DEVELOPMENT AND ANALYSIS OF AN EMBEDDED SOFTWARE FOR CILI-PADI PICKING ROBOT FRAMEWORK USING MATLAB

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DEVELOPMENT AND ANALYSIS OF AN EMBEDDED SOFTWARE FOR CILI-PADI PICKING ROBOT FRAMEWORK USING MATLAB WHICH HAS BEEN APPROVED BY FACULTY OF ELECTRONIC AND COMPUTER ENGINEERING (FKEKK)

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I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering with Honours.

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DEDICATION

I would want to thank everyone who helped make this project a reality, whether they were directly or indirectly involved. It's possible that I wouldn't have been able to finish all of this work without their help and encouragement. To express my gratitude for Dr. Zarina binti Mohd Noh's trust in me to complete my assigned thesis, I am happy to do so on this occasion. In addition, I would want to express my gratitude to Dr. Wira Hidayat bin Mohd Saad and all of the lecturers that helped me complete this PSM. I'd also like to thank everyone who helped make this assignment possible, especially my lecturer, Dr. Zarina binti Mohd Noh, for the guidance she provided over the course of this assignment and also other lecture who helped me with the PSM and this dissertation are also mentioned. I can't forget to thank my fellow soldiers, who have been a tremendous source of support and collaboration during the course of our mission. Finally, I'd want to thank all of my friends who helped me complete this project. Thanks a lot.

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ABSTRACT

The primary focuses of this research are the development, implementation, and verification of embedded software for robotic systems. The Cili-Padi Picking Robot places a significant amount of attention on being able to function all actuators and sensors by making use of MATLAB and having the ability to communicate with a GUI. However, in order to reach its full potential, the robot needs to be equipped with AI in its visual system so that it can recognise mature chilies. However, the focus of this project is on embedded systems for sensors and actuators in robots. This is accomplished by connecting MATLAB and Arduino so that they are capable of communicating with each other thanks to the utilisation of serial communication, which enables both programmes to send and receive data. Prior to that, it needs to be done for the purpose of robot analysis, which includes determining what actuators and sensors are utilised as well as what data will be used regardless of whether or not the parameters are modified. Additionally, this results in the formation of many subdivisions for the system that is integrated into the robot. Systems comparable to these include a manual navigation system, a Robot Arm system, a visual robot system to detect Chile, as well as other systems of a similar nature.

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ABSTRAK

Fokus utama penyelidikan ini ialah pembangunan, pelaksanaan dan pengesahan perisian terbenam untuk sistem robotik. Robot Pemetik Cili Padi memberi perhatian yang besar kepada keupayaan untuk berfungsi semua penggerak dan penderia dengan menggunakan MATLAB dan mempunyai keupayaan untuk berkomunikasi dengan GUI. Bagaimanapun, untuk mencapai potensi sepenuhnya, robot itu perlu dilengkapi dengan AI dalam sistem visualnya supaya ia dapat mengenali cili matang. Walau bagaimanapun, tumpuan projek ini adalah pada sistem terbenam untuk penderia dan penggerak dalam robot. Ini dicapai dengan menyambungkan MATLAB dan Arduino supaya mereka mampu berkomunikasi antara satu sama lain berkat penggunaan komunikasi bersiri, yang membolehkan kedua-dua program menghantar dan menerima data. Sebelum itu, ia perlu dilakukan untuk tujuan analisis robot, termasuk menentukan apakah penggerak dan penderia yang digunakan serta apakah data yang akan digunakan tanpa mengira sama ada parameter diubah suai atau tidak. Selain itu, ini mengakibatkan pembentukan banyak subbahagian untuk sistem yang disepadukan ke dalam robot. Sistem yang setanding dengan ini termasuk sistem navigasi manual, sistem Lengan Robot, sistem robot visual untuk mengesan Chile, serta sistem lain yang serupa.

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LIST OF SYMBOLS AND ABBREVIATIONS

ROS	:	Robot Operating System
GUI	:	Graphical User Interface
TICS	:	Task-Instruction-Contingency-Shaping

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CHAPTER 1

INTRODUCTION

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This chapter describes the idea general idea for this project which includes the background of the project, problem statement, objectives, scope of the project, and the report outline.

1.1 Project Background

"Industry 4.0" refers to the transition to cyber-physical systems, which marks the fourth major industrial revolution [1]. In the forth industrial revolution, the application of robot had been widely accepted to ease the work in the industry such as for agriculture propose. Because of this, the goal of this project is to find solutions to the challenges faced in the agriculture by constructing a robot structure with the capability of assisting farmer in tasks that can reducing their workload and reducing the amount of time they spend on such tasks. Therefore, this project is about how to build a robot framework through embedded software. By using the appropriate software to integrate the software for agriculture purpose, specifically for Cili Padi Picking Robot.

Selection of the right framework and middleware for software and hardware integration is a difficult process that can have far-reaching consequences for any robotics framework. In most cases, computational and memory resources are limited in the robotics software. The goal of this project is to create a framework through which embedded software like MATLAB can communicate to hardware like Arduino and demonstrate its application for robot's framework that can be used in agriculture. This project is also to run simulations with software and hardware also involve software simulation and hardware demonstration in real-world environment.

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1.2 Problem Statement

Malaysia should encourage rice and chilli farming due to its struggling economy [2]. An increasing population and worldwide market demand agricultural products. Malaysia needs a more advanced and reliable food production system to address food sustainability and minimize dependence on imported basic food supply.

Upgrade seeds, pesticides, insecticides, fertilizers, and farming procedures. After locating the chili, the robot arm can pick up the plants one by one. The robot's durability and endurance will outperform a human's speed. Preventing chilies from bruising and lowering crop quality depends on the robot arm and fruit picking process.

Robots are made up of numerous functional components and require a variety of specific talents. These algorithms may be tested in either a simulated or real-world environment. An experimental setup with real parts can be used to test a design, but this approach is both costly and limiting in terms of exploratory study. In addiction it is performed time-consuming to design a robot since each component has a distinct function, such as developing architecture robots, creating visual images, and creating arm robots. Hence, a simulation framework can cut down on the time, effort, and money needed to demonstrate working prototype of robot software [3].

In this project, the simulate framework will be integrated hardware involved in an embedded software to keep track of robot's system. The robotic system demonstrated of this prototype with utilized the Cili Padi Picking Robot, as an example one of the systems that can be used in agriculture.

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1.3 Objectives

The objectives of this project are to:

1. Analyze and broken down a Cili-Padi Picking robot framework large systems into smaller and more manageable pieces.

2. Develop an embedded software part of the Cili-Padi Picking robot function using MATLAB software (Simulink and App Designer) that can be interfaced with Graphical User Interface (GUI).
3. Demonstrate the functionality of the embedded software in real time.

1.4 Scope of Project

The scope of this project to analyses a robotic framework of a Analysis part of Robot Cili-Padi Picking Robot and develop its framework through the use of MATLAB Simulink software communicate the Arduino using serial communication and freeRTOS. The hardware prototype of the robot demonstration within the Arduino board as its base platform.

1.5 Report Outline

The information presented in this report on the project is broken up into five chapters which are the introduction, the background study, the methodology followed by the results and the discussion, and the conclusion. In chapter 1, the description of the ideal and concept for robot agriculture and explanation step by step to analysis and develop the robot framework. This is followed the project background, problem statement, objective and scope of project.

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In Chapter 2 focused on the literature review or background study on robotic framework and embedded software using MATLAB software. In explanation for this comparison of previous research papers concerning the framework and application.

In chapter 3 is a focus in methodology content to achieve the objective project. This is followed by objective 1, the explanation on how analysis of Cili-Padi picking robot framework. In objective 2 show the step to develop embedded software and

hardware interface using MATLAB. And objective 3 is the final step how embedded software can run in real time in hardware.

Chapter 4, as where the result show achieves of the objective project. Result in objective 1 with analysis of Cili-Padi picking robot framework and can defined which actuators and sensor has been used and parameter has been used. Next, the objective 2, result show the develop embedded software interfaced with hardware and software communicate to produce GUI. Lastly objective 3 show the result functionality of embedded software in real time.

Finally, chapter 5. conclusion and future works towards the project. At conclusion will explained the objective project has been successful. This also explained the limitation that project face and can explained the solve at future work.

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CHAPTER 2

BACKGROUND STUDY

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This chapter focuses on research on the development and analysis of embedded software for a robot. First, research about robotic frameworks and their applications Second, the basic embedded software for robots and robot functionality. Finally, a robot's software architecture and programming.