CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter discusses the four main project phases which are development of electronics circuit for the micro AUV, development of watertight electronics compartment for micro AUV, simulation of position control of micro AUV using Proportional–Integral–Derivative (PID) controller and the controller development for micro AUV. The flow chart of project methodology will also be discussed in this chapter to showcase the overall project flow.

3.2 Flowchart of Project Methodology

First of all, literature reviews were carried out to get better understanding of AUV in terms of its structure, control and navigation, sensors and power supply. An interview was carried out with Assoc. Prof. Dr. Shahbudin at International Islamic University Malaysia to get the insights of coral reef monitoring project and the need of AUV in the aforementioned project. Existing AUV structure was then modelled in Autodesk Inventor 2016. Electronics circuit and watertight electronics compartment were designed concurrently to suit the existing AUV without any necessary modification. The design was analysed with the built-in stress analysis in Autodesk Inventor check the structural integrity of the compartment. A simplified model of AUV based on the existing AUV was derived and position control of the AUV with PID controller was simulated in Matlab. At the same time, the watertight electronics compartment and electronics circuit were fabricated and assembled to the existing AUV. Microcontroller was further developed to control the AUV through tethered cable for future system identification test.
3.3 CAD Modelling of AUV

An existing AUV as shown in Figure 5 is available in Innovative Manufacturing, Mechatronics and Sports Laboratory (iMAMS Lab) for this project. This existing AUV uses thruster-based dynamic diving principle and it has three thrusters. The single thruster at the end of AUV is responsible for the pitch of the AUV. The two thrusters at the front of AUV are responsible for yaw of the AUV. Roll of the AUV is assumed to be negligible.

Figure 5: Existing AUV in iMAMS Lab
The two PVC tubes placed at the top of AUV contain air to provide neutral buoyancy for the AUV. Prior to diving, the AUV has to tilt by using the single thruster at the end of AUV. Once the AUV is tilted, the two thrusters at the front of AUV will propel forward and the diving process begins. When the desired depth is achieved, the single thruster at the end of AUV reacts to put the AUV into horizontal position as shown in Figure 6.

![Figure 6: The diving process of existing AUV](Image)

Due to poor documentation of the this existing AUV, no dimension of this existing AUV is available for the use during design of watertight electronics compartment. Therefore, the existing AUV was being modelled in Computer-Aided Design (CAD) Software, Autodesk Inventor 2016. The materials of each component of AUV were assigned according to the materials used. The availability of this 3D model eases the work of casing design.

![Figure 7: The 3D Model of existing AUV](Image)