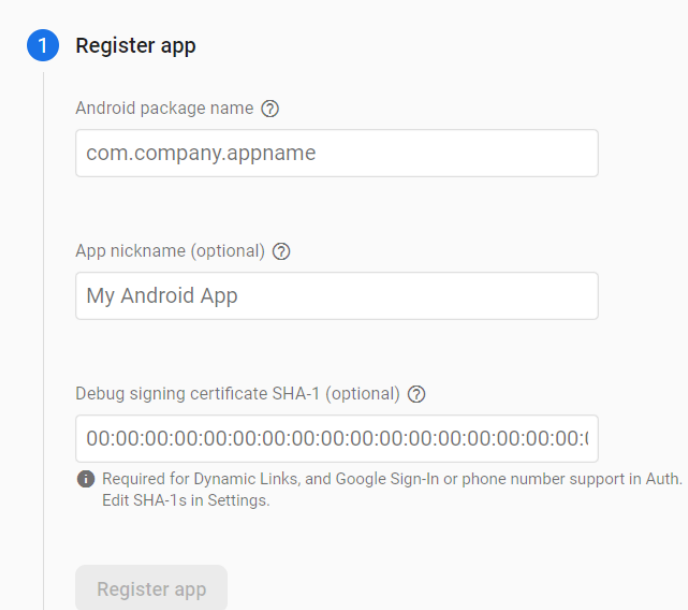


Figure 5.3.11 Firebase Setting and Configuration 2

Step 3: Download provided json file and add to Android Studio (Steps provided in Firebase)

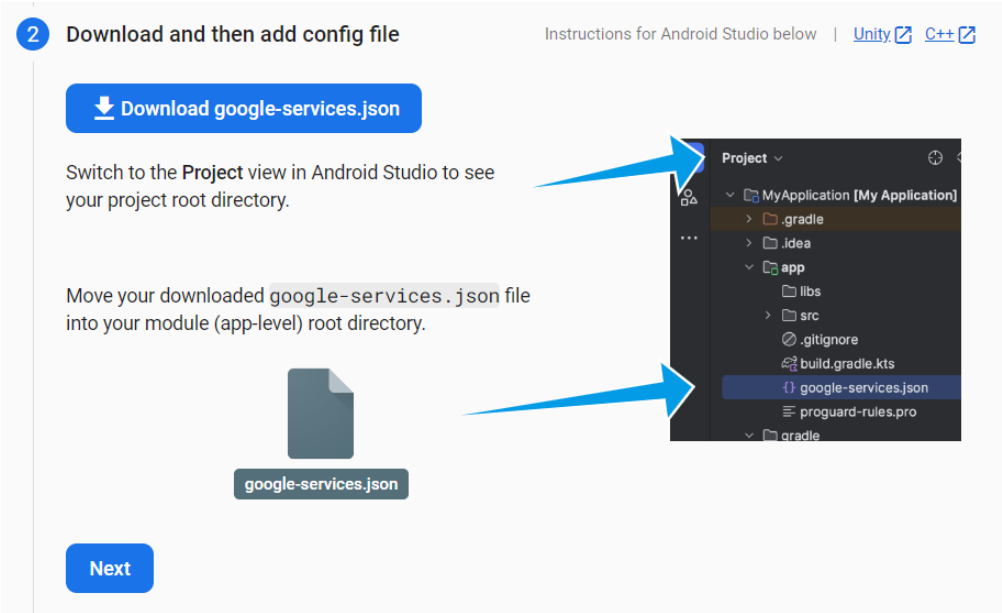


Figure 5.3.12 Firebase Setting and Configuration 3

Step 4: Add Firebase SDK in Module Gradle File

```
implementation(platform("com.google.firebase:firebase-bom:32.2.2"))
implementation 'com.google.firebase:firebase-storage-ktx:20.2.1'
```

Figure 5.3.13 Firebase Setting and Configuration 4

Step 5: Add Google service SDK in Project Gradle File and sync the project (Steps provided in Firebase)

```
dependencies {
    classpath "com.android.tools.build:gradle:7.0.4"
    classpath 'com.google.gms:google-services:4.3.15'
```

Figure 5.3. 14 Firebase Setting and Configuration 5

e) Teachable Machine Setting and Configuration

Teachable Machine is an online platform. It doesn't need to install or download anything in the project. There are several steps to complete machine learning.

Step 1: It requires to browse Teachable Machine from Google Browser and create an Image Project with standard image model.

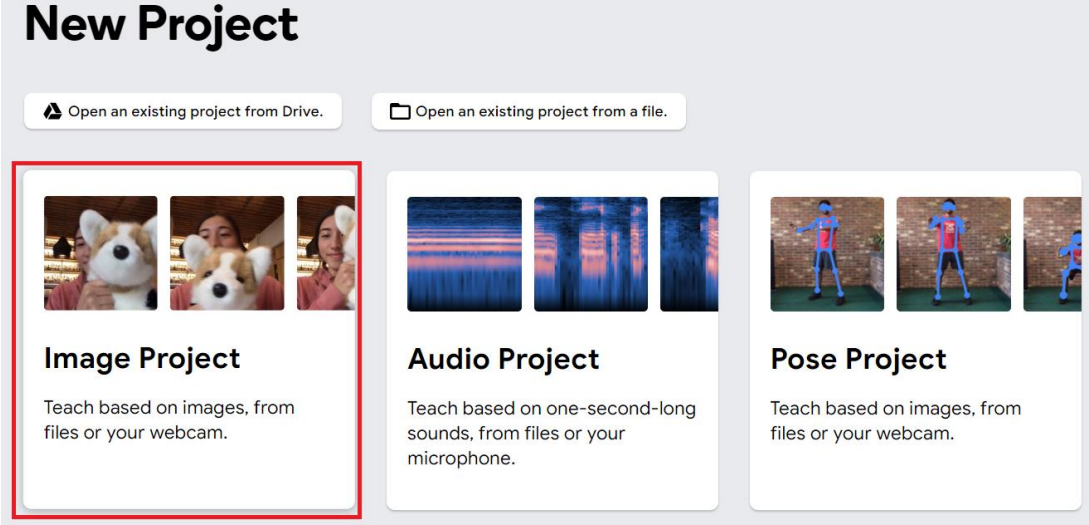


Figure 5.3. 15 Teachable Machine Setting and Configuration 1

Step 2: upload the images for each class and name for each class. After that, click Train Model and wait until training completed.

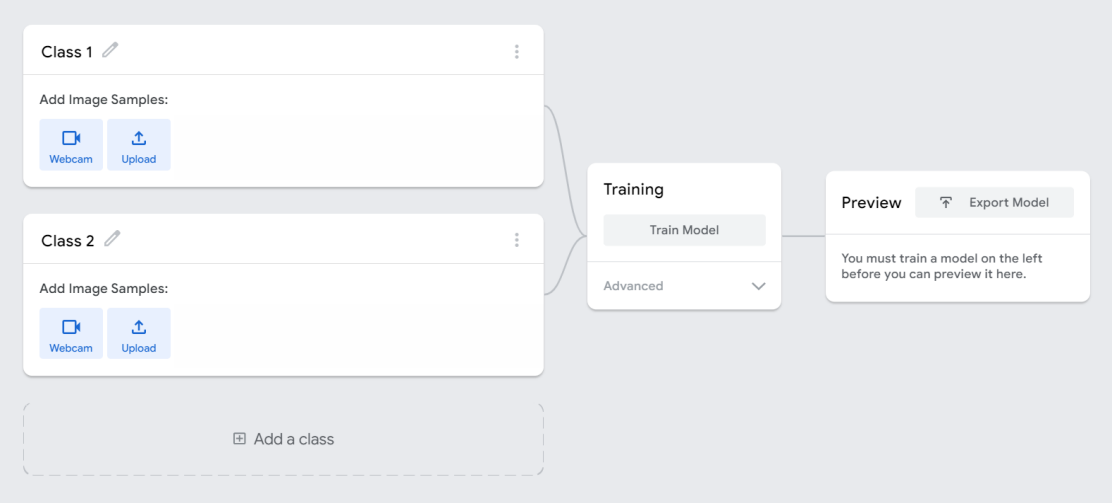


Figure 5.3.16 Teachable Machine Setting and Configuration 2

Step 3: Click Export Model button and download the model in Tensorflow Lite.

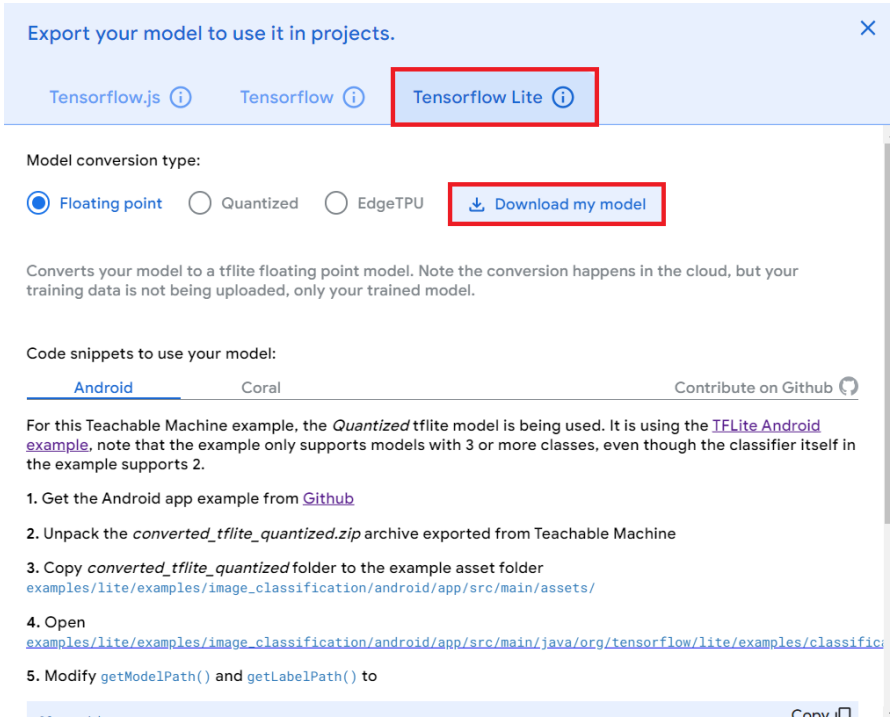


Figure 5.3.17 Teachable Machine Setting and Configuration 3

Step 4: Import the model into Android Studio

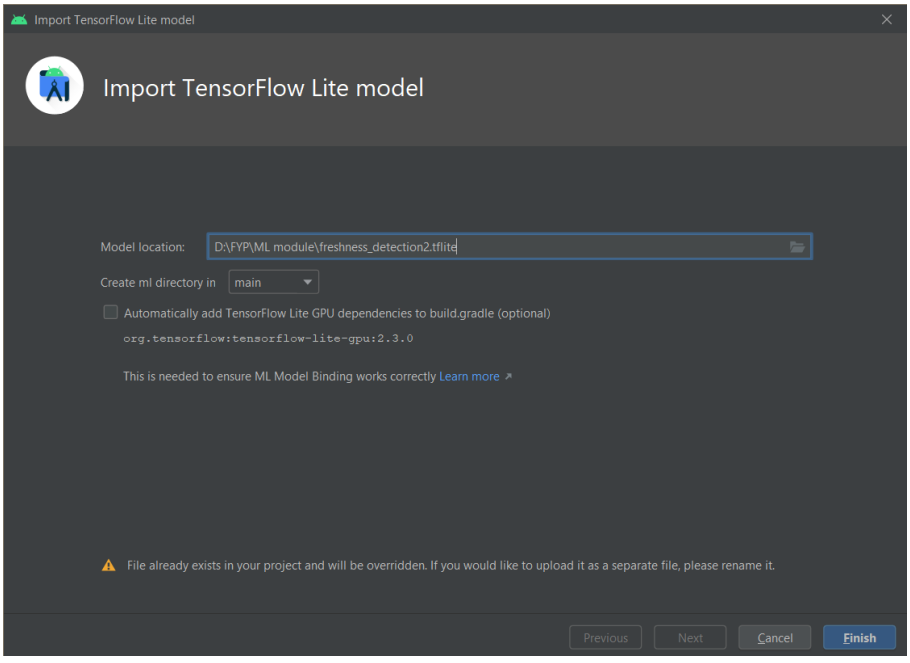


Figure 5.3.18 Teachable Machine Setting and Configuration 4

f) Google Colab Machine Learning Setting and Configuration

For the machine learning in Google Colab, it requires a Jupyter Notebook to implement machine learning training. Refer to [9], it is the Jupyter Notebook in Google Colab that I referred to do the object detection training. From the work of [9], it trains an SSD-MobileNet model or EfficientDet Model with custom dataset. After the training, it converts the model to Tensorflow Lite model. Before the model is generated, there are several tasks are needed in machine learning training.

For this project, the main purpose of the object detection is able to detect 3 types of marine life which is fish, prawn and crab. The first step of machine learning training is gather and label training images. The data images for this project are collected from online with 318 number of prawn images, 359 number of fish images and 357 number of prawn images to conduct the machine learning training.

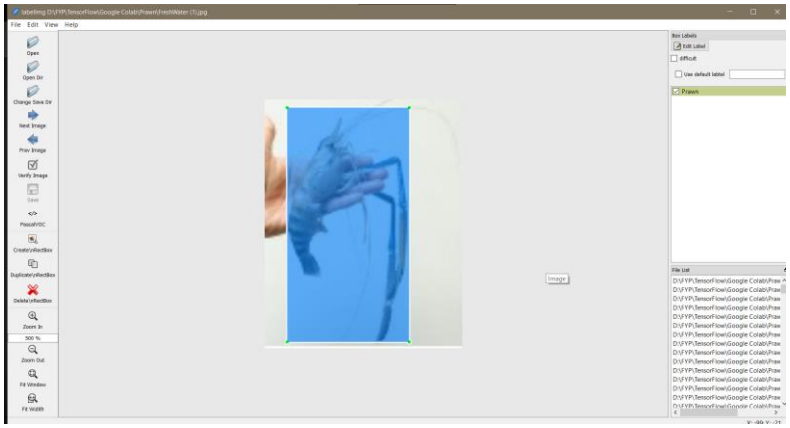


Figure 5.3.19 Image Labeling

From the figure 4.1 above, it shows the interface of image labeling that project use. It requires to import all the collected image to the application, then start to label the object in the box and provide the object name. For example, it labeled a prawn with object name Prawn and highlight the prawn in the image with a box. All the image requires to do some step in order to generate a xml file for later use and store it in a file and zip it.

```
[ ]  # Clone the tensorflow models repository from GitHub
     !git clone --depth 1 https://github.com/tensorflow/models
```

```
# Install the Object Detection API
!pip install /content/models/research/

# Need to downgrade to TF v2.8.0 due to Colab compatibility bug with TF v2.10 (as of 10/03/22)
!pip install tensorflow==2.8.0
```

Figure 5.3.20 Install Tensorflow Object Detection Dependencies

Once the gather and label training images done, we come to our second step which is install Tensorflow object detection dependencies. From the python code above, it requires to clone tensorflow model repository from Github. The repository is Tensorflow Model Garden offers a variety of advanced machine learning models for tasks such as vision and natural language processing, along with tools to set up and run these models on standard datasets. Whether you want to evaluate a model's performance, confirm the results of new research, or improve existing models, the Model Garden provides a valuable resource for advancing your machine learning research and applications [10]. Lastly, it requires to install Tensorflow 2.8.0 version.

```
[ ]  !mkdir /content/images
     !unzip -q images.zip -d /content/images/all
     !mkdir /content/images/train; mkdir /content/images/validation; mkdir /content/images/test
```

```
!wget https://raw.githubusercontent.com/EdjeElectronics/TensorFlow-Lite-Object-Detection-on-Android-and-Raspberry-Pi/master/util_scripts/train_val_test_split.py
!python train_val_test_split.py
```

Figure 5.3.21 Upload Dataset and Prepare Training Data

After installed Tensorflow object detection dependencies, it goes to step 3 which is upload image dataset and prepare training data. It requires to put all the image file and xml file into a folder and zip it and naming as images.zip. After that, upload the zip file to Google Colab for later use. After zip folder is uploaded, we can start to unzip the folder and split the images into 3 parts which is train, validation and test. Train image is the image that use to train the model. Validation images used by training algorithm to check the progress of training and adjust hyperparameters. Test images not use in training part, it is used by human to do the testing of the model to check the accuracy of the model.

```
### This creates a a "labelmap.txt" file with a list of classes the object detection model will detect.
%%bash
cat <<EOF >> /content/labelmap.txt
Fish
Crab
Prawn
EOF
```

```
[ ]  # Download data conversion scripts
     ! wget https://raw.githubusercontent.com/EdjeElectronics/TensorFlow-Lite-Object-Detection-on-Android-and-Raspberry-Pi/master/util_scripts/create_csv.py
     ! wget https://raw.githubusercontent.com/EdjeElectronics/TensorFlow-Lite-Object-Detection-on-Android-and-Raspberry-Pi/master/util_scripts/create_tfrecord.py

[ ]  # Create CSV data files and TFRecord files
     !python3 create_csv.py
     !python3 create_tfrecord.py --csv_input=images/train_labels.csv --labelmap=labelmap.txt --image_dir=images/train --output_path=train.tfrecord
     !python3 create_tfrecord.py --csv_input=images/validation_labels.csv --labelmap=labelmap.txt --image_dir=images/validation --output_path=val.tfrecord
```

Figure 5.3.22 Create Label Map and TFRecords

After prepared training data, it requires to create label map and TFRecords. TFRecord is a binary file format used in TensorFlow to efficiently store and read large amounts of data. It is a flexible and efficient way to store data in a way that can be easily accessed and processed by TensorFlow models [11]. First of all, it requires to create a labelmap.txt file that consist of a list of classes for object detection model. After label map created, it requires to download data conversion script in order to convert train and validation dataset into TFrecord file and also convert labelmap.txt to labelmap.pbtxt.

```
# Change the chosen_model variable to deploy different models available in the TF2 object detection zoo
chosen_model = 'ssd-mobilenet-v2-fpnlite-320'

MODELS_CONFIG = {
    'ssd-mobilenet-v2': {
        'model_name': 'ssd_mobilenet_v2_320x320_coco17_tpu-8',
        'base_pipeline_file': 'ssd_mobilenet_v2_320x320_coco17_tpu-8.config',
        'pretrained_checkpoint': 'ssd_mobilenet_v2_320x320_coco17_tpu-8.tar.gz',
    },
    'efficientdet-d0': {
        'model_name': 'efficientdet_d0_coco17_tpu-32',
        'base_pipeline_file': 'ssd_efficientdet_d0_512x512_coco17_tpu-8.config',
        'pretrained_checkpoint': 'efficientdet_d0_coco17_tpu-32.tar.gz',
    },
    'ssd-mobilenet-v2-fpnlite-320': {
        'model_name': 'ssd_mobilenet_v2_fpnlite_320x320_coco17_tpu-8',
        'base_pipeline_file': 'ssd_mobilenet_v2_fpnlite_320x320_coco17_tpu-8.config',
        'pretrained_checkpoint': 'ssd_mobilenet_v2_fpnlite_320x320_coco17_tpu-8.tar.gz',
    },
    # The centernet model isn't working as of 9/10/22
    #'centernet-mobilenet-v2': {
    #    'model_name': 'centernet_mobilenetv2fpn_512x512_coco17_od',
    #    'base_pipeline_file': 'pipeline.config',
    #    'pretrained_checkpoint': 'centernet_mobilenetv2fpn_512x512_coco17_od.tar.gz',
    #}
}

model_name = MODELS_CONFIG[chosen_model]['model_name']
pretrained_checkpoint = MODELS_CONFIG[chosen_model]['pretrained_checkpoint']
base_pipeline_file = MODELS_CONFIG[chosen_model]['base_pipeline_file']
```

```
[ ] # Create "mymodel" folder for holding pre-trained weights and configuration files
    %mkdir /content/models/mymodel/
    %cd /content/models/mymodel/

    # Download pre-trained model weights
    import tarfile
    download_tar = 'http://download.tensorflow.org/models/object_detection/tf2/20200711/' + pretrained_checkpoint
    !wget {download_tar}
    tar = tarfile.open(pretrained_checkpoint)
    tar.extractall()
    tar.close()

    # Download training configuration file for model
    download_config = 'https://raw.githubusercontent.com/tensorflow/models/master/research/object_detection/configs/tf2/' + base_pipeline_file
    !wget {download_config}
```

Figure 5.3.23 Training Configuration

After created label map and TFrecord, the next step is set up the training configuration. From the code above in Figure 3.4, it shows 3 type of training model from TF2 object detection zoo. For this project, ssd-mobilenet-v2-fpnlite-320 model has been chosen for the training. It is because the model is a lightweight and efficient object detection model that is well-suited for deployment on mobile and embedded devices with limited computational resources. However, the accuracy of ssd-mobilenet-v2-fpnlite-320 may not high as efficiencydet-d0 because it requires higher computational resources [12]. After selected training model, it can start to download the model. Since all training configuration done, we can start our training process. Once the training done, it can export the model and convert it into tflite file in order to able import in android studio.

g) Weight Estimation Configuration

```
if(labelResult.equals("Fish")){
    if(specieResult.equals("Pomfret")){
        weight = 0.267 * (Math.pow(result_length, 2.19));
        displayLength(anchorNode, stringLength: decfor.format(result_length) + "cm",
                stringWeight: decfor.format(weight) + "g", specieResult2: "Pomfret");

    }
    else if(specieResult.equals("Grouper")){
        weight = (0.0001 * (Math.pow(result_length, 2.5955))) * 1000;
        displayLength(anchorNode, stringLength: decfor.format(result_length) + "cm",
                stringWeight: decfor.format(weight) + "g", specieResult2: "Grouper");
```

```
else if(labelResult.equals("Crab")){
    if(specieResult.equals("Mud Crab")){
        weight = 0.1832 * (Math.pow(result_length, 3.0372));
        displayLength(anchorNode, stringLength: decfor.format(result_length) + "cm",
                stringWeight: decfor.format(weight) + "g", specieResult2: "Mud Crab");

    }
    else if(specieResult.equals("Flower Crab")){
        weight = 0.00002 * (Math.pow((result_length * 10), 3.293));
        displayLength(anchorNode, stringLength: decfor.format(result_length) + "cm",
                stringWeight: decfor.format(weight) + "g", specieResult2: "Flower Crab");
    }
```

```
else if(labelResult.equals("Prawn")){
    if(specieResult.equals("Black Tiger Prawn")){
        weight = 0.091 * (Math.pow(result_length, 2.388));
        displayLength(anchorNode, stringLength: decfor.format(result_length) + "cm",
                stringWeight: decfor.format(weight) + "g", specieResult2: "Black Tiger Prawn");

    }
    else if(specieResult.equals("Fresh Water Prawn")){
        weight = 0.0729 * (Math.pow(result_length, 2.5315));
        displayLength(anchorNode, stringLength: decfor.format(result_length) + "cm",
                stringWeight: decfor.format(weight) + "g", specieResult2: "Fresh Water Prawn");
    }
```

Figure 5.3.24 Weight Estimation Configuration

In this project, there is a feature to estimate weight of marine life. Since different species of marine life have different have different characteristic of body shape, so it will apply different formula for each species of marine life. There are six formula apply to different species of marine life to estimate their weight since project scope only cover for six type of marine life but the scope will be scale up in future work. The species of marine life that estimable in this project include mud crab [20], flower crab [21], grouper [22], pomfret [23], tiger prawn [24] and fresh water prawn [25] based on the length-weight relationship from online source.

5.4 System Operation (with Screenshot)

Application Icon

Figure 5.4.1 Application Icon

From the figure above, it shows the main icon that will be showed to users.

Marine Life Measuring Tool Main Page

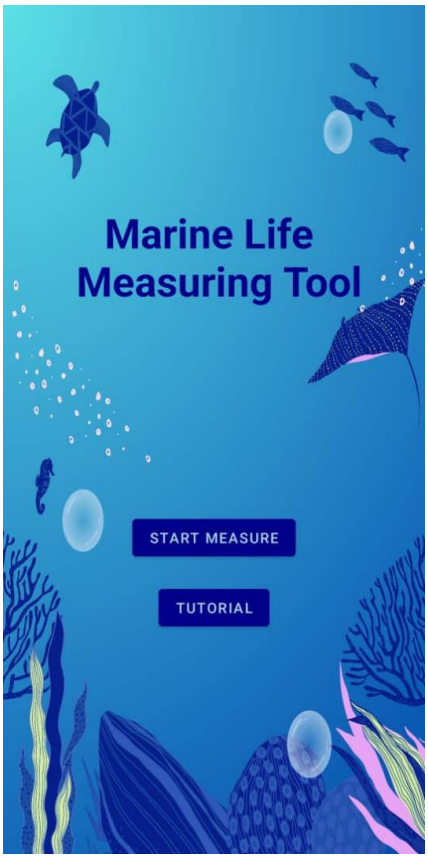


Figure 5.4.2 Marine Life Measuring Tool Main Page

From the figure above, it shows the main page of marine life measuring tool. In the main page, it contains two buttons to navigate to different page. The first button is “START MEASURE” button that navigate to the main activity of this project that estimate length, weight, species and freshness of marine life. The second button is “TUTORIAL” button that navigate to the apps tutorial that teach user how to use the app.

Marine Life Measuring Tool Tutorial

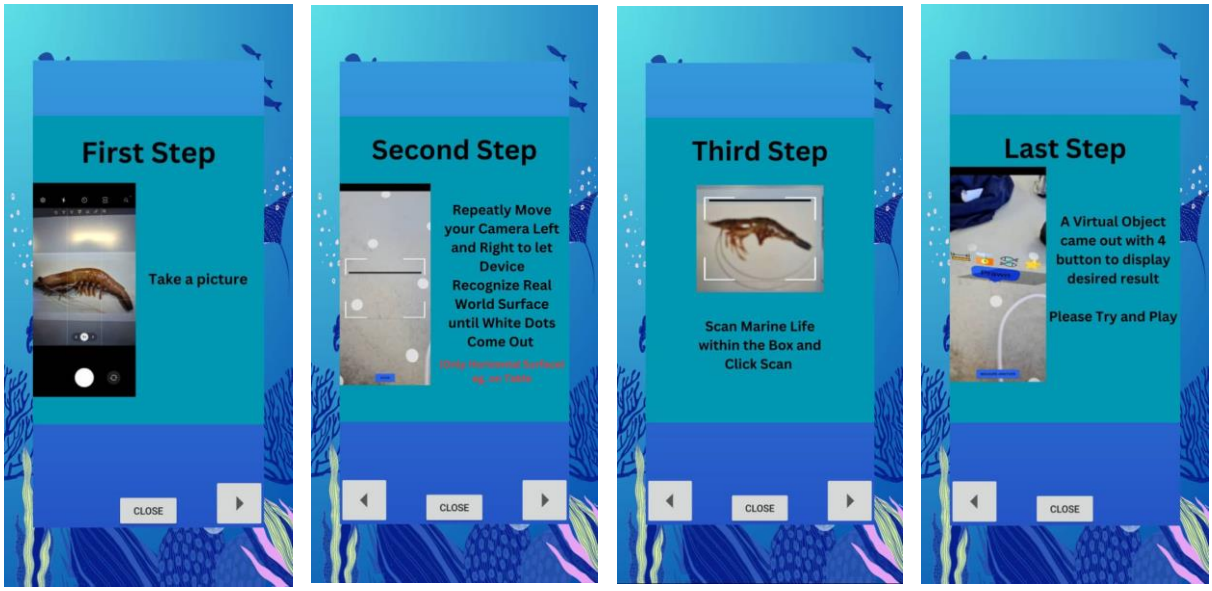


Figure 5.4.3 Marine Life Measuring Tool Tutorial

From the Figure above, it shows Marine Life Measuring Tool Tutorial. It is a pop-up window after user click “TUTORIAL” button in main page. In the first page of tutorial, it contains two button and first step of tutorial. The first button is close button that will close the pop-up window and next button that will navigate to second page of tutorial. In second and third page of tutorial, it contains the step of tutorial and three buttons. The first button is previous button that will navigate back to the previous page and second button that will close the pop-up window and third button is next button that will navigate to the next page of tutorial. In the last page of tutorial, it contains the last step of tutorial and 2 buttons which is previous and close button. The previous button will go back to previous page and close button will close the pop-up window.

Measure Marine Life

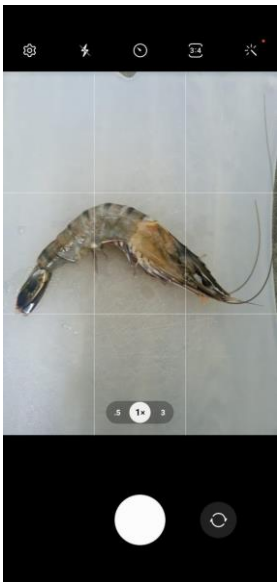


Figure 5.4.4 Take a Picture of Marine Life

After the clicked “START MEASURE” button, it requires user take a picture of marine life. After that, the application will detect the type of marine life and species of marine life. If marine life detected as fish, it will also estimate the freshness of marine life. The application will estimate the freshness of fish based on the eye of fish.

Store Image to Firebase

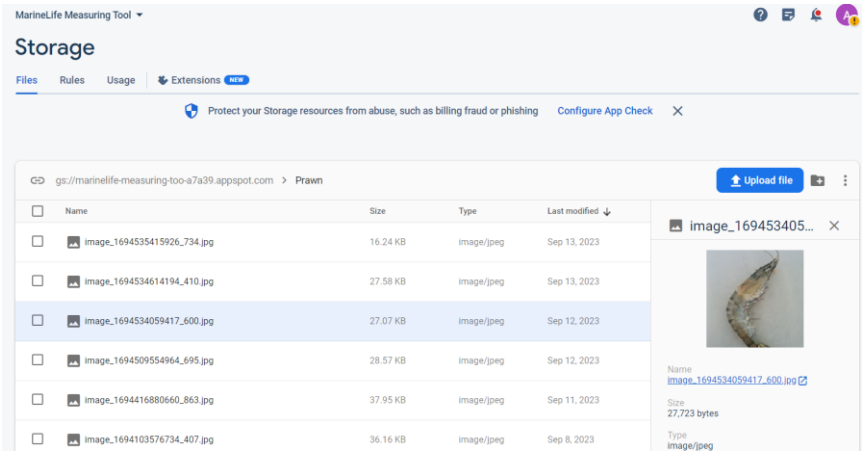


Figure 5.4.5 Store Image to Firebase

From the figure above, it shows the firebase store all the images. The images that user took will be stored into Firebase storage for future work.

Plane Discovering

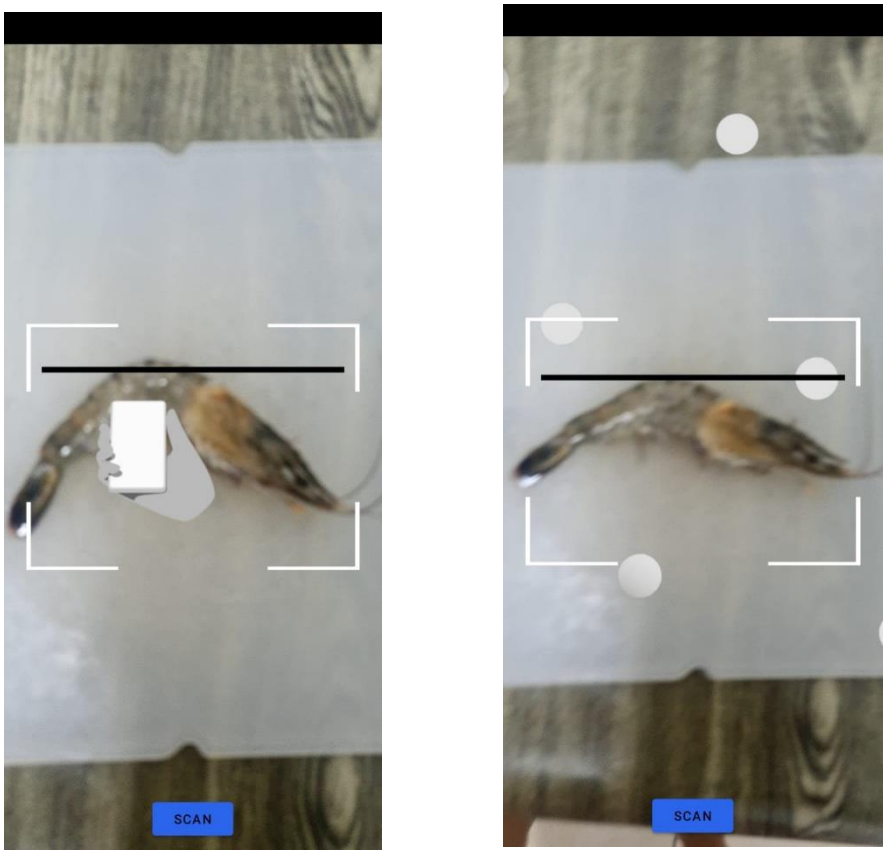


Figure 5.4.6 Plane Discovering

After user took a picture of marine life, the system will navigate to Augmented Reality Activity that require user to discover the plane in order to let device recognize the real-world environment. User require to move the device left to right repeatedly in order to let device able to detect real-world environment. After plane discovered, user require to scan the marine life within the box and click “SCAN” button.

Place the AR object on Discovered Plane

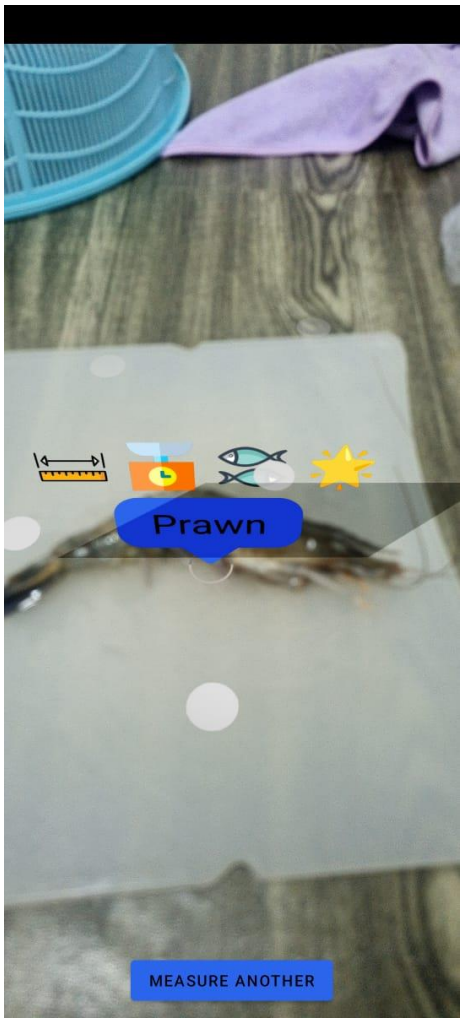


Figure 5.4.7 Place AR object on Discovered Plane

After user clicked “SCAN” button, it will place an AR object on discovered plane that will show the result of estimated length, weight, species and freshness of marine life in four different buttons. It will also estimate and length and weight of marine life after clicked “SCAN” button.

Result Display in Four Different Button

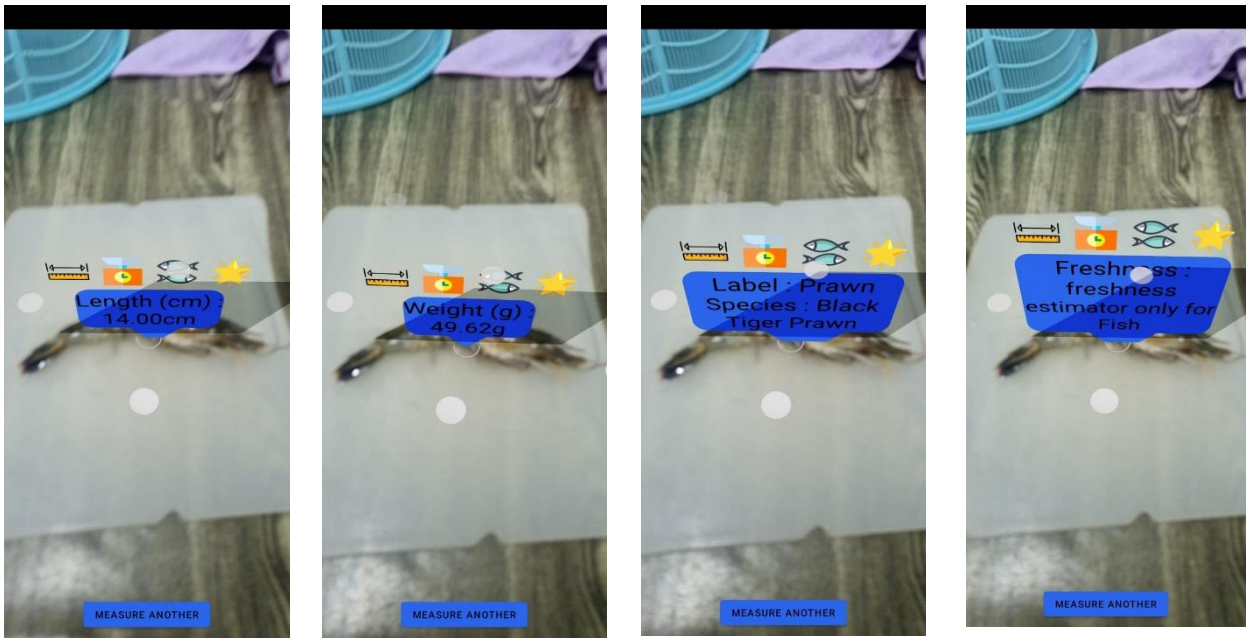


Figure 5.4.8 Result Display in Four Different Button

In the AR object, there are four different image buttons will show different type of result. The ruler button will show estimated length, weighing scale button will show estimated weight, fish button will show estimated species and star button will show freshness of fish.

Marine Life Not Detected

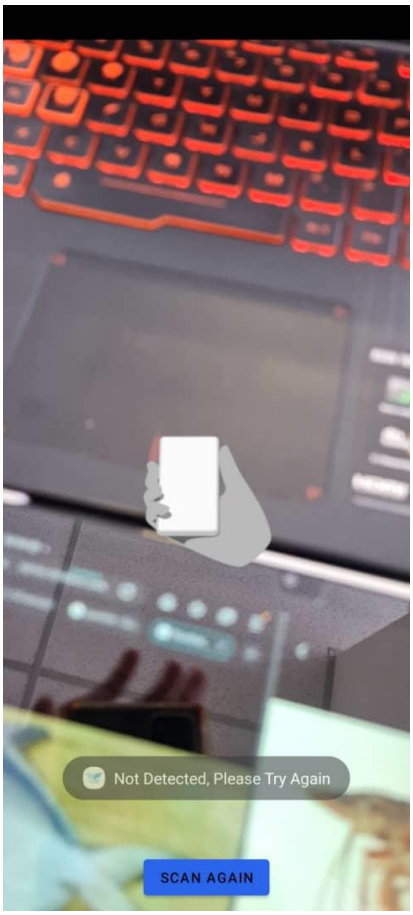


Figure 5.4.9 Marine Life Not Detected

From the figure above, it shows if device not detected marine life, the scan button will turn into “SCAN AGAIN” button and it will also prompt a message “Not Detected, Please Try Again”. It not able to let user measure marine life if device not detected any marine life after took a picture. So that, user can click “SCAN AGAIN” button to re-take a picture.

Plane Not Discovered

Figure 5.4.10 Plane Not Discovored

From the figure above, it shows if the plane not discovered, it will pop-up the tutorial to show user how to properly discover plane. After that, user can click “CLOSE” button to discover plane again and proceed to measure the marine life.

5.5 Implementation Issues and Challenges

First of all, there are some issues and challenges to implement AR sceneform. It is because, AR sceneform is stopped the maintenance and update by Google start from 1.16.0 version. So that, it cannot use the latest version of Android Studio because of the latest version of Android Studio is not support AR sceneform anymore. In this project, it has no choice to downgrade the Android Studio to version Arctic Fox | 2020.3.1 Patch 4. Although the archive version of Android Studio is support AR sceneform, but there is an implementation issue also. The issue is the camera will not focus while implementing AR fragment. That's mean the camera will not focus while running Augmented Reality sceneform and it will affect the use experience of user.

Other than that, another issue is there is class crashing from two dependencies which is flatbuffers from AR sceneform and tensorflow lite. That's mean there are same class name but different function of classes from AR sceneform and tensorflow lite dependencies. The dependency of AR sceneform use to create AR experience in the apps and tensorflow lite use to support the marine life detection model to execute the model. Since both of the dependencies are crashing, the project decided to excluded the flatbuffer module from the dependencies and it cause cannot run tensorflow lite dependency to execute marine life detection model. So that, it uses OpenCV SDK to replace tensorflow lite to run the model. There are available classes and function to replace tensorflow lite dependencies in order to execute the model in Android Studio.

In conclusion, there are 3 main implementation issues and challenges in this project. The first challenge and issue is the AR sceneform is stopped maintenance and update by Google that affect Android Studio must downgrade the version to fit with AR sceneform. The second challenge and issue is the camera of AR sceneform is not focusing. Although it hardcodes to set the camera to autofocus, but it still not working. The third challenge and issue is there are two classes name are crashing from two different dependencies.

5.6 Concluding Remark

In conclusion, marine life measuring tool able to estimate length, weight, species and freshness of marine life. The estimated result will be presented in AR sceneform object. For length estimation, it uses AR sceneform technique to recognize the environment of real world to let user device to calculate the distance between two points in order to estimate the length of marine life. For weight estimation, it applies some research formula from online source [20][21][22][23][24][25] to estimate the weight of marine life and different species of marine life will apply different formula to estimate the weight of marine life. For species and freshness detection, it requires to train an object detection model to estimate species and freshness of marine life.

CHAPTER 6 System Evaluation and Discussion

6.1 System Testing and Performance Metrics

The application will allow user view app tutorial. In the app tutorial, user able to control the navigation of tutorial pages with some buttons. After that, user able to measure length, weight, species and freshness of marine life.

1. User able to view app tutorial

No	Test Case	Inputs	Expected Output	Actual Output	Remark
1	Navigate to tutorial page	A button click labelled as "TUTORIAL"	From main page of the app navigate to first page of tutorial	From main page of the app navigate to first page of tutorial	PASS
2	Navigate to next page of tutorial	A button click labelled with a previous arrow	From current page of tutorial navigate to next page, next button will disappear in last page	From current page of tutorial navigate to next page, next button will disappear in last page	PASS
3	Navigate to previous page of tutorial	A button click labelled with a previous arrow	From current page of tutorial navigate to previous page, previous button will disappear in first page	From current page of tutorial navigate to previous page, previous button will disappear in first page	PASS
4	Close the tutorial window	A button click labelled as "CLOSE"	Able to close the tutorial window in every page of tutorial and back to the main page	Able to close the tutorial window in every page of tutorial and back to the main page	PASS

Table 6.1.1 Verification Plan 1

2. User able to measure length, weight, species and freshness of marine life

No	Test Case	Inputs	Expected Output	Actual Output	Remark
1	Take a Picture of Marine Life	A button click labelled as "START MEASURE"	From main page navigate to take picture activity and able to take a picture of marine life	From main page navigate to take picture activity and able to take a picture of marine life	PASS
2	Detect type of marine life and species of marine life	The picture took previously	Navigate to AR Activity, then prompt a message "Detected" and display a button labelled as "SCAN" when marine life detected	Navigate to AR Activity, then prompt a message "Detected" and display a button labelled as "SCAN" when marine life detected	PASS
3	Not detected any marine life	The picture took previously	Navigate to AR Activity, then prompt a message "Not Detected" and display a button labelled as "SCAN AGAIN" that let user retake a picture when marine life not detected.	Navigate to AR Activity, then prompt a message "Not Detected" and display a button labelled as "SCAN AGAIN" that let user retake a picture when marine life not detected.	PASS
4	Retake picture	A button click labelled as "SCAN AGAIN"	From AR activity back to take picture activity to retake a picture	From AR activity back to take picture activity to retake a picture	PASS
5	Plane Discovering	User require to move their device left and right repeatedly	System will recognize the plane. Once plane is discovered, it will show some white dot on the plane	System will recognize the plane. Once plane is discovered, it will show some white dot on the plane	PASS
6	Place AR object with estimated result	A button click labelled as "SCAN"	It will place an AR object that will display the type of marine life that detected previously and also there are four image buttons on the AR object. At the same time, it will estimate the length	It will place an AR object that will display the type of marine life that detected previously and also there are four image buttons on the AR object. At the same time, it will estimate the length	PASS

			and weight of marine life	and weight of marine life	
7	Pop up tutorial while plane not discovered properly	A button click labelled as "SCAN"	It will pop up the second page of tutorial while plane not discovered properly after user click "SCAN" button	It will pop up the second page of tutorial while plane not discovered properly after user click "SCAN" button	PASS
8	View estimated length result	An image button click labelled with a ruler image	It will display the estimated length result	It will display the estimated length result	PASS
9	View estimated weight result	An image button click labelled with a weight scaler image	It will display the estimated weight result	It will display the estimated weight result	PASS
10	View estimated type and species result	An image button click labelled with two fishes' image	It will display the estimated type and species of marine life result	It will display the estimated type and species of marine life result	PASS
11	View estimated freshness of fish	An image button click labelled with star image	It will display the estimated freshness result	It will display the estimated freshness result	PASS
12	Measure another marine life	A button click labelled as "MEASURE ANOTHER"	It will navigate back to take picture activity to retake another marine life picture in order to measure another marine life	It will navigate back to take picture activity to retake another marine life picture in order to measure another marine life	PASS

Table 6.1.2 Verification Plan 2

6.1.1 Marine Life Measuring Tool Testing

- **Prawn**

Figure 6.1.1 Estimated Result of Prawn

	Length	Weight	Type	Species	Freshness
Actual	**15.25cm**	**36.00g**	**Prawn**	**Tiger Prawn**	**-**
Estimated	**13.66cm**	**46.83g**	**Prawn**	**Tiger Prawn**	**-**

Table 6.1.3 Comparison between Actual and Estimated Result of Prawn

From table above, it shows the comparison between actual and estimated result of prawn. The actual length of prawn is 15.25cm and estimated length is 13.66cm. The estimated length of the prawn is approximately 1.59 cm less than the actual length. The actual weight of prawn is 36.00 gram and estimated weight of prawn is 46.83 gram. The estimated weight of the prawn is approximately 10.83 gram more than the actual weight. Moreover, there are estimated a true value of type and species of marine life which is Prawn and Tiger Prawn. And also, the freshness estimation is not available for prawn.

- **Crab**

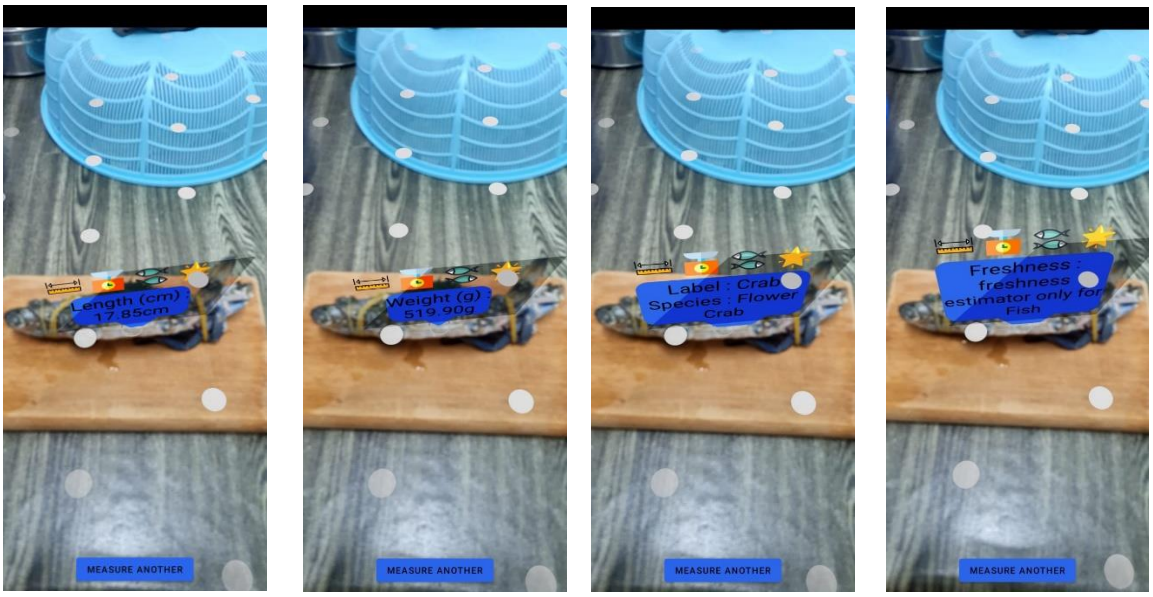


Figure 6.1.2 Estimated Result of Crab

	Length	Weight	Type	Species	Freshness
Actual	**19.65cm**	**408.0g**	**Crab**	**Flower Crab**	**-**
Estimated	**17.85cm**	**519.9g**	**Crab**	**Flower Crab**	**-**

Table 6.1.4 Comparison between Actual and Estimated Result of Crab

From table above, it shows the comparison between actual and estimated result of crab. The actual length of crab is 19.65cm and estimated length is 17.85cm. The estimated length of the crab is approximately 2.00 cm less than the actual length. The actual weight of crab is 408.00 gram and estimated weight of crab is 519.9 gram. The estimated weight of the crab is approximately 111.9 gram more than the actual weight. Moreover, there are estimated a true value of type and species of marine life which is Crab and Flower Crab. And also, the freshness estimation is not available for crab.

- **Fish**

Figure 6.1.3 Estimated Result of Fish

	Length	Weight	Type	Species	Freshness
Actual	**11.00cm**	**32.00g**	**Fish**	**Pomfret**	**Stale**
Estimated	**9.26cm**	**34.98g**	**Fish**	**Pomfret**	**Stale**

Table 6.1.5 Comparison between Actual and Estimated Result of Fish

From table above, it shows the comparison between actual and estimated result of fish. The actual length of fish is 11.00cm and estimated length is 9.26cm. The estimated length of the fish is approximately 1.74 cm less than the actual length. The actual weight of fish is 32.00 gram and estimated weight of fish is 34.98 gram. The estimated weight of the fish is approximately 2.98 gram more than the actual weight. Moreover, there are estimated a true value of type and species of marine life which is Fish and Pomfret. And also, the freshness estimation result is stale that same with actual value.

6.2 Project Challenges

First of all, there are several difficulties to implement this project. The first challenge of this project is collect dataset. Dataset act an important role in this project since there are three object detection model need to build which is freshness detection model, type of marine life detection model and species of marine life detection model. It is very difficult to collect large dataset to train the model. If dataset not collected properly, it may affect the performance of model and user experience.

Moreover, the second challenge of this project is it require a high standard of develop environment to develop the project. It is because, the project requires to train machine learning model and Android Studio will consume high resource of the laptop to run the code. Not only that, Android Studio require to handle variety SDK such as Firebase, OpenCV and others. So that, it consume a lot of resource during development.

Other than that, the third challenge of this project is the application only develop for Android user since it use Android Studio platform to develop the app, it results iOS user cannot use the application. Since iOS user cannot use the application, it will be lost some of the user that will provide some command and review as an improvement for the application.

In conclusion, the main challenge of this project is collect dataset, project development consume high resource and lost some iOS user since application only for Android user.

6.3 Objectives Evaluation

The project objectives are important as a guidance for developer to keep follow the same way to complete the project. The first objective of this project is providing an augmented reality measuring tool for marine. In this project, it using Augmented Reality technique to recognize real world environment in order to able measure the length of marine life. After that, it uses formula to estimate the weight of marine life. The measuring target of this project is focusing on fish, crab and prawn. So that, user able to use the measuring tool to estimate the length and weight of crab, fish and prawn. Moreover, the detected result will be displayed in Augmented Reality. So that, it achieves the first objectives which is provide an augmented reality measuring tool for marine life.

The second objective is user Artificial Intelligence to analyse the species of marine and freshness of fish. From the project, it had trained three object detection model which is freshness detection model, species detection model and type of marine life detection model. The freshness detection model able to estimate the freshness of fish based on the fish eye. Type of marine life detection model will be able to detect fish, crab and prawn. After that, the species detection model will be able to detect six species of marine life which is grouper, pomfret, mud crab, freshwater prawn, flower crab and tiger prawn. So that, it achieves the second objective which is user artificial intelligence to analyse the species of marine life and freshness of fish.

CHAPTER 7 CONCLUSION AND RECOMMANDATION

7.1 Conclusion

In summary of this project, the scope of this project included develop an augmented reality measuring tool to measure marine life and use Artificial Intelligence to train model to detect type and species of marine life and also freshness of fish. The measuring target of this project is crab, fish and prawn. It able to estimate length and weight of measuring target and display the result in Augmented Reality.

First of all, the project use Android Studio as development platform to develop a marine life measuring tool Android apps. The project is using Augmented Reality technique of AR sceneform and ARCore to recognize real world environment to estimate length. After that, it use estimated length to estimate the weight of marine life with variety mathematic formula. After estimated length and weight, it will display the result in AR object.

Other than that, it also trained three type of machine learning model to detect type and species of marine life and freshness of fish. It imports the trained model as tensorflow lite into Android Studio to implement the detection. It able to detect crab, fish and prawn as mentioned above. The species of marine life detection model able to detect 2 species of each type of marine life which is mud crab, flower crab, pomfret, grouper, tiger prawn and freshwater prawn. It requires user to take a picture and the system will detect the type and species of marine life. After that, it will show into AR object together with estimated length and weight result. Although the app only able detect three of type of marine life and six species of marine life, it is not enough to benefit most of the user, but the project able to capture the picture of user took and store into Firebase. After that, the pictures as dataset can be used to train a new and better detection model.

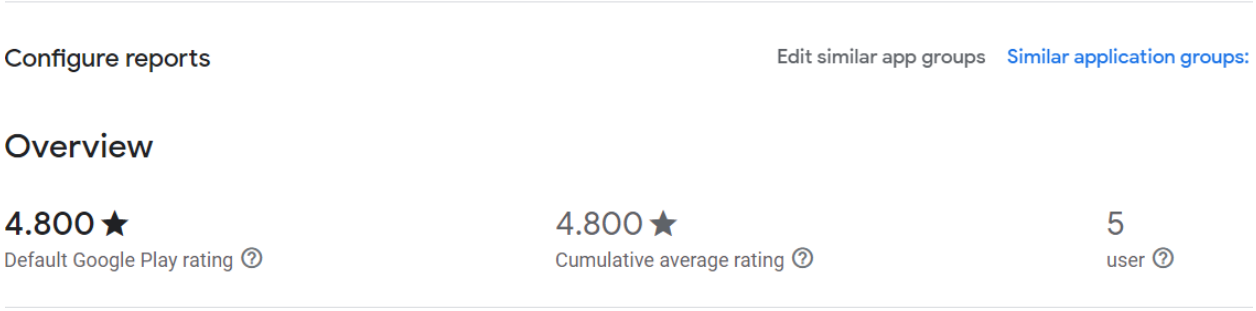


Figure 7.1.1 Google Play Rating

Lastly, the application uploaded to Google Play Store. Android user able to download and try the application on Google Play Store. Currently there are 5 active user and cumulative average rating is 4.8.

7.2 Recommendation

After completed this project, it has several aspects can be improve to become a more friendly and outstanding application. The first thing is three detection model which is type, species and freshness detection model can be combined in one model. Since the project is more focusing on Augmented Reality measuring tool to measure marine life, the detection models will be separate in three detection model because of easier to build and implement the machine learning training. Combined the three detection models to one model can get several benefits. One of the benefits is it will save the machine learning training cost such as time, computation resource and others. Another benefit is simplified deployment. It will be easier to serve one model instead of three model in the application. It makes the deployment pipeline become easier and it may improve resource utilization.

Oher than that, the second recommendation of this project is use augmented reality object tracking to present the result of estimation. Augmented reality object tracking able to real-time tracking the object and overlays digital content on the object. If augmented reality object tracking technique apply in the project, it able to overlays the estimation result on detect marine life. It can be more user friendly and good experience to user. Although the technique and idea is good, but augmented reality object tracking not a free resource from online. There is no open source of augmented reality object tracking to let developer try and use. It can be cost expensive if developer subscribe with the technique such as Wikitude.

BIBLIOGRAPHY

[1] "Fisheries country profile: Malaysia (2022)," SEAFDEC, 12-Sep-2022. [Online]. Available: http://www.seafdec.org/fisheries-country-profile-malaysia-2022/. [Accessed: 23-Nov-2022].

[2] SeafoodSource, "Investigation exposes short-weight seafood," SeafoodSource Official Media, 10-Sep-2019. [Online]. Available: https://www.seafoodsource.com/news/supply-trade/investigation-exposes-short-weight-seafood. [Accessed: 14-Apr-2023].

[3] NOAA, "Seafood fraud," Seafood Fraud, 13-Feb-2023. [Online]. Available: https://www.fisheries.noaa.gov/national/sustainable-seafood/seafood-fraud. [Accessed: 14-Apr-2023].

[4] NOAA, "Forced labor and the Seafood Supply Chain," NOAA, 22-Dec-2022. [Online]. Available: https://www.fisheries.noaa.gov/international/international-affairs/forced-labor-and-seafood-supply-chain. [Accessed: 14-Apr-2023].

[5] "Fish Ruler - apps on Google Play," Google. [Online]. Available: https://play.google.com/store/apps/details?id=com.maruar.fishruler&hl=en_US&gl=US. [Accessed: 16-Apr-2023].

[6] " Fisherman's mobile weigh station, " Google Play. [Online]. Available: https://play.google.com/store/apps/details?id=com.mobileweighstation.android&hl=zh&gl=US. [Accessed: 16-Apr-2023].

[7] N. Kato, "Ar fishing measure, Fish Ruler," App Store, 05-Feb-2021. [Online]. Available: https://apps.apple.com/us/app/ar-fishing-measure-fish-ruler/id1549776641. [Accessed: 16-Apr-2023].

[8] Valacich, J.S. & George, J.F. (2020). Modern System Analysis and Design. (9th ed). Pearson.

[9] E. Juras, TensorFlow Lite Object Detection API in Colab, 28-Jan-2023. [Online]. Available: https://colab.research.google.com/github/EdjeElectronics/TensorFlow-Lite-Object-Detection-on-Android-and-Raspberry-Pi/blob/master/Train_TFLite2_Object_Detction_Model.ipynb. [Accessed: 16-Apr-2023].

[10] "Model garden overview Tensorflow Core," TensorFlow. [Online]. Available: https://www.tensorflow.org/guide/model_garden. [Accessed: 16-Apr-2023].

[11] "TFRecord and Earth engine | Google Earth engine | google developers," Google. [Online]. Available: https://developers.google.com/earth-engine/guides/tfrecord. [Accessed: 17-Apr-2023].

[12] E. Juras, "TensorFlow lite object detection model performance comparison," EJ Technology Consultants. [Online]. Available: https://www.ejtech.io/learn/tflite-object-detection-model-comparison. [Accessed: 17-Apr-2023].

[13] Google, "Meet android studio: Android developers," Android Developers, https://developer.android.com/studio/intro (accessed Sep. 7, 2023).

[14] Google, “Sceneform Overview | sceneform (1.15.0) | google for developers,” Google, https://developers.google.com/sceneform/develop (accessed Sep. 7, 2023).

[15] OpenCV, “About,” OpenCV, https://opencv.org/about/ (accessed Sep. 7, 2023).

[16] Google, “Overview of arcore and supported development environments | google for developers,” Google, https://developers.google.com/ar/develop (accessed Sep. 7, 2023).

[17] Google, “What is Colaboratory?” Google colab, https://research.google.com/colaboratory/faq.html (accessed Sep. 7, 2023).

[18] Google, “Teachable machine by google creative lab - experiments with google,” Google, https://experiments.withgoogle.com/teachable-machine (accessed Sep. 7, 2023).

[19] Educative, “What is Firebase?” Educative, https://www.educative.io/answers/what-is-firebase (accessed Sep. 7, 2023).

[20] J. M. S. Tetelepta1, Y. Natan1, J. A. Pattikawa1, O. T. S. Ongkers1, and B. J. Pattiasina1, “Fishery of mud crab Scylla serrata of Kotania Bay, Western Seram District: potency, stock status and sustainable management,” IOP Conference Series: Earth and Environmental Science, https://iopscience.iop.org/article/10.1088/1755-1315/339/1/012002 (accessed Sep. 11, 2023).

[21] J. Jose, “Morphometrics and Length-Weight Relationship in the Blue Swimmer Crab, Portunus Pelagicus (Linnaeus, 1758) (Decapoda, Brachyura) from the Mandapam Coast,

India," ResearchGate, https://www.researchgate.net/publication/233516348_Morphometrics_and_Length-Weight_Relationship_in_the_Blue_Swimmer_Crab_Portunus_Pelagicus_Linnaeus_1758_Decapoda_Brachyura_from_the_Mandapam_Coast_India (accessed Sep. 11, 2023).

[22] Fatma, A. Mallawa, Najamuddin, M. Zainuddin, and F. R. Ayyub, "Biological aspects of brown-marbled grouper (epinephelus fuscoguttatus) from Taka Bonerate National Park, district of Selayar Islands, South Sulawesi, Indonesia," Biodiversitas Journal of Biological Diversity, https://smujo.id/biodiv/article/view/9858 (accessed Sep. 12, 2023).

[23] S. Barua, Q. Liu, M. S. Alam, P. Schneider, and M. M. H. Mozumder, "Application of Length-Based Assessment Methods to Elucidate Biological Reference Points of Black Pomfret Stock in the Bay of Bengal, Bangladesh," ResearchGate, https://www.researchgate.net/publication/366185723_Application_of_Length-Based_Assessment_Methods_to_Elucidate_Biological_Reference_Points_of_Black_Pomfret_Stock_in_the_Bay_of_Bengal_Bangladesh (accessed Sep. 11, 2023).

[24] Y. Li et al., "Length–weight relationship and condition factor of giant tiger shrimp, Penaeus Monodon (fabricius, 1798) from four breeding families - springerplus," SpringerOpen, https://springerplus.springeropen.com/articles/10.1186/s40064-016-2979-6 (accessed Sep. 12, 2023).

[25] R. Ratnakumar, "Length-weight relationships and condition factor of giant freshwater prawn, Macrobrachium Rosenbergii (de Man, 1879) in five perennial reservoirs in Northern Province, Sri Lanka," International Journal of Fisheries and Aquatic Studies, https://www.academia.edu/45489284/Length_weight_relationships_and_condition_factor_of_giant_freshwater_prawn_Macrobrachium_rosenbergii_De_Man_1879_in_five_perennial_reservoirs_in_Northern_Province_Sri_Lanka (accessed Sep. 12, 2023).

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 1**
Student Name & ID: Yong Chung Wei 19ACB06074	
Supervisor: Ts Dr Cheng Wai Khuen	
Project Title: Develop an Augmented Reality Measuring Tool for Marine Life	

1. WORK DONE

- Review FYP1 report

2. WORK TO BE DONE

-Research on length-weight relationship of fish, crab and prawn

3. PROBLEMS ENCOUNTERED

- No problems encountered for this week.

4. SELF EVALUATION OF THE PROGRESS

Managed to complete self- assigned task within the timeframe

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 2**
Student Name & ID: Yong Chung Wei 19ACB06074	
Supervisor: Ts Dr Cheng Wai Khuen	
Project Title: Develop an Augmented Reality Measuring Tool for Marine Life	

1. WORK DONE

- Research on length-weight relationship of fish, crab and prawn

2. WORK TO BE DONE

- improve type and species of marine life detection model
- collect more data to train the model

3. PROBLEMS ENCOUNTERED

- No problems encountered for this week.

4. SELF EVALUATION OF THE PROGRESS

- progress on track

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 3**
Student Name & ID: Yong Chung Wei 19ACB06074	
Supervisor: Ts Dr Cheng Wai Khuen	
Project Title: Develop an Augmented Reality Measuring Tool for Marine Life	

1. WORK DONE

- improve type and species of marine life detection model
- collect more data to train the model

2. WORK TO BE DONE

- deploy the models to Android Studio

3. PROBLEMS ENCOUNTERED

- No problems encountered for this week.

4. SELF EVALUATION OF THE PROGRESS

- the progress on this week still on track and meeting our goals

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 4**
Student Name & ID: Yong Chung Wei 19ACB06074	
Supervisor: Ts Dr Cheng Wai Khuen	
Project Title: Develop an Augmented Reality Measuring Tool for Marine Life	

1. WORK DONE

- deploy the models to Android Studio

2. WORK TO BE DONE

- start to do freshness detection
- research on how to determine the freshness of fish

3. PROBLEMS ENCOUNTERED

- No problems encountered for this week.

4. SELF EVALUATION OF THE PROGRESS

- the progress on this week still on track and meeting our goals

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 5**
Student Name & ID: Yong Chung Wei 19ACB06074	
Supervisor: Ts Dr Cheng Wai Khuen	
Project Title: Develop an Augmented Reality Measuring Tool for Marine Life	

1. WORK DONE

- start to do freshness detection
- research on how to determine the freshness of fish

2. WORK TO BE DONE

- collect and pre-processing data to train freshness detection model
- train freshness detection model

3. PROBLEMS ENCOUNTERED

- No problems encountered for this week.

4. SELF EVALUATION OF THE PROGRESS

- my process is falling much behind because trouble with machine learning.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 6**
Student Name & ID: Yong Chung Wei 19ACB06074	
Supervisor: Ts Dr Cheng Wai Khuen	
Project Title: Develop an Augmented Reality Measuring Tool for Marine Life	

1. WORK DONE

- collect and pre-processing data to train freshness detection model

2. WORK TO BE DONE

- train freshness detection model

3. PROBLEMS ENCOUNTERED

No problems encountered for this week.

4. SELF EVALUATION OF THE PROGRESS

- still catching up the progress

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 7**
Student Name & ID: Yong Chung Wei 19ACB06074	
Supervisor: Ts Dr Cheng Wai Khuen	
Project Title: Develop an Augmented Reality Measuring Tool for Marine Life	

1. WORK DONE

- train freshness detection model

2. WORK TO BE DONE

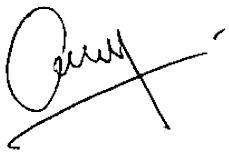
- require to collect more dataset for freshness detection model
- train the detection model again

3. PROBLEMS ENCOUNTERED

- the result of freshness detection model perform not well, try to collect more data and retrain it.

4. SELF EVALUATION OF THE PROGRESS

- still catching up the progress



Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 8**
Student Name & ID: Yong Chung Wei 19ACB06074	
Supervisor: Ts Dr Cheng Wai Khuen	
Project Title: Develop an Augmented Reality Measuring Tool for Marine Life	

1. WORK DONE

- require to collect more dataset for freshness detection model
- train the detection model again

2. WORK TO BE DONE

- deploy the freshness detection model
- design layout of the app

3. PROBLEMS ENCOUNTERED

- No problems encountered for this week.

4. SELF EVALUATION OF THE PROGRESS

- need to push a little bit myself to keep the progress

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 9**
Student Name & ID: Yong Chung Wei 19ACB06074	
Supervisor: Ts Dr Cheng Wai Khuen	
Project Title: Develop an Augmented Reality Measuring Tool for Marine Life	

1. WORK DONE

- deploy the freshness detection model

2. WORK TO BE DONE

- design layout of the app
- create measuring tool tutorial

3. PROBLEMS ENCOUNTERED

- need more time to design the layout and make it more understandable to user

4. SELF EVALUATION OF THE PROGRESS

- Push a little bit myself to keep the progress

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 10**
Student Name & ID: Yong Chung Wei 19ACB06074	
Supervisor: Ts Dr Cheng Wai Khuen	
Project Title: Develop an Augmented Reality Measuring Tool for Marine Life	

1. WORK DONE

- design layout of the app
- create measuring tool tutorial

2. WORK TO BE DONE

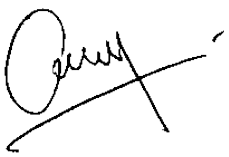
- promote the app to friend
- get review and command
- fix the error of app

3. PROBLEMS ENCOUNTERED

- no problems encountered for this week.

4. SELF EVALUATION OF THE PROGRESS

- catching up the progress



Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S3	**Study week no.: 11**
Student Name & ID: Yong Chung Wei 19ACB06074	
Supervisor: Ts Dr Cheng Wai Khuen	
Project Title: Develop an Augmented Reality Measuring Tool for Marine Life	

1. WORK DONE

- promote the app to friend
- get review and command
- fix the error of app

2. WORK TO BE DONE

- start to do FYP2 report

3. PROBLEMS ENCOUNTERED

- no problems encountered for this week.

4. SELF EVALUATION OF THE PROGRESS

- catching up the progress, try to finish the project

Supervisor's signature

Student's signature

POSTER

Develop an Augmented Reality Measuring Tool for Marine Life

By: Yong Chung Wei Supervised by: Ts Dr Cheng Wai Khuen

Introduction

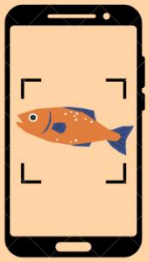
The purpose of the project is develop and Augmented Reality Measuring Tool for Marine Life. It help to reduce seafood fraud cases such as short-weight seafood and mislabelling. It also help to reduce forced labour cases such as non-payment or underpayment of wages and excessive overtime

Objective

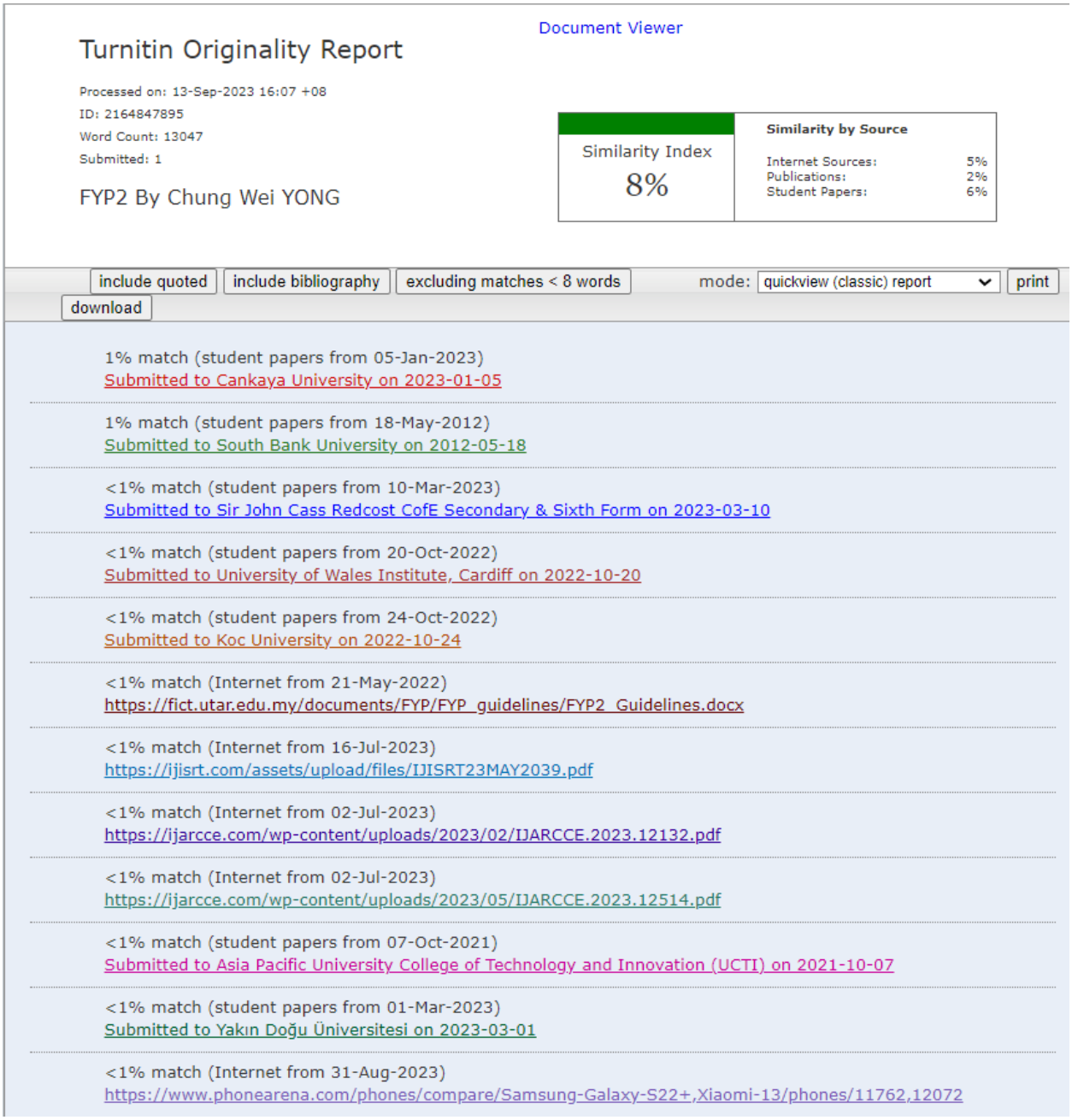
- augmented reality measure tool for marine life is provide a tool to let human can estimate the length and weight of marine life
- providing an AI service to recognize marine life species and estimate freshness of seafood

Main Features

- Measure size of marine life
- Recognise type of marine life
- Recognise species of marine life
- Estimate freshness of marine life



PLAGIARISM CHECK RESULT



Document Viewer

Turnitin Originality Report

Processed on: 13-Sep-2023 16:07 +08
ID: 2164847895
Word Count: 13047
Submitted: 1

FYP2 By Chung Wei YONG

Similarity Index	Similarity by Source	
8%	Internet Sources:	5%
	Publications:	2%
	Student Papers:	6%

include quoted | include bibliography | excluding matches < 8 words | mode: quickview (classic) report | print | download

1% match (student papers from 05-Jan-2023)
Submitted to Cankaya University on 2023-01-05

1% match (student papers from 18-May-2012)
Submitted to South Bank University on 2012-05-18

<1% match (student papers from 10-Mar-2023)
Submitted to Sir John Cass Redcost CofE Secondary & Sixth Form on 2023-03-10

<1% match (student papers from 20-Oct-2022)
Submitted to University of Wales Institute, Cardiff on 2022-10-20

<1% match (student papers from 24-Oct-2022)
Submitted to Koc University on 2022-10-24

<1% match (Internet from 21-May-2022)
https://fict.utar.edu.my/documents/FYP/FYP_guidelines/FYP2_Guidelines.docx

<1% match (Internet from 16-Jul-2023)
https://ijisrt.com/assets/upload/files/IJISRT23MAY2039.pdf

<1% match (Internet from 02-Jul-2023)
https://ijarcce.com/wp-content/uploads/2023/02/IJARCCE.2023.12132.pdf

<1% match (Internet from 02-Jul-2023)
https://ijarcce.com/wp-content/uploads/2023/05/IJARCCE.2023.12514.pdf

<1% match (student papers from 07-Oct-2021)
Submitted to Asia Pacific University College of Technology and Innovation (UCTI) on 2021-10-07

<1% match (student papers from 01-Mar-2023)
Submitted to Yakın Doğu Üniversitesi on 2023-03-01

<1% match (Internet from 31-Aug-2023)
https://www.phonearena.com/phones/compare/Samsung-Galaxy-S22+,Xiaomi-13/phones/11762,12072

PLAGIARISM CHECK RESULT

<1% match (Internet from 08-Mar-2023)
https://steamcommunity.com/app/362890/discussions/5/3183486955464328892/

<1% match (student papers from 25-Feb-2023)
Submitted to Colorado Technical University on 2023-02-25

<1% match (student papers from 13-Aug-2022)
Submitted to National College of Ireland on 2022-08-13

<1% match (student papers from 05-May-2023)
Submitted to University of Glamorgan on 2023-05-05

<1% match (student papers from 26-Jun-2015)
Submitted to Universiti Teknologi MARA on 2015-06-26

<1% match (student papers from 08-Jul-2015)
Submitted to Universiti Teknologi MARA on 2015-07-08

<1% match (student papers from 06-Jun-2020)
Submitted to Champlain College on 2020-06-06

<1% match (student papers from 24-Jun-2023)
Submitted to Universiti Teknologi Malaysia on 2023-06-24

<1% match (Internet from 02-Aug-2021)
http://docplayer.net

<1% match (Internet from 02-Apr-2019)
http://ng4graduates2.blogspot.com

<1% match (Internet from 21-Nov-2019)
https://pdfs.semanticscholar.org/78c7/a1e06febca05d651b470432000d3f2c5d3c8.pdf

<1% match (Elcy Tsen Yi Ching, Chin Kim on, Rayner Alfred, Mohd Hanafi Ahmad Hijazi, Tan Tse Guan. "An Android Mobile-based Measurement Application – Object and Interior Room Measurement App", International Journal of Interactive Mobile Technologies (iJIM), 2020)
Elcy Tsen Yi Ching, Chin Kim on, Rayner Alfred, Mohd Hanafi Ahmad Hijazi, Tan Tse Guan. "An Android Mobile-based Measurement Application – Object and Interior Room Measurement App", International Journal of Interactive Mobile Technologies (iJIM), 2020

<1% match (student papers from 07-Jan-2022)
Submitted to St. Joseph Academy High School on 2022-01-07

<1% match (K.N. Dominiak, A.R. Kristensen. "Prioritizing alarms from sensor-based detection models in livestock production - A review on model performance and alarm reducing methods", Computers and Electronics in Agriculture, 2017)
K.N. Dominiak, A.R. Kristensen. "Prioritizing alarms from sensor-based detection models in livestock production - A review on model performance and alarm reducing methods", Computers and Electronics in Agriculture, 2017

<1% match (Internet from 24-Jan-2022)
http://infotech-soccult.knukim.edu.ua

PLAGIARISM CHECK RESULT

<1% match (student papers from 11-Sep-2023)
Submitted to The University of Buckingham on 2023-09-11

<1% match (Internet from 03-Feb-2023)
https://drive.uqu.edu.sa/_/juc_computersc/files/Graduation.pdf

<1% match ()
Universiti Teknologi MARA Cawangan Melaka Kampus Jasin, i-JaMCSIIX. "International Jasin Multimedia and Computer Science Invention and Innovation Exhibition (i-JaMCSIIX 2020)", i-JaMCSIIX, Universiti Teknologi MARA Cawangan Melaka Kampus Jasin, 2020

<1% match (student papers from 28-Mar-2023)
Submitted to Da Vinci Institute on 2023-03-28

<1% match (student papers from 03-Jul-2022)
Submitted to Xiamen University on 2022-07-03

<1% match ()
Marcell, Kevin. "ANDROID APPLICATION FOR E-MENU", 2021

<1% match (Hyusim Park, Shanthala Lakshminarayana, Liem H. T. Nguyen, Chenyun Pan, Sungyong Jung. "Portable Indoor Air Quality Measurement System", 2022 E-Health and Bioengineering Conference (EHB), 2022)
Hyusim Park, Shanthala Lakshminarayana, Liem H. T. Nguyen, Chenyun Pan, Sungyong Jung. "Portable Indoor Air Quality Measurement System", 2022 E-Health and Bioengineering Conference (EHB), 2022

<1% match (Reham Alabduljabbar, Raseel Alsakran. "Leveraging IoT to Address Separation Anxiety in Preschoolers: A Techno-Psychological Approach", Electronics, 2023)
Reham Alabduljabbar, Raseel Alsakran. "Leveraging IoT to Address Separation Anxiety in Preschoolers: A Techno-Psychological Approach", Electronics, 2023

<1% match (Internet from 07-Aug-2022)
https://obsproject.com/forum/threads/obs-pixelation.71034/

<1% match (Internet from 16-Jan-2023)
https://vdocument.in/student-attendance-recording-system-woo-wing-hong-a-manual-punch-card-attendance.html

<1% match (Internet from 10-Oct-2013)
http://www.epubbud.com

<1% match (Internet from 26-Apr-2023)
https://www.rfsafe.com/phone/samsung-galaxy-s20-fe/

<1% match (student papers from 17-May-2023)
Submitted to New York Institute of Technology on 2023-05-17

<1% match ("Proceedings of the 4th International Conference on Data Science, Machine Learning and Applications", Springer Science and Business Media LLC, 2023)
"Proceedings of the 4th International Conference on Data Science, Machine Learning and Applications", Springer Science and Business Media LLC, 2023

PLAGIARISM CHECK RESULT

<1% match ()
Williams, Richard Christopher. "Developing open source tools and support materials to measure geographical accessibility to screening and cancer support services", 2021

<1% match (Internet from 25-Apr-2023)
https://vdocuments.mx/eko-verdianto.html

<1% match (student papers from 09-Sep-2023)
Submitted to Brigham Young University, Hawaii on 2023-09-09

<1% match (Internet from 10-Dec-2020)
https://carisinyal.com/hp-samsung-terbaru/

<1% match (Internet from 19-Oct-2022)
http://eprints.usm.my

<1% match (Internet from 18-Apr-2021)
https://heartbeat.fritz.ai/image-classification-on-mobile-with-flutter-tensorflow-lite-and-teachable-machine-f7de39598e0c?gi=11a220a081c3

<1% match (Internet from 31-May-2017)
http://repository.um.edu.my

<1% match (Internet from 22-Nov-2022)
https://su-plus.strathmore.edu/bitstream/handle/11071/6011/MPLS%20%28Multi-Protocol%20Label%20Switching%29%20assisted%20routing%20procedure%20in%20Software%20Defined%20Netw
isAllowed=y&sequence=6

<1% match (Internet from 07-Dec-2020)
https://www.bbc.co.uk/news/live/world-54083725/page/3

<1% match (Internet from 01-Sep-2016)
https://www.scribd.com/document/241403474/Periodontics-Revisited01

PLAGIARISM CHECK RESULT

Form Title: Supervisor's Comments on Originality Report Generated by Turnitin for Submission of Final Year Project Report (for Undergraduate Programmes)			
Form Number: FM-IAD-005	Rev No.: 0	Effective Date:	Page No.: 1of 1

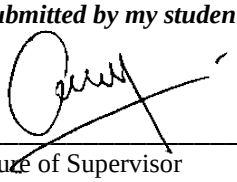
FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

Full Name(s) of Candidate(s)	Yong Chung Wei
ID Number(s)	19ACB06074
Programme / Course	IA
Title of Final Year Project	DEVELOP AN AUGMENTED REALITY MEASURING TOOL FOR MARINE LIFE

Similarity	**Supervisor's Comments (Compulsory if parameters of originality exceed the limits approved by UTAR)**
Overall similarity index: 8 % **Similarity by source** Internet Sources: 5 % Publications: 2 % Student Papers: 6 %	OK
Number of individual sources listed of more than 3% similarity: 0	
Parameters of originality required, and limits approved by UTAR are as Follows: **(i) Overall similarity index is 20% and below, and** **(ii) Matching of individual sources listed must be less than 3% each, and** **(iii) Matching texts in continuous block must not exceed 8 words** ***Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words.***	

Note: Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.



Signature of Supervisor

Name: Ts Dr Cheng Wai Khuen

Date: 13 September 2023

Signature of Co-Supervisor

Name: _____

Date: _____

FYP 2 CHECKLIST

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY
(KAMPAR CAMPUS)

CHECKLIST FOR FYP2 THESIS SUBMISSION

Student Id	19ACB06074
Student Name	Yong Chung Wei
Supervisor Name	Ts Dr Cheng Wai Khuen

TICK (√)	DOCUMENT ITEMS Your report must include all the items below. Put a tick on the left column after you have checked your report with respect to the corresponding item.
√	Title Page
√	Signed Report Status Declaration Form
√	Signed FYP Thesis Submission Form
√	Signed form of the Declaration of Originality
√	Acknowledgement
√	Abstract
√	Table of Contents
√	List of Figures (if applicable)
√	List of Tables (if applicable)
N/A	List of Symbols (if applicable)
√	List of Abbreviations (if applicable)
√	Chapters / Content
√	Bibliography (or References)
√	All references in bibliography are cited in the thesis, especially in the chapter of literature review
√	Appendices (if applicable)
√	Weekly Log
√	Poster
√	Signed Turnitin Report (Plagiarism Check Result - Form Number: FM-IAD-005)
√	I agree 5 marks will be deducted due to incorrect format, declare wrongly the ticked of these items, and/or any dispute happening for these items in this report.

*Include this form (checklist) in the thesis (Bind together as the last page)

I, the author, have checked and confirmed all the items listed in the table are included in my report.

(Signature of Student)
Date: 13 September 2023