



Faculty of Computer Science and Information Technology

***DEVELOPING LEAF IDENTIFICATION MOBILE  
APPLICATION FOR FRST PLANTATION STUDY USING  
CONVOLUTIONAL NEURAL NETWORK***

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71318

Bachelor of Computer Science with Honors

(Software Engineering)

2023

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This project is submitted in partial fulfillment of the requirements for the degree of Bachelor of  
Computer Science with Honours (Software Engineering)

Faculty of Computer Science and Information Technology  
UNIVERSITY MALAYSIA SARAWAK  
2023

**MEMBANGUNKAN APLIKASI MUDAH ALIH PENGENALAN DUAN UNTUK FSTS  
TUMBUHAN PELAJARAN DENGAN MENGGUNAKAN RANGKAIAN SARAF  
KONVOLUSI**

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Projek ini merupakan salah satu keperluan untuk Ijazah Sarjana Muda Sains  
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## ABSTRACT

*Malaysia is one of the countries well-known for abundant biodiversity, especially in Sarawak state, which has been internationally recognised as one of the famous biological hot spots. To investigate biodiversity, many local educational institutions such as UNIMAS have offered courses in natural science. Practical training is also provided for students to enhance their learning experience and gain natural science-related knowledge. However, students of the Faculty of Resource and Technology (FRST), UNIMAS still faced difficulties to identify plant species with conventional approaches. In this project, a mobile leaf identification application named SarawakPlant is proposed to facilitate FRST students who study plant science to identify species of plants effectively and innovatively. This application works by capturing a picture of a leaf through the camera on Android mobile devices. This function is achieved by using the object-detection technique to extract characteristics such as the shape of a leaf and using this captured information to match through the pre-trained dataset. This pre-trained dataset would be taken from the Google image. The matched data with high accuracy will be returned to the users. This application is developed by using TensorFlow Lite and Android Studio. Moreover, supervised learning is applied in this leaf identification mobile application to integrate with the pre-trained dataset. Lastly, this system aims to engage students and assist them to have higher accuracy in plant species identification.*

## ABSTRAK

*Malaysia merupakan salah sebuah negara yang terkenal dengan kepelbagaian biodiversiti terutamanya negeri Sarawak yang telah diiktiraf sebagai satu kawasan biologi yang terkenal di peringkat antarabangsa. Untuk mengkaji dan menyelidik biodiversiti, banyak institusi pendidikan tempatan seperti UNIMAS telah menawarkan mata pelajaran sains semula jadi. Latihan amali juga disedia untuk pelajar bagi meningkatkan pengalaman pembelajaran mereka dan membantu mereka memperoleh pengetahuan tentang sains semula jadi. Bagaimanapun, pelajar Fakulti Sains dan Teknologi Sumber (FSTS), UNIMAS masih menghadapi kesukaran untuk mengenal pasti spesies tumbuhan. Dalam projek ini, aplikasi pengenalan daun mudah alih yang bernama SarawakPlant dicadangkan untuk memudahkan pelajar FSTS yang mempelajari sains tumbuhan untuk mengenal pasti spesies tumbuhan dengan cara yang berkesan dan inovatif. Aplikasi ini berfungsi dengan menangkap gambar daun melalui kamera pada peranti mudah alih. Aplikasi ini berfungsi dengan menggunakan teknik pengesanan objek untuk mengekstrak ciri seperti bentuk daun lalu memadankan maklumat yang ditangkap ini dengan set data yang telah dilatih. Set data pra-latihan ini akan menggunakan imej Google. Data yang dipadankan dengan ketepatan yang tinggi akan dikembalikan untuk kegunaan keputusan pengenalan. Aplikasi ini dibangunkan dengan menggunakan TensorFlow Lite dan Android Studio. Selain itu, pembelajaran terselia digunakan dalam aplikasi pengenalan tumbuhan mudah alih ini untuk disepadukan dengan set data terlatih. Akhir sekali, sistem ini bertujuan untuk memberikan penglibatan kepada pelajar dan membantu mereka mendapat ketepatan yang lebih tinggi dalam pengenalan spesies tumbuhan.*



## CHAPTER 1: INTRODUCTION

### 1.0 Introduction

Malaysia is a country well-endowed with a variety of biological resources, especially in Sarawak, which has gained international recognition as one of the twenty-five biological hot spots due to its abundant biodiversity and distinctive ecosystems (Poh & Ryan, 2014). According to Adom, Umachandran, Ziarati, Sawicka and Appiah (2019), the word ‘biodiversity’ refers to biological diversity, it encompasses all species of fauna and flora in different kinds of habitats. Fauna refers to all the animals in an ecosystem whereas flora is the plant life in an ecosystem (Nelson, 2017). Plant life undertakes an important role in sustaining the rest of life in the ecosystem by providing food and energy. In Malaysia, there are an estimated 15,000 species of vascular plants (plants with xylem tissues and phloem tissues for transporting water and food), of which about 12,000 species are in Sarawak and Sabah (Saw & Chung, 2015). With the diversity of ecology in our country, natural science becomes an interesting field to be investigated.

To explore the biodiversity in Malaysia, many local educational institutions have offered natural science courses which include Botany, Horticulture, Agricultural Science, Applied Plant Science, etc. Besides, local education institutions also provide practical training for students to enhance their learning experience. With this effort, students not only can learn natural science knowledge from the lectures and field trips but also be given a chance to apply their knowledge during the training. However, plantation study is still difficult to appreciate due to traditional teaching methods and huge learning materials. Conventionally, students are taught to identify the plants by comparing them with the image and characteristics provided in the reference books or learning materials available on the internet. This could make the identification process becomes tedious and time-consuming since students must read through

many learning materials to accurately identify the plant species. Therefore, advanced technology is highly recommended to be integrated into this learning environment to promote engagement and improve students' learning experience.

According to Phang and Kamsin (2022), the rapid growth of technology and the evolution of the 5G system has made so many fields begin to transform into technological elements, including the education field. As a result, mobile devices slowly becoming vital in the current education system. This simultaneously leads the learning process in natural science with an emphasis on botany being transformed from the conventional learning context into an innovative way through the development of mobile systems (Dias & Victor, 2017). Conventionally, biology students use textbooks in the field and in courses to identify species instead of employing mobile application tools. This traditional species identification method might be boring, time-consuming, and lower degree of accurate identification of sedges (Jeno et al., 2017). Therefore, it is possible that mobile and artificial intelligence technology could be integrated and developed to support local plantation studies.

This project introduces an alternative way to facilitate students in learning plantation knowledge with a leaf identification mobile application. This application works by detecting and identifying the leaf's image through the camera on the mobile device without the use of the internet. It is developed with a convolution neural network (CNN), python programming, and an Android system. This application is believed can enhance students' interest in plantation study as well as help researchers to do better studies on local botanicals.

## **1.1 Problem Statement**

The purpose of teaching natural science at the Faculty of Resource Science and Technology (FRST) at the University Malaysia Sarawak (UNIMAS) is to introduce students to the value of biodiversity. However, fewer reading resources and learning hours have become a challenge for students to study botany. From the survey, students of Plant Science and Management indicate that botany as being challenging to study because most of the plants have similar characteristics or outlooks. Although plantation identification applications do exist, however, they are mostly developed by other countries and are not relevant in the Sarawak context. Therefore, it is necessary to build a leaf identification mobile application with a local context to complement the learning in botany.

## **1.2 Objectives**

1. To design and develop an automatic leaf identification application in Android to facilitate FRST students in studying plant science subject.
2. To develop a leaf identification application that is relevant to the Sarawak botany context.
3. To evaluate the accuracy of the proposed system in identifying the plant species as well as its usability for FRST students in plantation study.

### 1.3 Methodology

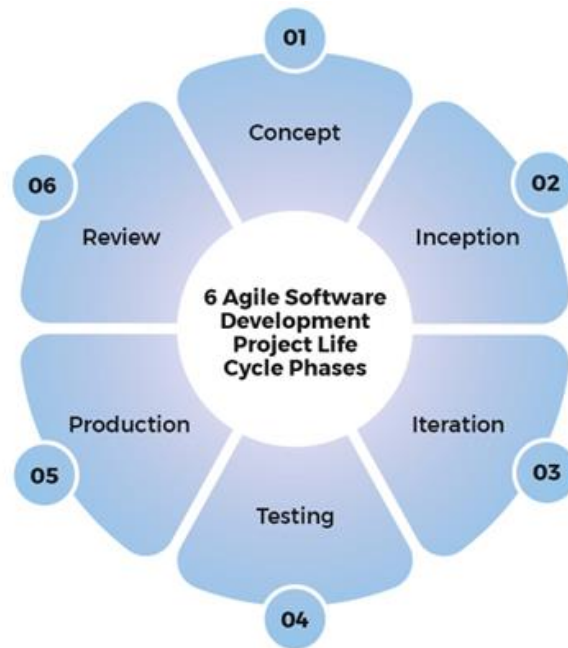


Figure 1.0: Life Cycle of Agile Methodology (Ihor, 2022)

An agile methodology is adopted in developing the proposed application. The agile methodology is chosen in this project due to its simplicity and flexibility for a future update or harnessing change for a competitive advantage. These make it highly adaptable in developing a high-demand and competitive mobile application. Besides, the agile methodology also minimises overhead costs as it possesses the principles of satisfying customers through early and continuous delivery of valuable work. The agile methodology ensures a high-quality final product produced as user feedback is a core component throughout the development. The agile methodology framework used in this project is the Kanban framework. The Kanban framework is chosen as it provides better visibility of how the tasks are moving through the process. It helps improve productivity by shifting the focus from starting work to finishing work. The following section depicts the tasks conducted in each phase.

### **1.3.1 Concept**

The concept phase is also known as the requirement phase. In this phase, a survey is conducted. The user requirement is collected and analysed to envision a potential project to aid FRST student in learning botany. The scope of the project and the expected functionalities of the proposed application are determined.

### **1.3.2 Inception**

In this phase, an initial architecture for the mobile application is built to tackle the requirements. The user interface (UI) of the proposed mobile leaf identification application is mocked-up and reviewed by the users.

### **1.3.3 Iteration**

Iteration is also known as the construction or development phase. This phase is divided into several modules which include the application interface, image recognition, pre-trained database, and system integration. Developing and testing is carried out repeatedly in each module, and eventually, all the modules will be integrated as one system. During this phase, regular delivery of working modules to users and various revision is carried out to ensure the quality of the product.

#### **1.3.4 Testing**

Quality assurance testing of the product is performed to ensure the application is bug-free and evaluate if the product complies with the end-user requirements, and if the product is ready for deployment.

#### **1.3.5 Production**

During this phase, the mobile leaf identification application is fully deployed and available for users. In order to ensure the application runs smoothly, is useful, and is productive after being deployed, ongoing support is required to assist users in using the product.

#### **1.3.6 Review**

Once all the previous phases are successfully completed, the progress toward accomplishing the requirements and stakeholders' feedback is reviewed. After this, the agile development life cycle starts a new iteration.

### **1.4 Project Scope**

This application is only focused on vascular plants in Sarawak. Secondly, this application only targets Android platform smartphones, Thirdly, the system is implemented with the object detection technique on plants' leaves using TensorFlow Lite. Lastly, the target users for this application are mainly students taking Plant Resource and Management at FRST, UNIMAS, and any university students who are interested in plantation study.

### 1.4.1 System Environment

Table 1.0 below shows the hardware and software to be used to design, develop and implementation for leaf identification mobile applications.

Table 1.0: System Environment for Leaf Identification Mobile Application

Hardware	Laptop and Android phone <ul style="list-style-type: none"><li>• A platform used to design and develop the application.</li></ul>
Software	Google Colaboratory <ul style="list-style-type: none"><li>• A free web IDE for python that supports free GPU and storage.</li></ul> TensorFlow Lite <ul style="list-style-type: none"><li>• An open-source cross-platform deep learning framework that converts a pre-trained model to a special format that can be optimised for speed or storage.</li></ul> Android Studio <ul style="list-style-type: none"><li>• An IDE for Android app development.</li></ul>

### 1.5 Significant of Project

This project encourages the use of mobile devices to assist students who are interested in plantation study at FRST, UNIMAS. This is crucial to enhance FRST students' interest and engagement in learning natural science focusing on botany.

# 1.6 Project Schedule

Developing Leaf Identification Mobile Application for FRST Plantation Study Using Convolutional Neural Networks

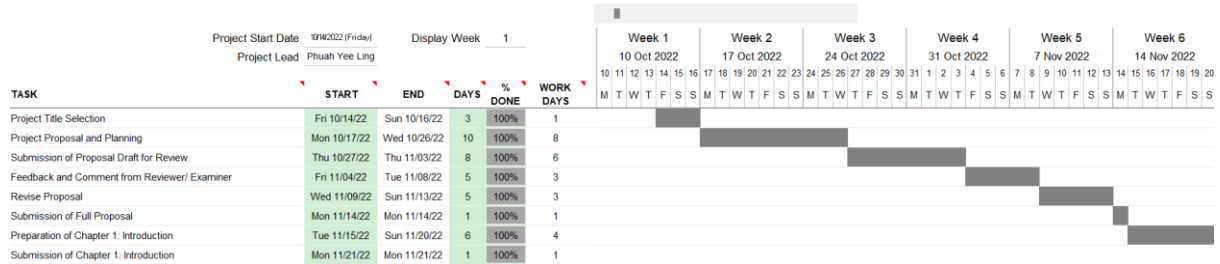


Figure 1.1: Gantt Chart for Developing Leaf Identification Mobile Application for FRST Students Using Convolutional Neural Network

Developing Leaf Identification Mobile Application for FRST Plantation Study Using Convolutional Neural Networks

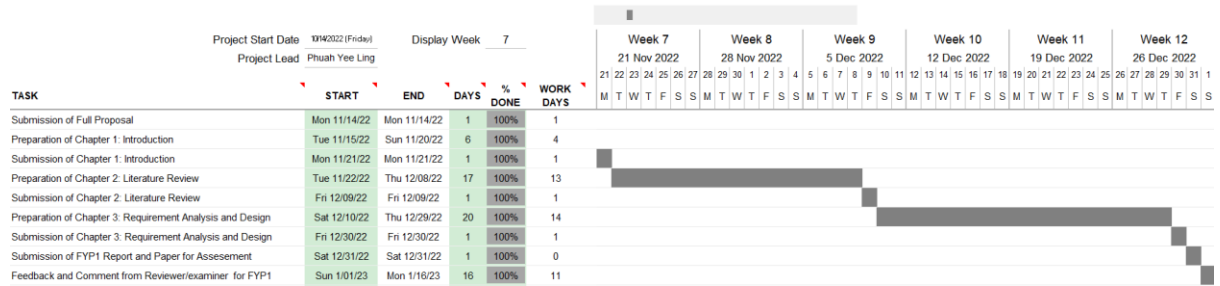


Figure 1.2: Gantt Chart for Developing Leaf Identification Mobile Application for FRST Students Using Convolutional Neural Network (Cont'd)

Developing Leaf Identification Mobile Application for FRST Plantation Study Using Convolutional Neural Networks

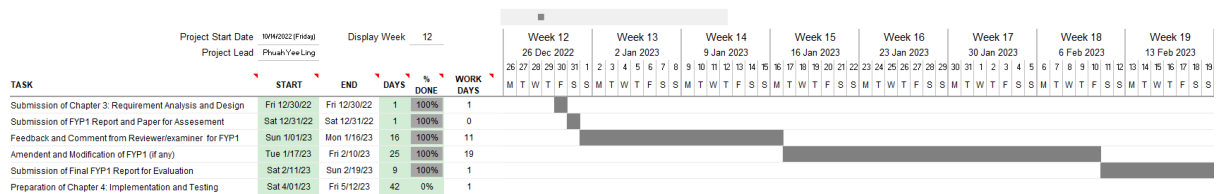


Figure 1.3: Gantt Chart for Developing Leaf Identification Mobile Application for FRST Students Using Convolutional Neural Network (Cont'd)