Fakulti Sains Komputer Dan Matematik

Tarikh Kuatkuasa: 1 Oktober 2021

SENARAI SEMAK PERMOHONAN SEMAKAN ETIKA FSKM

Panduan kepada Pemohon:

Bil.	Tindakan/Dokumen yang Diperlukan	Tandakan (√)
1.	Pastikan permohonan lengkap dengan menyertakan dokumen sokongan di bawah: i. Exemption- Senarai Semak Permohonan ii. FERC/BERC 4 iii. Proposal	✓
2.	Dokumen yang perlu ditandatangani oleh pemohon/ *Supervisor*/ *Internal Assessor* hendaklah dalam bentuk pdf.	✓
3.	Permohonan yang dihantar kepada *Person in Charge* (PIC) hendaklah dalam bentuk **single pdf** bagi seorang pemohon.	✓
4.	Aturan dokumen dalam **single pdf** hendaklah mengikut susunan berikut: I. Exemption - Senarai Semak Permohonan II. FERC/BERC 4 III. Proposal	✓
5.	Dokumen **single pdf** perlu dinamakan seperti format berikut: **KOD PROGRAM_NAMA PELAJAR/GROUP_NO PELAJAR_MR/MMR**	✓

Dikemukakan oleh (Pemohon):	Perakuan Penerimaan (Pejabat PJI)
syukri --- Tandatangan: Nama: MUHAMAD SYUKRI BIN ISHAK Tarikh: 11/2/2022	--- Tandatangan: Nama: Tarikh:

***Nota**: Sekiranya permohonan yang dikemukakan tidak lengkap dan tidak mematuhi Template Seragam Senarai Semak Dokumen dan Senarai Semak Terperinci, pihak Pejabat Penyelidikan dan Jaringan Industri (PJI) berhak untuk menolak/membatalkan permohonan.*

FERC/BERC 4

Faculty/Branch Ethics Review Committee
Universiti Teknologi MARA

Application for Exemption from Ethical Review
Permohonan Pengecualian daripada Penilaian Etika

Please attach a copy of the Research Proposal.
Sila lampirkan salinan kertas cadangan penyelidikan.

Part A : Details of Researcher
Bahagian A: Maklumat Penyelidik

Title of Research Project : *Tajuk Penyelidikan*	Animals Image Recognition Using Convolutional Neural Networks
Name of Student : *Nama Pelajar*	MUHAMAD SYUKRI BIN ISHAK
Name of Supervisor : *Nama Penyelia*	DR. NORMALY KAMAL ISMAILI
Address of Department/ Institute : *Alamat Jabatan/ Institut :*	FACULTY OF COMPUTER SCIENCE AND MATHEMATICS, UNIVERSITI TEKNOLOGI MARA SHAH ALAM, 40450 SHAH ALAM, SELANGOR
Te. No/ Email : *No.Telefon/ Emel:*	01137692762/2020872296@student.uitm.edu.my

☑ Undergraduate / *Sarjana Muda*
☐ Postgraduate by Coursework/ *Pasca Siswazah Kerja Kursus*

Part B : Research Details

Bahagian B: Maklumat Penyelidikan

Executive summary
(Please include research justification, objectives, research methodology, significance, risks)

Ringkasan eksekutif
(Sila masukkan justifikasi, objektif, metodologi, kepentingan dan risiko penyelidikan)

1. **Research Justification**
   Justifikasi Penyelidikan

   To develop an application that can help people differentiate the species of the animal and get their informations by using images and deep learning methods.

2. **Research Objectives**
   Objektif Penyelidikan
   1. To study suitable neural network methods to classify animals using images.
   2. To develop a system that can recognize animals and get information about them.
   3. To test that developed system.

3. **Research Methodology (including sample size, if applicable)**
   Metodologi Penyelidikan (termasuk saiz sampel, sekiranya ada)

   The research methodology will be the waterfall methodology. This model is a sequential software development process in which progress is seen as steadily falling downwards like a waterfall through the phases of Requirement, Data Collection, System Design, Implementation, Testing, and Maintenance.

Requirement Analysis and Planning	To properly execute the project with the least level of risk, the technical feasibility study must identify the several technological approaches that might be applied.
Data Collection	Google Photos images will be utilized as the datasets for training the image classification model, with images from Google Images serving as the source of the datasets for training. There will be more than 1000 datasets that will be used for this application.
System Design	An initial design of the project's purpose and goals, as well as its general traffic flow, is

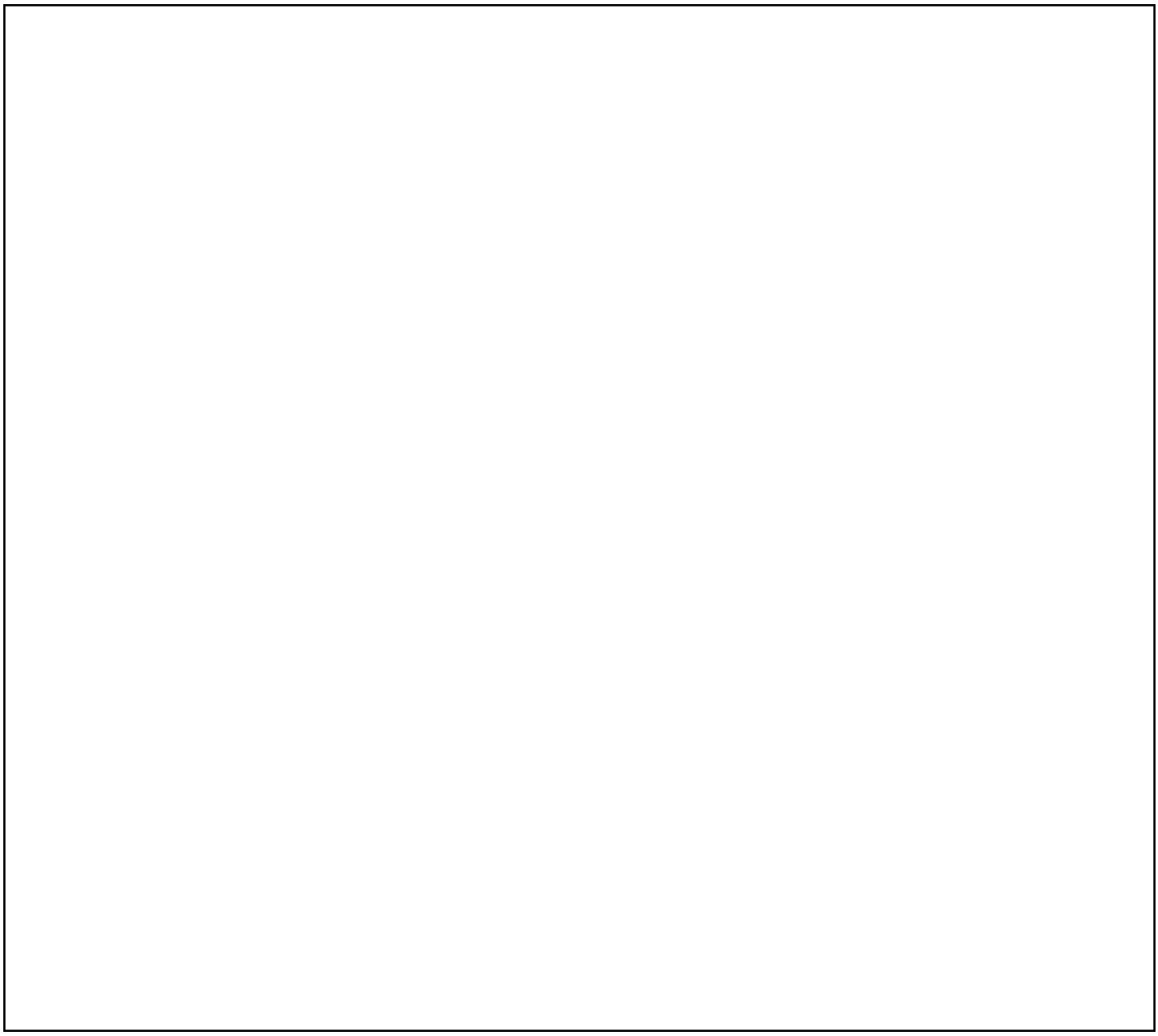
	created to establish the project's overall purpose and goals
Implementation	For the implementation phase, all systems based on the requirements from the system design such as login/registration, nearest zoo location and animal classification will be developed, then integrate all the systems together
Testing	Test the functionality of the system

4. **Research Significance**
   Kepentingan Penyelidikan

   The significance of the research is that it may aid anyone in improving their awareness of animals, especially children who are naturally interested in their surroundings. Information on the animals will be offered in the application and presented to users when the photograph has been analyzed and is deemed suitable for display. This research will also provide individuals with new methods to connect with nature via their smartphones, which they will be able to use from anywhere and at any time. Finally, visitors to the zoo may keep their social distance and feel safer by not congregating in a large group of individuals while at the zoo.

5. **Research Risks**
   Risiko Penyelidikan

   Minimal Risk



Part C : Justification for Exemption from Ethical Review (tick where applicable, can be more than one)
Bahagian C: Justifikasi Pengecualian daripada Semakan Etika (tandakan yang berkenaan, boleh melebihi daripada satu)

C1	**This research does not involve:** ***Penyelidikan ini tidak melibatkan:***	*YES* *Ya*	*NO* *Tidak*
1.	Human participants, human tissues and/or biological samples. *Penyelidikan ini tidak melibatkan peserta manusia, tisu manusia dan/atau sampel biologi.*		✓
2.	Collecting sensitive* and identifiable secondary data of an individual. *Mengumpul data sekunder yang sensitif * dan yang dapat dikenal pasti identiti individu.*		✓
3.	Collecting sensitive* data of an individual or organization that reflects these attributes: ● Corruption - *Rasuah* ● Fraud or cyber fraud - *Penipuan atau penipuan siber* ● Specific-entity review - *Ulasan entiti khusus* ● Vulnerable group - *Kumpulan rentan*		✓

C2	**This research involves:** ***Penyelidikan ini melibatkan:***	Tick where applies *Tandakan yang berkenaan*
1.	**Content analysis / textual analysis / meta-analysis**. (E.g.: non-identifiable data lawfully collected, public/private records, published/unpublished reports, and documents available in libraries, repositories, archives, websites. *Penyelidikan ini melibatkan analisa kandungan / teks / meta-analisis. (Contoh: pengumpulan data yang tidak akan dapat dikenal pasti identiti diperolehi secara sah daripada rekod awam / swasta, laporan yang diterbitkan / tidak diterbitkan, dan dokumen yang terdapat di perpustakaan, repositori, arkib, laman web.*	✓
2.	**Case study / doctrinal study / policy study** that utilizes a qualitative approach that does not involve human participants / sensitive* / identifiable data of an individual. *Kajian kes / kajian doktrin / kajian dasar yang menggunakan pendekatan kualitatif serta tidak melibatkan peserta manusia / data sensitif * / data yang dapat dikenal pasti identiti individu.*	NA
3.	**Concept Paper** which synthesizes knowledge from a previous study on a particular topic and presents it in a new context with the aim of fulfilling	NA

	knowledge gaps. This research does not involve human participants and does not collect sensitive* and / identifiable data of an individual. *Kertas konsep yang mensintesis pengetahuan dari hasil kajian lampau mengenai topik tertentu dan membentangkannya dalam konteks baru dengan tujuan merapatkan jurang pengetahuan. Penyelidikan ini tidak melibatkan peserta manusia dan tidak mengumpulkan data sensitif * dan / data yang dapat dikenal pasti identiti individu*	
4.	**Market survey, opinion poll / online vote, and consumer acceptability tests** that do not collect sensitive* and / identifiable data of an individual. *Tinjauan pasaran, persepsi / undian dalam talian, dan ujian penerimaan pengguna yang tidak mengumpulkan data sensitif * dan / data yang dapat dikenal pasti identiti individu.*	NA
5.	**Observational studies** based on video recording obtained from public domains that do not collect sensitive* and / identifiable data of an individual. Kajian pemerhatian berdasarkan rakaman video yang diperolehi daripada domain awam yang tidak mengumpulkan data sensitif * dan / *data yang dapat dikenal pasti identiti individu*.	NA
6.	**Filming of documentary / documentation of cultural / traditional practices** that have obtained prior approval from the relevant parties / authorities and does not collect sensitive* and / identifiable data of an individual. (*random video/photo) *Penggambaran dokumentari / dokumentasi amalan budaya / tradisi yang telah mendapat persetujuan daripada pihak berkenaan / berkuasa dan tidak mengumpulkan data sensitif * dan / data yang dapat dikenal pasti identiti individu.*	NA
7.	**Quality assurance purposes** (e.g., clinical audit, communication audit, compliance audit) related to the evaluation of public service programs, public health surveillance, educational evaluation. *Aktiviti untuk tujuan jaminan kualiti (contoh: audit klinikal, komunikasi, pematuhan) yang berkaitan dengan penilaian program perkhidmatan awam, surveilan kesihatan awam, penilaian pendidikan.*	NA
8.	**Others** (provide details): *Lain-lain (nyatakan butiran):*	NA

Part D: Agreement to Conduct the Research Project
Bahagian C: Pengesahan Persetujuan Menjalankan Penyelidikan

Must be completed and signed by all members of the research group.
Mesti dilengkapkan dan ditandatangani oleh semua ahli kumpulan penyelidikan.

1. Student (to be filled by Undergraduate/Post-graduate by Coursework Student only)
   Pemohon (untuk dilengkapkan oleh Pelajar Siswazah / Pasca-siswazah Kerja Kursus sahaja)

Staff ID/Student ID: *No.Staf/No. Pelajar:*	2020872296	
Mobile phone: *Telefon bimbit:*	01137692762	
Email: *Emel:*	2020872296@student.uitm.edu.my	
Signature: *Tandatangan:*	syukri	**Date:** *Tarikh:* 11/2/2022

2. Supervisor
   Penyelia

Staff ID/Student ID: *No.Staf/No. Pelajar:*	114572	
Mobile phone: *Telefon bimbit:*	0163427569	
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Signature: *Tandatangan:*		**Date:** *Tarikh:* 10/3/2022

Dr. Normaly Kamal Ismail
Pensyarah
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Universiti Teknologi MARA Malaysia
40450 Shah Alam
Selangor

Part E: Verification from Department or Postgraduate Research Committee
Bahagian D: Pengesahan Jawatankuasa Penyelidikan Jabatan atau Pascasiswazah

The Department or Postgraduate Research Committee has reviewed the study protocol and recommends for exemption from ethical review.
Jawatankuasa Penyelidikan Jabatan atau Pascasiswazah telah mengkaji protokol kajian dan mengesyorkan untuk pengecualian daripada semakan etika.

Signature *Tandatangan:* **Undergraduate / Postgraduate / Research Coordinator** *Koordinator Peringkat Pra-siswazah/Pasca-siswazah/Penyelidikan*	**Official stamp***:* *Cop rasmi***:**	**Date***:* *Tarikh***:**

UNIVERSITI TEKNOLOGI MARA

ANIMALS IMAGE RECOGNITION USING CONVOLUTIONAL NEURAL NETWORKS (CNN)

MUHAMAD SYUKRI BIN ISHAK

BACHELOR OF COMPUTER SCIENCE (HONS.)

MARCH 2022

Universiti Teknologi MARA

ANIMALS IMAGE RECOGNITION USING CONVOLUTIONAL NEURAL NETWORKS (CNN)

MUHAMAD SYUKRI BIN ISHAK

Thesis submitted in fulfilment of the requirements for Bachelor of Computer Science (Hons.) Faculty of Computer and Mathematical Sciences

March 2022

SUPERVISOR APPROVAL

ANIMALS IMAGE RECOGNITION

USING CONVOLUTIONAL NEURAL NETWORKS

(CNN)

By

MUHAMAD SYUKRI BIN ISHAK

2020872296

The thesis was prepared under the supervision of the project supervisor, Dr Normally Kamal Ismail. It was submitted to the Faculty of Computer and Mathematical Sciences and was accepted in partial fulfilment of the requirements for the degree of Bachelor of Computer Science (Hons.).

Approved by

……

Dr Normally Kamal Ismail

Project Supervisor

MARCH 23, 2022

STUDENT DECLARATION

I certify that this thesis and the project to which it refers is the product of my own work and that any idea or quotation from the work of other people, published or otherwise are fully acknowledged in accordance with the standard referring practices of the discipline.

……

MUHAMAD SYUKRI BIN ISHAK

2020872296

MARCH 23, 2022

ACKNOWLEDGEMENT

Alhamdulillah, thanks to Allah's Almighty and His uttermost, and praise Him. Thank you for the grace of finishing research on time. As a result, I'd want to use this research to convey my deepest gratitude to each one of the people that inspired me to complete this project. In the first place, I would like to express my gratitude to my supervisor, Dr Normaly Kamal Ismail, who helped me with my project by contributing, encouraging me, and assisting me with the composition and completion of this project. Throughout the course of this project's implementation, he gave me with the most valuable inspiration and guidance. Finally, I'd want to thank all the individuals who have helped and advised me during this project's completion. Thank you to everyone who was involved in any way, even if their names weren't included here.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

This chapter's objective is to provide background information and justify the inquiry. It dives into the global issues before laying out the problem statement that inspired the undertaking in the first place. This chapter goes deep into the project's purpose and aims before moving on to the scope and relevance of the project. Finally, a summary of the topics of this chapter is provided.

1.1 Project Background

To make their lives easier, people in the contemporary day use a wide range of technological innovations. As one of the technologies, Artificial Intelligence has been employed in a wide range of industries, including business and finance; health and education; banking and autonomous vehicles. AI systems are capable of learning and adapting. In response to AI's ability to process vast volumes of data faster and more accurately than humans, artificial neural networks and deep learning AI are rapidly advancing. In contrast to a human researcher, AI systems that apply machine learning can swiftly translate large amounts of data into meaningful information (Ed Burns, Nicole Laskowski, Linda Tucci, 2021). Image recognition may benefit from the use of convolutional neural networks (CNN), a deep learning approach. This sort of deep learning neural network is termed a convolutional neural network. Image recognition has taken a major leap forward thanks to CNNs. When it comes to image recognition, they're often used to look at visuals and analyse them. Ecologists are becoming interested in convolutional neural networks (CNNs) and other deep learning approaches. There are a broad range of data types that may be analysed with the use of these tools, including abundance of species, behaviour, and even images and audio (AC Ferreira, 2020).

There's also some information in this chapter on how the pandemic Covid-19 affected Malaysian zoos. Those who have received a full vaccination from the Malaysian authorities are allowed to enter the country. Prime Minister Datuk Seri Ismail Sabri Yaakob made the declaration as the nation prepared to face the endemic phase soon. Many tourist attractions, including Malaysia's zoos, have reopened because of the news. Visitors began forming outside the ticket office at 7 a.m. when Zoo Negara reopened after a four-month hiatus. Visitors flocked to Zoo Negara on the first day of the reopening in record numbers, according to vice president Rosly@Rahmat Amat Lana of the organisation. Five to a thousand visitors were anticipated on the first day of operation." At 3 p.m., we'd already had more than 1,000 visitors," he said (TheStar, 2021). After almost 10 months of shutdown owing to the Covid-19 outbreak, the Melaka Zoo hopes to return to the public by the end of this week. Datuk Shadan Othman, head of the Hang Tuah Jaya Municipal Council, stated, "We hope to have guests by Friday (Oct 1)." (TheStar, 2021). Zoos should anticipate many tourists who have been cooped up in their homes for some time. The Kementerian Kesihatan Malaysia (KKM) normal operating practices, such as social distance, cleaning hands constantly, and wearing masks, must still be adhered to. To stop the development of the Covid-19 epidemic in the state, everyone must take responsibility for their actions by following the Standard Operating Procedure (SOP) (BeritaHarian, 2021).

1.2 Problem Statement

Animal knowledge is essential for us as humans who live in a world with other species. As humans, researcher also need to require knowledge about animals and the ability to distinguish between species. However, some people, particularly toddlers and teens, do not take this topic seriously and are still unable to distinguish between animals. Several European experts have expressed worry over the lack of awareness about common animals among today's youth. (Tuula H. Skarstein, 2019). Furthermore, there was a significant difference in species literacy between professionals and laypeople. Children's knowledge of common, native animals was notably lacking, with only 35% of the species correctly named on average (Vincent Devictor, Amanda Bates & Graeme Cumming, 2017). The reason why this situation is happening is because children did

not get enough knowledge and information about animals. To solve these problems, building an app that can help children or adults to get more information and knowledge about animals seems like a good idea. It's because, nowadays, practically everyone, even youngsters, uses their smartphone almost 24 hours a day. According to a 2018 Pew Research Report, 45 percent of kids use the Internet "nearly constantly," while another 44 percent go online many times per day. According to the study, 50% of adolescent girls are "near-constant" online users, compared to 39% of adolescent guys. A smartphone is used by 95% of teenagers (Katie Hurley, LCSW, 2020). This matter can take as an advantage, by building an app that easily can recognize and get information about animals wherever or whenever they are.

Animal species and subspecies aren't always obvious to the untrained eye. Species and subspecies might be difficult for some individuals to tell between. The definition of a species is well understood by the public, however identifying a subspecies is more difficult because of the ambiguity and subjectivity involved. (Mihai Andrei, the year 2022) It is possible to tackle this problem by designing a smartphone app that can identify different kinds of animals. To create an app that can distinguish between various kinds of animals, the app must first know which species the animals belong to. Convolutional neural networks (CNN) may be used to categorize animals by training and testing photos from databases. This sort of deep learning neural network is termed a convolutional neural network. Image recognition has taken a major leap forward thanks to CNNs. Visual analysis is the most common use for them, and they're often engaged in picture classification behind the scenes Anne Bonner (Anne Bonner, 2019).

People have been unable to attend zoos because of the complications caused by a virus called COVID-19, which affects all nations. When COVID-19 struck, most of us hadn't heard of the term "social distance" before. We're doing all can to keep people at a distance from one another at the zoo to prevent the spread of the coronavirus. Emily Lynch, 2020) Making an app that allows users to readily obtain information about animals without creating a crowd seems like a solution to ensure that people can safely visit zoos without fear of infection.

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1.3 Project Objectives

- To study suitable neural network methods to classify animals using images.
- To develop a system that can recognize animals and get information about them.
- To test that developed system.

1.4 Scope of Study

This initiative is mainly focused on Malaysians, notably youngsters and visitors to Malaysian zoos, with a secondary focus on tourists. To train and evaluate the system, particular photos of mammal species found in Malaysia will be used as datasets. The datasets for this project will be trained and evaluated using the Convolutional Neural Network (CNN) approach, which is described in detail below. Specifically, the emphasis of this investigation will be on mobile applications as a system platform. With mobile apps on their smartphones, which they can carry with them wherever they go, people will be able to make better use of this system more readily. This research will make use of React Native, an open-source framework for creating mobile apps for Android, Android TV, iOS, macOS, tvOS, the web, Windows, and Universal Windows Platform (UWP).

1.5 Significance of Study

The significance of the research is that it may aid anyone in improving their awareness of animals, especially children who are naturally interested in their surroundings. To grasp the world around him, a young child must begin from the beginning (Jill Purdy, 2020). Information on the animals will be offered in the application and presented to users when the photograph has been analysed and is deemed suitable for display. This research will also provide individuals with new methods to connect with nature via their smartphones, which they will be able to use from anywhere and at any time. Finally, visitors to the zoo may keep their social distance and feel safer by not congregating in a large group of individuals while at the zoo.

1.6 Summary

It has been a long time since people all around the globe have been pent up, but due to vaccines, it is now safe to go outdoors and engage in outdoor activities. The COVID-19 virus should be avoided at all costs. Even those who have been vaccinated

should keep a safe social distance, wear a mask, and wash their hands often to prevent catching the disease. Individuals will find it simpler to keep their distance from one another when learning about animals in Malaysia because of this research. It also infers that artificial intelligence is a popular technology currently that has the potential to tackle a wide range of issues.

CHAPTER 2

LITERATURE REVIEW

This chapter will concentrate on research that is important to this study, such as the specifics of the dataset for this study on selected Malaysian mammals. The study goes on to discuss machine learning and deep learning in further depth. Then it will go into the techniques, software and libraries that will be used in this research in greater depth. It will also go through any similar or comparable applications to this research. Finally, it will give the chapter's summary.

2.1 Mammals In Malaysia

In Malaysia, there is a wide variety of creatures to be found. Malaysia is home to around 200 different mammal species, according to current knowledge. There are numerous different species that may be found in Malaysia's Taman Negara National Park, including elephants, monkeys, deer, hornbills, and lizards to name a few. There is a possibility of finding these species there. Mulu World Heritage Area, which has a rainforest that is 60 million years old, is one of Southeast Asia's most popular natural attractions. This is where the Sarawak Chamber (the world's biggest subterranean chamber) and Clear Water Cave both set world records in terms of size and volume (the longest cavern network). When the sun sets and bat colonies emerge from their

underground tunnels, the Bat Exodus is well-known to most of the population. More exotic Malaysian fauna includes gibbons and orangutans, along with other birds like hornbills and Sumatran rhinoceroses.

2.2 Animals for research

For this study, it will be specified on certain mammals only, such as elephants, sun bears, deer, tigers, orangutans, monkeys, bats, squirrels, and tapir that may be the datasets for building an images recognition application. To be more detailed, this chapter will do research about those animals.

2.2.1 Malayan Tiger

Malayan tigers are scientifically known as Panthera *tigris jacksoni*. 'Jacksoni' refers to a British tiger conservationist called Peter Jackson. In the class Mammalia, it is a member of the Felidae, which includes this huge cat. "harimau," or "rimau," is the Malaysian word for "tiger." In English, this tiger is referred to as Pak Belang, or Uncle Stripes. It is one of six subspecies of tigers. In this category include the Siberian or Amur, Bengali, Sumatran, south China, and Indochina tigers (AZ Animals, 2021).

Its back, tail, head, and face are all orange with black stripes. Its bottom is white. This huge cat has long whiskers and piercing golden eyes. The papillae on the Malayan tiger's tongue give the animal's tongue its distinctive appearance. The tiger's prey is scraped clean by the papillae. As a result, the tiger is unable to consume feathers or fur when feeding. Male Malayan tigers may grow up to eight feet long from head to tail, while females can grow up to seven feet. There are two distinct genders of Malayan tigers: males may reach up to 220 pounds, while females range from 170 to 240 pounds. A mature kangaroo weighs about the same as a 200-pound tiger. The Malayan tiger subspecies is the smallest of its kind on the mainland. This tiger is little in comparison to the Siberian tiger, which can grow to a length of 10.5 feet and a weight of 660 pounds.

2.2.2 Elephant

Malaysia has Asian and Bornean elephants. The Asian elephant is found in 13 Asian countries. Asian elephants are called *Elephas maximus*. There are many sub-species within the species' range. The Indian elephant is found in India, China, Vietnam, Myanmar, Thailand, Laos, Cambodia, and Malaysia (Elephas maximus indicus). The Asian elephant has two subspecies on the Indonesian islands of Sumatra and Borneo (Othman, 2017).

An Asian elephant subspecies found in Malaysia's east coast Sabah and Indonesia's northern Kalimantan, the Bornean elephant. Bornean elephants have the smallest range among the four subspecies, according to Othman (2017). Male Bornean elephants vary in height from 1.57 m to 3.64 m, with an average of 2.17 m. Females are 1.45-2.26 meters tall, with an average of 1.96 meters.

2.2.3 Orangutan

Orangutans are native to Malaysia and Indonesia. *Pongos* are orangutans. On the island of Borneo, Malaysia, live Bornean Orangutans (P. pygmaeus pygmaeus) (Misato Hayashi, Fumito Kawakami, Rosimah Roslan, Nurhafizie M. Hapiszudin & Sabapathy Dharmalingam, 2018). Their habitat is thick woods with taller trees. Nest trees are chosen for their comfort, stability, and predator protection. More nests per hectare with a more diversified forest structure (N L Auliah, M Maulana, O Onrizal, 2021). Orangutans choose palm tree nests because they are higher than neighbouring oil palm plants and provide better views and protection. The following nests were confirmed in 2008: Sandakan Bay (8), Sugut floodplain (15), Beluran (7), and Lower Segama (7) (Marc Ancrenaz, Felicity Oram, Nardiyono Nardiyono, Muhammad Silmi, Marcie E. M. Jopony, Maria Voigt, Dave J. I. Seaman, Julie Sherman, Isabelle Lackman, Carl Traeholt, Serge A. Wich, Truly Santika, Matthew J. Struebig, Erik Meijaard, 2021).

2.2.4 Bats

Chiroptera is the taxonomic order that includes bats. Subspecies of Malaysian bats exist. Bats accounted for half of all mammal species in tropical forests, and 20% of all mammal species globally. Even though there are more than 1,300 identified

species globally, no one knows how many of them live in Peninsular Malaysia (Voon-Ching Lim, Ramli.R, John-James Wilson, 2017). Painted Woolly and Marshall's Horseshoe Bats, two of seven species, have been spotted just once. More than a half-dozen species had their most recent record prior to 2000. The present absence of data will need further bat surveys to identify whether the decline in bat populations or other reasons is to blame (Voon-Ching Lim, Ramli.R, John-James Wilson, 2017). Caverns, limestone cliff faces, and mountains were home to these creatures. They may be found in Malaysia's Krau Wildlife Reserve and Ulu Gombak Forest Reserve. There was a cave collapse in Kedah in 1982 because of limestone quarrying, for example. Ramli.R and John-James Wilson are the authors of this study.

2.2.5 Malayan Tapir

Only the Malayan Tapir, the biggest tapir on Earth, can be found in Asia. Malaysia, Myanmar, Thailand, and the Indonesian island of Sumatra are presently home to tapir. In Peninsular Malaysia's woods, tapirs are found in swamps and lowland forests, like elephants and tigers. According to current estimates, Peninsular Malaysia's tapir population is between 1100 and 1500. (M MOHAMAD, D YAWAH, D MAGINTAN, 2019). They're well-known for their ability to swim over rivers with ease. If they can remain underwater for lengthy periods of time, they may be able to travel along riverbeds.

2.2.6 Sun Bear

Known as *Helarctos malayanus*, a large bear that dwells in Southeast Asia's jungles, the sun bear is a threatened species. Sumatra and Borneo islands in Southeast Asia are home to this species, which may be found as far away as Northeast India. The insular region, which has the largest surviving tracts of intact forest for the sun bear, is home to 35–44% of the species' present range (Mei-Hsiu Hwang,Mark A. Ditmer,Shu-De Teo,Siew Te Wong,David L. Garshelis, 2021). One of the Ursid bears, the Malayan sun bear is the smallest and least researched of the bears in the genus (M Izzat-Husna, MS Mansor, N Nabilah, KZ Abidin, Z Kamarudin, R Topani, S Md Nor, 2021). Known as "honey bears" in Malaysia, sun bears are known as beruang badu because of their

love of honey. Their only diet consists of termites, millipedes, and a broad variety of fruits.

2.2.7 Deer

Malaysian deer subspecies include Cervus nippon (sika), Cervus timorensis (rusa), and Cervus unicolor (sika) (sambar). The male Javan Rusa (Cervus timorensis) is bigger than the female. Both sexes average 152 kg. Male antlers resemble a lyre and weigh roughly 2.5 kg. Both sexes have grayish brown coats. They have wide, broad ears. The creatures seem stubby and elongated due to their short legs. The Javan rusa inhabits Southeast Asian islands' deciduous woods, plantations, and grasslands. They are plentiful at the forest border.

The Cervus unicolor is found across Asia (sambar). These animals' antlers are used to produce knives and handles. Tropical seasonal forest creatures are easy prey for tigers, leopards, and crocs. They warn with a stomp. Sambars have short black hair on their topsides and lighter brown to creamy white hair on their bottoms. Their bushy tails with white backs and undersides lift as a signal. Males are usually bigger and have a thicker mane than females. Male Sambar antlers have three or four times and shed and regenerate often. Antlers may exceed 100 cm in height. Men may weigh 185-260 kg, but women can only weigh 162 kg. Sambars inhabit both gentle and steep wooded hillsides.

2.2.8 Monkey

Malaysia has Long-tailed Macaques, Proboscis Monkeys, and Silvered Leaf Monkeys. These naughty monkeys have a lengthy tail. They may be found throughout Southeast Asian islands and even on the region's mainland. Long-tailed macaques prefer woods near rivers and beaches but can survive in practically any situation. They are mostly frugivorous, or fruit eaters, when accessible. Long-tailed macaques eat crabs, frogs, shrimp, bird eggs, grass, and seed. In Malaysia, they often beg visitors for food and raid gardens (Karen Schweitzer, 2019). The proboscis monkey is Asia's biggest monkey. Males may weigh up to 50 lbs. Borneo (East Malaysia) has Proboscis monkeys only found in the woods. Proboscis monkeys eat a range of plants, insects, saplings, and leaves. Deforestation has rendered them a vulnerable species (Karen

Schweitzer, 2019). This little monkey has olive-coloured hair and a pig-like tail. This species is found in Malaysia in numerous locations. Some sources mention pig-tailed macaques residing in swamps and lowland rain forests. They consume mostly fruit, but also other plant components, seeds, insects, fungi, and dirt (Karen Schweitzer, 2019).

2.3 Machine Learning

When a system can learn and develop without being explicitly designed, it is known as machine learning (ML). Research into how to build computer programmes that can access data and figure things out for themselves is known as "machine learning. Supervised, Unsupervised, Semi-supervised, and Reinforcement Learning are all examples of machine languages.

2.3.1 Types of Machine Learning

2.3.1.1 Supervised Learning

Supervised learning can teach computers to predict future occurrences using well-labelled training data. Labelled data is data that has already been tagged with the intended result (D. Fumo, 2017). Inferred functions predict output values using a known training dataset. A target for each new input will be provided by the system. A reworkable model is another property of a learning method (expert.ai, 2020). Closest Neighbour, Naive Bayes, Decision Trees and Linear Regression are all extensively employed in supervised machine learning. Nearest Neighbour is a popular supervised machine learning technique.

2.3.1.2 Unsupervised learning

In unsupervised machine learning, no human supervision is required. Instead, it allows the model to discover new patterns and data. It utilizes unlabelled data (D. Johnson, 2021). Unsupervised learning methods allow

people to do more difficult tasks. Unsupervised learning may be more unpredictable (D. Johnson, 2021). Unsupervised learning aims to identify patterns in training data and categorize incoming objects accordingly (Mary K. Pratt, 2020). An algorithmic approach to extracting data from large databases. Unstructured inputs may be transformed into specified outputs by looking for relationships between samples or objects. Datasets for algorithms may include animal photographs. Fur, scales, and feathers may be used to classify animals. Learning to discriminate between categories may allow it to organize photos more precisely (Mary K. Pratt, 2020). Surveillance using unsupervised learning methods like neural networks and k-means clustering.

2.3.1.3 Semi-supervised Learning

Semi-supervised machine learning approaches, which use both labelled and unlabelled data for training, fall between the extremes of supervised and unsupervised machine learning algorithms in terms of complexity. It is possible that, if properly implemented, this method will considerably improve the accuracy of learning in systems that make use of it. It is common practice to train/learn from labelled data using semi-supervised learning, and it is successful only when it is carried out with competent and appropriate resources. In contrast to this, obtaining unlabelled data is often feasible without incurring additional costs (D. Fumo, 2017).

2.3.1.4 Reinforcement Learning

When a computer programme is trained to make a series of right or erroneous judgments, this is referred to as "reinforcement learning," and it is a method of teaching. It is the agent's responsibility to understand how to attain agoal in an environment that is both unknown and possibly difficult. Reinforcement learning pits an artificial intelligence against a game-like environment. To resolve the problem, the computer employs a technique knownas "trial and error." Artificial intelligence is either rewarded or penalized for theactivities that it does, depending on the preferences of the programmer. It aspire to increase the overall reward to the greatest extent possible (B. Osiski, K.Budek, 2018).

Based on these types of machine learning, the technique that will used for this research is the Supervised learning because of by using well-labelled training data, it can adjust performance criteria based on past experience by allowing for the collection of data.

2.4 Deep Learning Techniques

2.4.1 Convolutional Neural Networks

Image classification and segmentation are key uses of convolutional neural networks (CNNs), neural networks with one or more convolutional layers (C. Thomas, 2019). To manage rising degrees of complexity and data pre-treatment and compilation, it is created. CNNs are one of the most adaptable models for focusing on both image and non-image input (P. Vadapalli, 2020).

One layer of input neurons is used for interpreting primary visual data, such as pixels in a picture, and a single layer of output neurons is used in some CNNs to analyse images on their inputs via distributed linked convolutional layers. A third layer, known as the "sample layer," is present in CNNs to limit the number of neurons engaged at each level. Linking layers between the sample and output layers is a common feature in CNNs (P. Vadapalli, 2020).

The convolutional model is developed in four phases when the input data is imported into the convolutional model: Following the convolution process, a function is applied to the feature maps generated from the input data. Then, CNN uses a technique called Max-Pooling, which helps the network discover images based on alterations. After that, the data is flattened for CNN analysis, which follows the Flattening phase. Also known as "the hidden layer," the Full Connection calculates a loss function for a model (P. Vadapalli, 2020).

2.4.2 Recurrent Neural Networks

RNNs are a kind of artificial neural network that are especially built to deal with time series data or data that includes sequences. Neural networks intended for unrelated data are called feed-forward neural networks. But if one data point relies on the previous data point, the neural network must be adjusted to account for the dependencies. Memory is a property of RNNs, allowing them to use previous inputs to build the next output in the sequence (Mehreen Saeed, 2021). To tackle an issue, there are two RNN designs that may be employed. One is Gated RNNs, and the other is Long Short-Term Memory (LSTMs). Temporal data may benefit from LSTMs trained on memories. The three gates are Input, Output, and Forget. Memory-based data prediction of temporal sequences is also

a strong suit of gated RNNs. The two gates are called "Update" and "Reset" (P. Vadapalli, 2020).

2.4.3 Generative Adversarial Networks

Generative modelling is an unsupervised machine learning activity that includes detecting and learning regularities or patterns in incoming data (J. Brownlee, 2019). So, it's a mix between a Generator and a Discriminator. The Discriminator works with the Generator Network to distinguish between authentic and fraudulent data. To stay competitive, the Generator and Discriminator must continue to generate and distinguish between actual and fraudulent data. It will build simulation results from actual photographs if an image library is required. Then a deconvolution neural network is formed (P. Vadapalli, 2020).

2.4.4 Comparison between deep learning techniques

Table 2.1: Comparison between deep learning techniques

Convolutional neural networks (CNNs)	**Recurrent neural network (RNN)**	**Generative Adversarial Networks**
Works best in: ● Image recognition ● Image analysing ● Image segmentation ● Video analysis	Works best in: ● Image classification. ● Image captioning that includes several	Works best in: ● Image and Text Generation ● Image Enhancement

● Natural language processing	words from a single image. ● Sentiment Analysis. ● Video classification.	● New Drug Discovery processes

Based on the Table 2.1, the deep learning that will be use in this research is the Convolutional Neural Networks (CNN) because of its high accuracy in Image recognition. It is because CNN follows a hierarchical architecture that builds a network, like a funnel, and eventually produces a fully connected layer where all the neurons are linked to each other, and the output is processed.

2.5 Methods for Image Recognition

2.5.1 Image Clasification

Images may be categorized based on the number of pixels or vectors in a certain region. Use spectral or textural characterizations with classification regulations. Supervised or unsupervised image classification techniques exist (G. Boesch, 2021). Two methods to categorize photographs: Machine learning approaches may next classify photos into groups or classes based on the first stage's visual attributes (Nisar, Khalid, 2018). A machine learning algorithm's ability to extract hidden information from a collection of structured and unstructured samples is a crucial advantage (Supervised Learning). Deep learning is the most common approach used in artificial intelligence (G. Boesch, 2021). Deep learning, along with powerful AI and GPU technology, has enabled remarkable picture categorization performance. Thus, deep learning algorithms have achieved human-level performance in image recognition, face recognition, and image classification approaches (G. Boesch, 2021).

2.5.2 Object Detection

It is a common job in computer vision to identify and locate specified types of items in a picture. For determining the location of an object, people may either create a box around it or identify every pixel in the picture that includes it (called segmentation) (P. Ganesh, 2019).

2.5.2.1 Two-Step Object Detection

After detecting bounding boxes that may contain objects, two-step object detection categorizes each bounding box as an individual item. In the beginning, a Region Proposal Network is needed to give several regions that are then transferred to typical DL-based categorization structures. For these region proposal networks, there are many various approaches, from the hierarchical grouping algorithm (which is very slow) to the CNN and ROI pooling and anchoring in Fast RCNNs (which are much faster) to training end-to-end with the use of these techniques (RPNs) (P. Ganesh, 2019).

2.5.2.2 Heatmap-based Object Detection

When it comes to real-time object detection, several one-step object detection architectures have been proposed, such as YOLO and its variants YOLOv2, SSD, and RetinaNet. These designs try to integrate the detection and classification stages. Regression's bounding box prediction was one of these algorithms' most remarkable accomplishments. It's considerably simpler to integrate detection and classification processes if each bounding box can be easily represented with a few values (for example, xmin, xmax, ymin, and ymax) (P. Ganesh, 2019).

2.5.3 Comparisons

Table 2.2: Comparison between image classification and object detection

Image Classification	Object Detection
An image classification approach may be categorised as parametric or non-parametric or hard or soft. Preparation of images and choice of classification method are all steps in	Object detection is the process of locating items in an image and classifying them according to their characteristics, such as colour, shape, or size. It is possible to categorise natural photos using

the image classification process. Finally, the total accuracy is assessed after each step has been completed and a classification system has been selected. An image of a certain item, like a rabbit in a picture, is often used as an input, and the predicted classes that define and match the object are the outputs. **Disadvantage:** Unsupervised and supervised image classification methods have their drawbacks, which include lengthy training periods and inability to handle large datasets.	object detection as a method for locating specific instances of objects that fall into one of a variety of predetermined categories. Image and video processing systems using this approach have been able to find certain types of things, such as automobiles or humans or animals or birds, by using this technique. Face recognition, pedestrian detection, vehicle detection, traffic sign detection, and video surveillance are just a few examples of how it may be use in the real world. **Disadvantage:** Object detection has been greatly improved in a controlled setting in recent years. However, when items are put at random positions in a crowded and obstructed environment, the issue remains unresolved.

Based on Table 2.2, the methods that will use in this research is the image classification because by using image as the input for the animal recognition is more convenience using Convolutional Neural Networks.

2.6 Software for mobile app development

2.6.1 Android Studio

Android Studio is a specialized IDE for Android app development that was created by Google themselves. This programme is built on top of IntelliJ IDEA, a Java integrated development environment. Android Studio employs a Gradle-based build system, an emulator, code templates, and Github integration to facilitate Android application development. There are one or more modalities in Android Studio for every project. Modules for Android apps, Library modules, and Google App Engine modules are all examples of this kind of technology.

2.6.2 Flutter

An open-source mobile UI framework developed by Google that was published in May 2017 is known as Flutter. With Flutter, people can construct a native mobile app from scratch using only one codebase. As a result, developer may design two distinct applications with only one set of code and one set of tools for iOS and Android. With a Software Development Kit (SDK), developer have all the tools they need to create their own Flutter-based apps. Compilation tools are included in this package (code for iOS and Android). Additionally, it includes a Framework (UI Library based on widgets), a collection of premade UI components that may be customized for your own purposes. Using Dart, a programming language developed by Google in October 2011, Flutter can run on a variety of devices.

2.6.3 React Native

As a JavaScript framework, React Native enables developers to create actual, natively produced mobile apps for iOS and Android. Rather than being aimed at desktop computers, React Mobile is a JavaScript library for creating user interfaces for mobile devices. Web developers now also can create native-looking mobile apps using the JavaScript library. React Native also makes it simple to create for both Android and iOS at the same time since much of the code programmers write can be shared across platforms. In 2015, Facebook published the open source React Native project. Within a few years, it has become one of

the most popular mobile development tools in the industry. Popular mobile applications like Instagram, Facebook, and Skype all employ React Native development. This page goes into further detail about these and other React Native-poweredapplications.

2.6.4 Comparisons

Table 2.3: Comparison between software development

	Android Studio	**Flutter**	**React Native**
Developers	Google	Google	Facebook
Language	Java	Dart	Javascript
Type	Native app	Hybrid app	Hybrid app
Performance	Fast	Fast	Close to Native
Codebase	Distinct repositories for each platform	Single cross-platform codebase	Single cross-platform codebase
Pace development	Slow	Fast	Fast

The platform that will use to create mobile application for this research is the React Native framework because it can be used in hybrid app which is it can be use in Android and iOS, so it can benefit for both users and it is easy to use for mobile app development.

2.1 Libraries for image recognition

This section is for the libraries that will use for image recognition such Tensorflow Scikit-learn, Matplotlib and opencv.

2.1.1 Tensorflow

TensorFlow, an open-source toolkit for numerical computing and large-scale machine learning, was developed by the Google Brain team. Using a common concept, TensorFlow brings together a variety of machine learning and deep learning (also known as neural networking) models and methods. As a front-end Python API, it makes it easy to construct apps using the framework, while the framework itself executes the programmes in fast C++.

2.1.2 Scikit Learn

Machine learning models of various kinds may be built and evaluated using the Scikit-Learn open-source library in Python. Defining machine learning algorithms and comparing them to one another is easy using Scikit- Learn, which contains tools for preprocessing your dataset. Support Vector Machines, Random Forests, K-means clustering, and every other machine learning model that can think of are all included in the Scikit-Learn library.

2.1.3 Matplotlib

When it comes to charting data, Python's Matplotlib is one of the best options out there. John D. Hunter, the man of Matplotlib, made it open source so that everyone might benefit from it. The majority of Matplotlib is written in Python, with a few pieces in C, Objective-C, and Javascript included for backward compatibility with other platforms.

2.1.4 Opencv

This massive open-source library for computer vision, machine learning, and image processing is currently playing a big part in real-time operation, which is very vital in today's systems. Images and videos may be processed using it to identify objects, faces, or even handwriting of a person. NumPy, for example, allows Python to parse the OpenCV array structure for analysis. Programmers employ vector space and execute mathematical operations on these features to identify visual patterns and their varied characteristics.

2.2 Similar Application

2.2.1 Seek By iNaturatlist

Seek by iNaturalist is a nature identification tool that makes use of picture recognition technologies. There are hundreds of species of plants, animals, birds, and fish that people may learn about with this app. To create this software, they worked with a team of professionals. People who like learning about the world will find all they need here. Search by iNaturalist lets people identify animals, learn about creatures, and more from anywhere in the world. More than 10 million species may be found in the app's database, which people can quickly browse.

2.2.2 Picture Insect: Bug Identifier

Pictures of insects - Insect ID Pro is a freemium educational program for kids of all ages developed by Glority LLC and available for download on iOS and Android devices. With the help of this software, people may learn the names of insects in a short amount of time, allowing people to better appreciate the beauties of the insect world. Simply pointing your camera at an insect will be enough to get people started on their learning journey. It can distinguish between more than a thousand distinct types of bugs. The extensive collection is divided into more than 90 unique categories. Insects may be discovered in every category, and new discoveries are made every day, according to researchers. The material in Picture Insect is not limited to insects; it also contains information on birds and a broad range of other creatures.

2.2.3 SnakeSnap

Unknown snakes may be identified using SnakeSnap, a smartphone app. To help people learn more about snakes, this app utilizes visual identification to assist people identify them. With the support of snake aficionados, the program has been designed to provide all necessary services precisely and comprehensively. It is the goal of this application to provide a complete application that teaches everyone how-to live-in harmony with fantastical beings of the imagination.

2.2.4 Comparisons

	Seek	Picture Insect	SnakeSnap
Platform	Android and iOS	Android and iOS	Android and iOS
Recognize	More than 10 million species consist of plants, animals, birds,	More than 90 distinct categories of insects	Variety types of snakes
	fish, etc.		

2.3 Summary

To summarize this chapter, it can say that it has covered study topics such as datasets that will be utilized for the system or application, techniques and software that may be used for the system, as well as other research fields. It also reviewed applications that are comparable to the programme that researcher want to develop and provided some suggestions on how to construct the image recognition application.

CHAPTER 3

METHODOLOGY

In this chapter, researcher will examine the approach that will be employed in this project. Besides, this chapter will outline the stages of the implementation and methodologies that will be employed in this project. Furthermore, all the implementation details will be given in this chapter as well.

3.1 Development Methodology

To create, test and release high-quality applications, software developers have been encouraged to use Software Development Life Cycle (SDLC). The SDLC's goal is to provide high-quality software that meets or exceeds expectations while staying on schedule and staying under budget. When it comes to creating top-notch applications, the Software Development Life Cycle (SDLC) is the method used by the industry. Software that meets or exceeds expectations while staying on budget and on schedule are the goals of the SDLC. There are a variety of software development life cycle models that may be used throughout the process of creating software. They are also known as "Software Development Process Models" (SDPM). Each process model has a unique set of stages that must be followed to assure the success of the software development process. Most often used SDLC models include Waterfall Model, Spiral Model, V-Model and Big Bang Model, among others.

3.2 Project Framework

For this research it will focus more on the Waterfall model, where phase-to-phase progress cannot be made if the previous phase has not been finished. The Waterfall Model is a step-by-step approach to software development that uses predefined stages to keep things organized. Before the following phase may begin, the previous one must be finished with no overlap. The SDLC is divided into phases, each

of which has a particular task to accomplish. Winston Royce first debuted it in 1970 (Rungta, K. 2021).

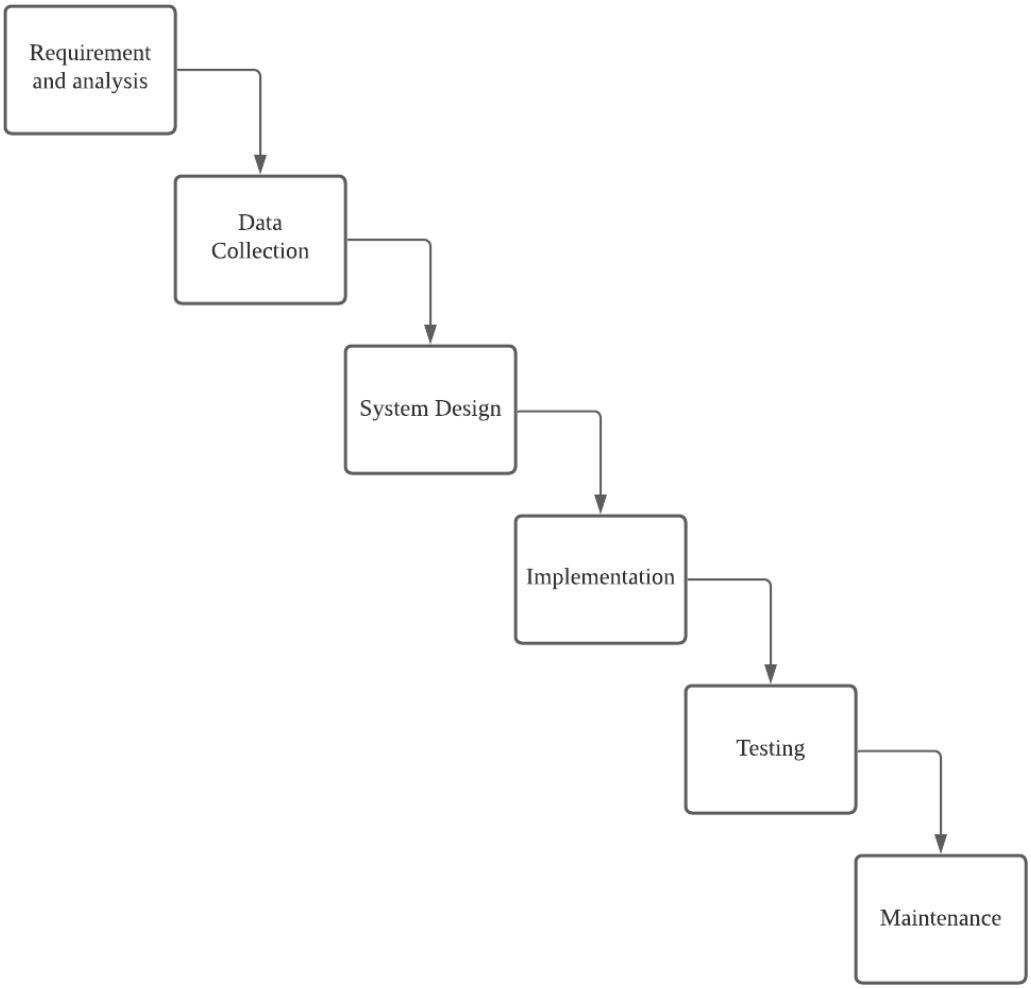


Figure 3.1: Waterfall Model

3.2.1 Requirement Analysis and Planning

This is the most crucial and foundational step of the SDLC, as well as the most time-consuming. An examination of the previous chapters of this study has been carried out to determine what kind of application is going to be used, the issue statements, the scope of this investigation, as well as the methodologies and software that will be appropriate for this research. The information gathered from the core project methodology and product feasibility studies is used to plan and execute the project once it has been formed. The planning step considers the project's quality assurance requirements as well as any potential dangers or risks. To properly execute the project with the least level of risk, the technical feasibility study must identify the several technological approaches that might be applied.

3.2.2 Data Collection

A particular species of animal in Malaysia, namely the mammal, will be the focus of this research's data gathering efforts. Google Photos images will be utilized as the datasets for training the image classification model, with images from Google Images serving as the source of the datasets for training. Because Google photos are free and open source, it will be utilized in this research. Kaggle is another option I'm considering for obtaining datasets in addition to Google and it also an open-source platform

3.2.3 System Design

A software developer's work is guided by product requirements such as scenario layouts and data models. An initial design of the project's purpose and goals, as well as its general traffic flow, is created to establish the project's overall purpose and goals. As part of this step, you'll need to figure out the specifics of the system flow and design it. For this reason, programmers and entrepreneurs alike employ flowcharts. Flowcharts are a valuable tool for understanding the rationale behind even the most complicated and lengthy problems. Additionally, a use case diagram should be included in this step so that it may help the user understand how the technology created will be used. In

the end, it should aid in the development and organizing of the needs. Now that the system flowchart and use case diagram have been done, it makes sense to start working on the application's user interface.

3.2.3.1 System Flowchart

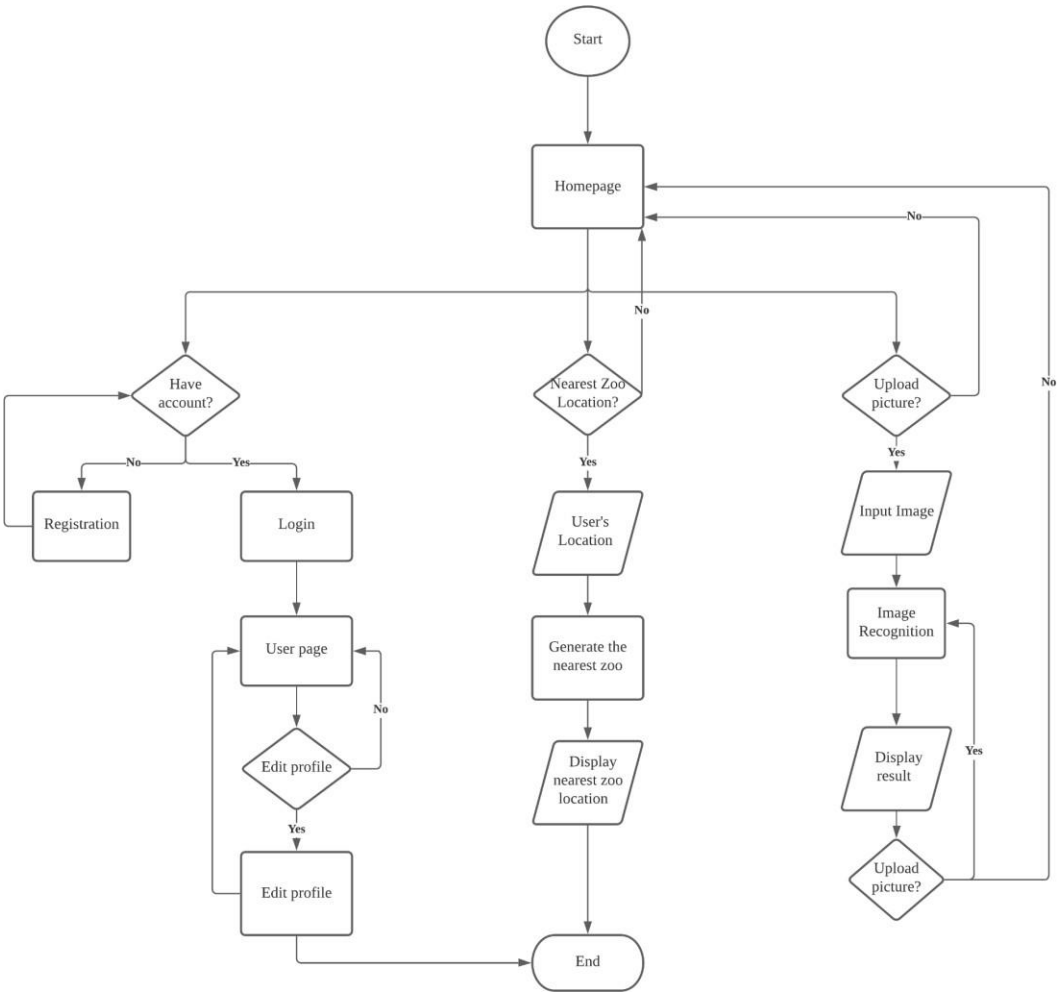


Figure 3.2: Flowchart of the system

Based on the Figure 3.2, it shows a brief about the system flow where it starts with displaying the homepage of the application then users have been given options to choose such as login or registration, nearest zoo location and upload a picture of an animal to start the process of the image recognition then display the output of the recognition and the details about the animal. After the user's login to the system, it will

go to the user page where it will display the details about the user and display the history of what animals that have been recognized by the system and users can edit and update their details. Users need to give permission to turn on their location to know the nearest zoo. For the image recognition, users are allowed to upload an image to start the prediction animal then it will display the result of the prediction.

3.2.3.2 Use case Diagram

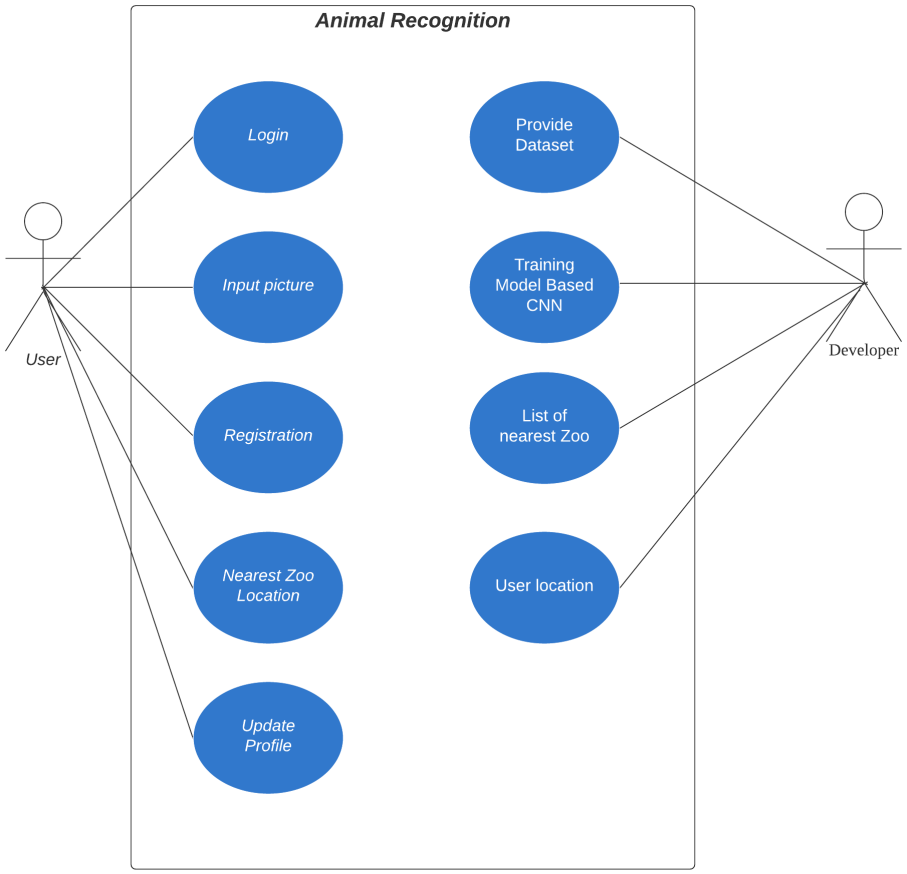


Figure 3.3: Use case diagram

Based on the figure 3.3, it shows what functions and pages that will provide to the user.

3.2.3.3 System Architecture

The architecture of a system is defined by its conceptual model, which identifies the system's structure, behavior, among other operational details. Abstract representations that may be used to draw conclusions about the structure and behavior of systems are known as architecture descriptions, which are formally described and represented systems.

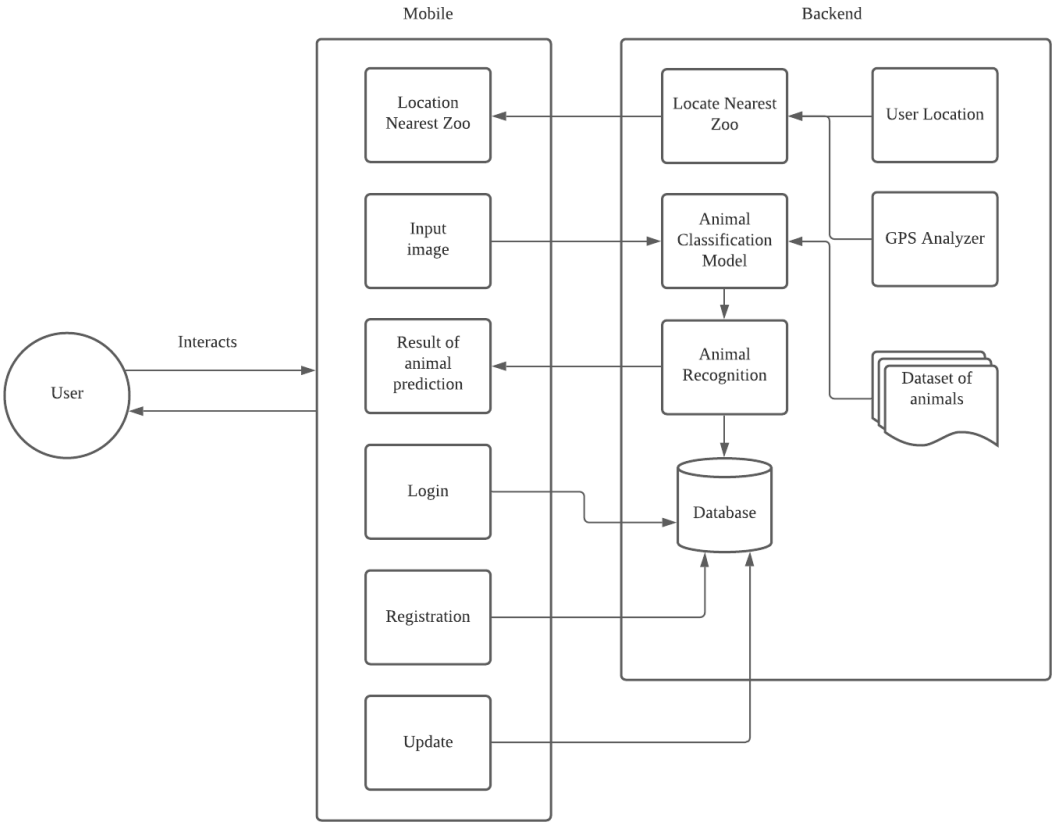


Figure 3.4: System Architecture diagram

Based on Figure 3.4, it shows an overview of how the picture that was uploaded by the user was predicted by utilizing TensorFlow and Keras, and then how the result of the prediction was stored in the database and then displayed to the application.

3.2.3.4 Image Classfication using Convolutional Neural Networks (CNN)

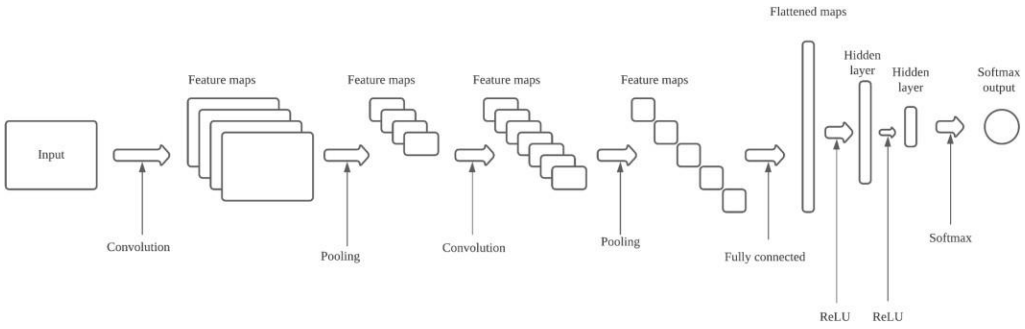
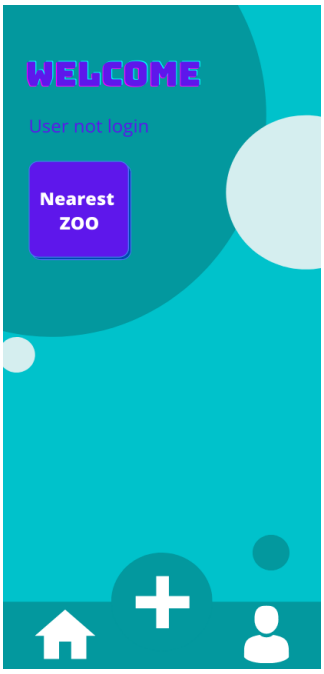
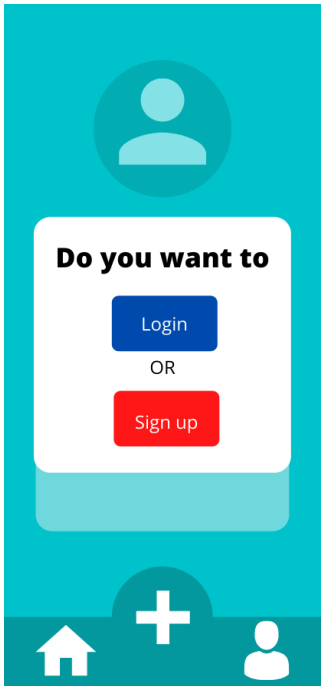


Figure 3.4: Convolutional Neural Networks (CNN) Architecture

The image's raw data is stored in the Input Layer. Afterward, the Convolution Layer, which computes volume by calculating the dot product between each filter and picture patch, follows. It's possible to create an output volume of 32 x 32 x 12 by using 12 filters on this layer. When it gets to Pool Layer, it does so on a periodic basis, which is essential for speeding up computation while reducing memory use and preventing overfitting. Max pooling and average pooling are two of the most popular forms of pooling layers. Next Full-Connected Layer, which is a normal neural network layer that receives input and computes class scores and outputs a 1-D array of size equal to the number of classes. Activation Function Layer is next in line of progression where the output of the convolution layer will be activated by an element-wise activation function in this layer. RELU is a commonly used activation function.

3.2.3.5 User Interface Design

Sketch	Explanation
 *Figure 3.5: Homepage*	This is the homepage of the application where it will display the nearest zoo button to go to the nearest zoo page and it will display either the user login or not. It also has a bottom navigation bar to navigate the application pages.
 *Figure 3.6: Login or Sign up*	These options will pop up after the user clicks on the profile button on the navigation bar. These options allow users to choose either to login or sign up for a new account.

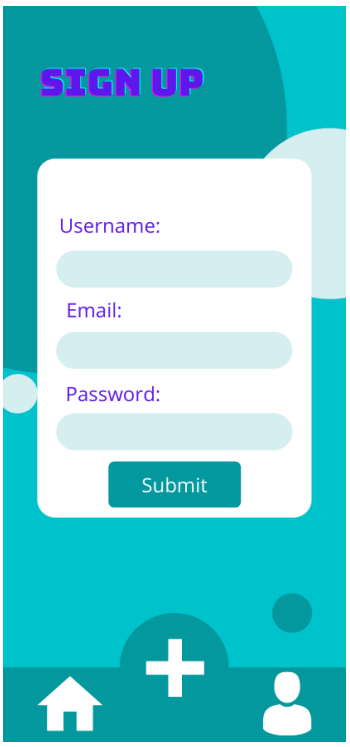
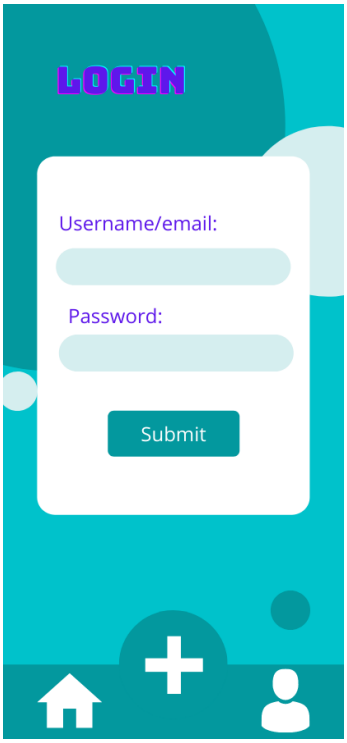
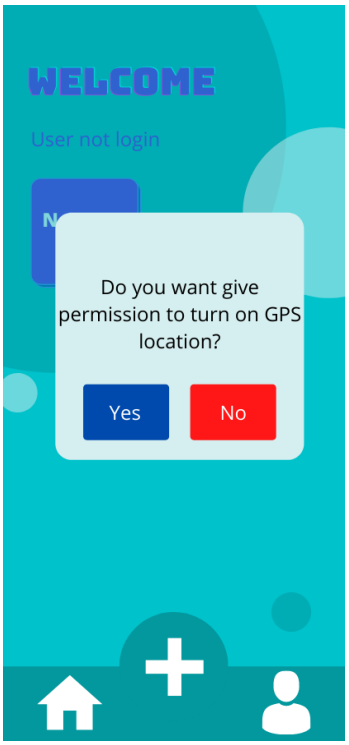
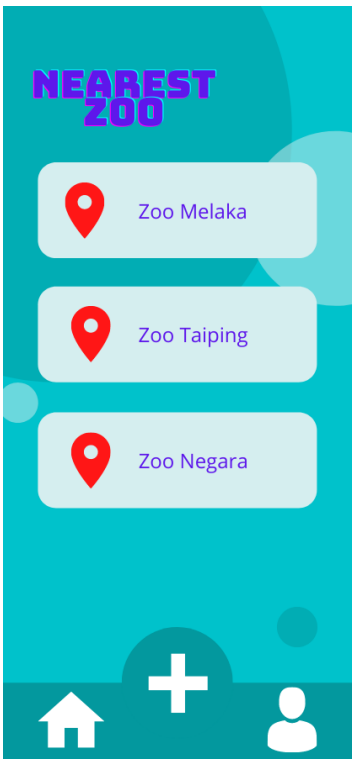
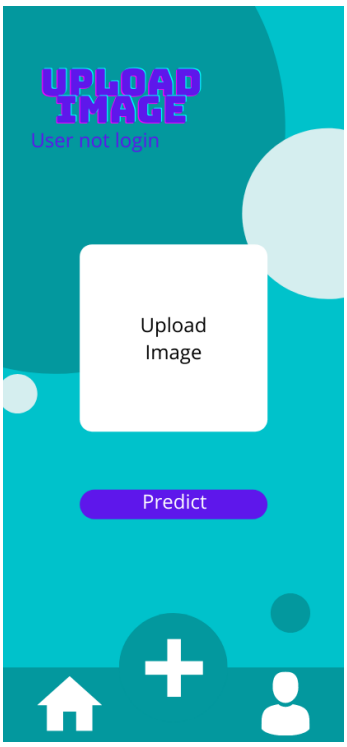
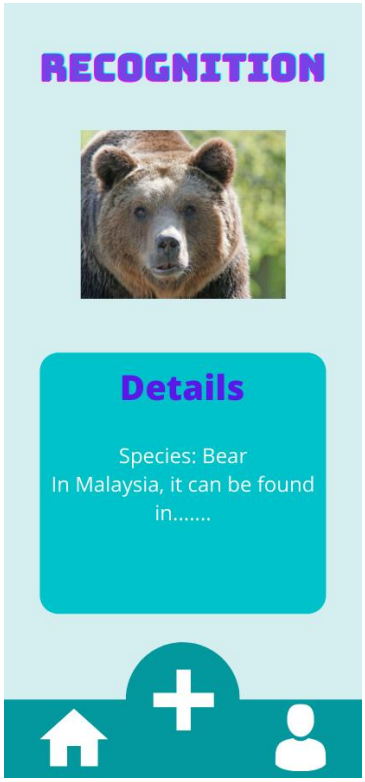
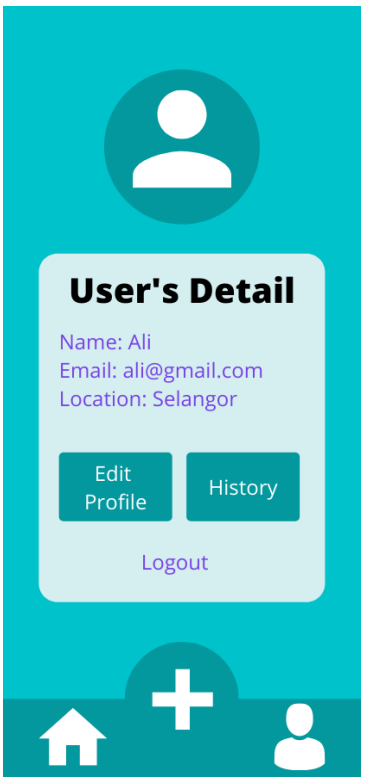
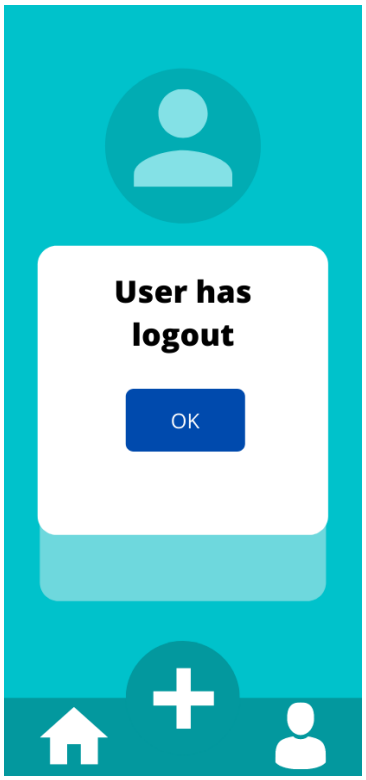
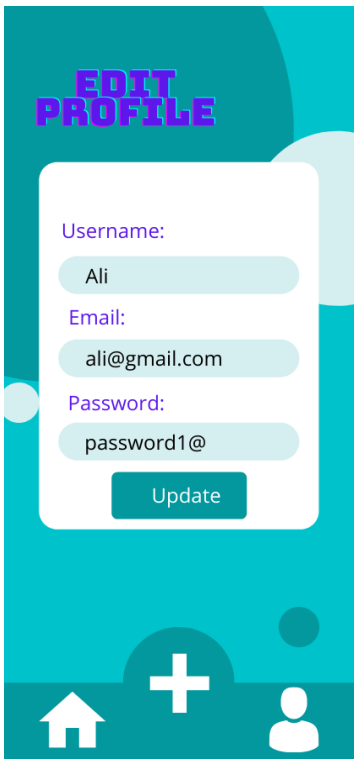
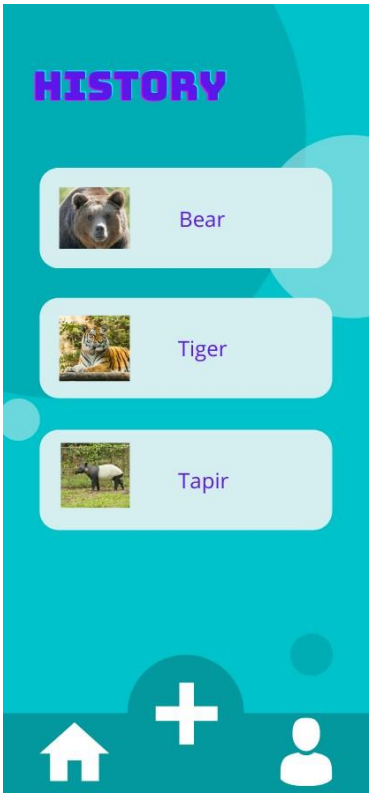
 *Figure 3.7: Sign up page*	This is a sign-up page where users need to fill up their username, email and password to create a new account.
 *Figure 3.8: Login page*	After users have signed up it will go to this login page to login to their account.

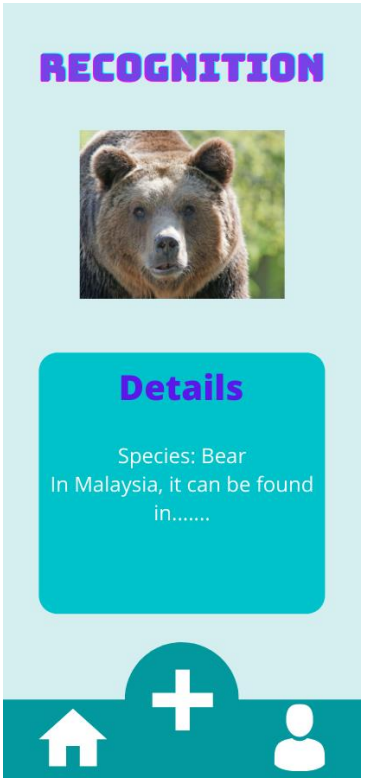
 *Figure 3.9: Display username*	After login, the user's name will be displayed on the homepage.
 *Figure 3.10: GPS permission*	After users click on the Nearest Zoo button on the homepage, they will be asked for permission to turn on GPS location on their phone so the application can detect which state users are in.

 *Figure 3.11: Nearest zoo page*	This is the Nearest Zoo page where it will display a list of nearest zoos.
 *Figure 3.12: Nearest zoo map*	This is the nearest zoo map where it will appear after users click on one of the nearest zoo options.

 *Figure 3.13: Upload image page*	This is an upload image page where users need to upload an image of an animal that they want to predict.
 *Figure 3.14: Prediction page*	After users upload an image and click on the predict button, it will go to this page where it will display the recognition of the imageand give the details about the animal.

 *Figure 3.15: User's page*	This is the user's page where it will display details such as username, email, and location of the users. It also displays an option to edit profile, history of predictions that have been done by the users and logout button.
 *Figure 3.16: Logout message*	This message will pop after users click on the logout button.

 *Figure 3.17: Edit profile page*	This edits profile page where users can edit and update their information.
 *Figure 3.18: History page*	This history page where it will display a list of history about what animal that user has predicted using this application.

 *Figure 3.9: Recognition page*	The recognition page will be displayed after users click on one of the lists in the history page.

3.2.3.6 Pseudocode

- **Login:**

```
Start

Input username,password

If username and password authenticated then

    Print "Successfully login",

Else

    Print "Incorrect username or password"

EndIF

End
```

- **Registration:**

```
Start

Input username,email,password
```

```
Get user
If username == user then
     Print "Username already exist"
Else
     Print "Successfully Registered"
EndIf
End
```

- **Edit and update:**

```
Start
Get username,email,password
Print username,email,password
Input newusername,newemail,newpass
If newpass == password then
     Print "Update not success"
Else
     Print "Successfully update"
End
```

3.3 Implementation

For the implementation phase, all systems based on the requirements from the system design such as login/registration, nearest zoo location and animal classification will be developed, then integrate all the systems together.

3.3.1 Animals Image Recognition Application

In this step, mobile application's interfaces, and certain functionality, such as logging in or registering, logging out, and entering an image for the

image recognition will be developed. A mobile app for the Animals Image Recognition will be built on React Native to fulfil this level which will use mostly JavaScript as its front end and back end of the application.

3.3.2 Image Recognition Using Convolutional Neural Networks (CNN)

As part of my study for Chapter 2, it will use the Convolutional Neural Networks technique to detect the animals in photos that will get the input from the user, which will be used to identify the animals. This part will be coded in the Python programming language, with various open-source libraries such as TensorFlow, Matplotlib, and OpenCV being used as resources. TensorFlow will allow me to design a model that will be used to train and test on the dataset that will be created.

3.3.3 Nearest Zoo location

GPS technology to locate users' whereabouts for this feature. It will use this information to determine the location of the users, after which it will display all the zoo locations in the specified state. Users will be prompted for permission to switch on their GPS location for the system to know which state they are in to do this operation. This will be coded using JavaScript and some React Native libraries for the geolocation and GPS

3.3.4 Hardware

Table 3.1: List of hardware

No	List of hardware	Specification
1	Processor (CPU)	Intel i3-6006U
2	Graphic Card (GPU)	Nvidia GeForce 920mx

3	RAM	12 GB

3.3.5 Software

Table 3.2: List of software

No	List of software	Details
1	Windows	Windows 10 Pro edition 64-Bit Operating System
2	React Native	Platform to develop a mobile application
3	MySQL	Database for the application
4	Sqlite3	Database form the application
5	Android Studio	To deploy the phone emulator
6	Canva	To design the mobile application

3.4 Testing

An application's TEST CASE is a sequence of activities carried out to validate a certain feature or operation of the program. A test case comprises the procedures,

data, preconditions, and postconditions produced for a given test scenario to check any requisites that may be specified. To assess if a software product is meeting the needs of the client, testing engineers use a set of variables or conditions to compare predicted and actual outcomes.

Test Case ID	**Test Scenario**	**Steps**	**Input**	**Output**	**Result**
1	Launch the application	Open the phone emulator on the Android Studio	None	The application will display the homepage	Success or fail
2	Login as user	Click on the login option	Username and password	The application will go to the user page	Success or fail
3	Registration as a user	Click on the registration option	Username, password, and email	The application will go back to login page if success	Success or fail
4	Animal recognition	Click on the upload image option then choose either to upload image using camera or pick image from gallery	Animal image	Display the result of the recognition	Success or fail
5	Nearest zoo location	Users need to give permission to turn on	User's GPS location	Display all list of nearest	Success or fail

		their GPS location.		zoos	
6	Logout	Click on the logout option	Username and password	Proceed to the homepage without login as user	Success or fail
7	Image prediction accuracy	Using TensorFlow libraries to get the prediction accuracy	Animal Image	Accuracy of the prediction	Success or fail
8	Edit and update profile	Users can edit their information and then update it.	Username, email, password	Updated information	Success or fail

3.5 Summary

This chapter explains the project's methodology and the Waterfall model of the Software Development Life Cycle (SDLC). This project's structure includes the project's goals, phases, activities, and results. In this project, the five processes of analysis, data collecting, system design, implementation and testing are covered in depth. Animals in Malaysia, hardware and software requirements have been examined throughout the requirements analysis process. The use case for the application, the system flowchart, the system architecture, and the CNN architecture were all created and discussed throughout the system design phase. The platform will be used to build a mobile app in React Native using open-source frameworks and Python as the language to train and test the model in the implementation phase. During the testing process, this application will check for the mobile app's operation and determine the recognition accuracy.

REFERENCES

Malayan tiger. (2021, February 15). AZ Animals. https://a-z-animals.com/animals/malayan-tiger/

Nurzhafarina binti Othman (2017, September). *Behaviour and Spatial Ecology of the Bornean elephant (Elephas maximus borneensis) in Lower Kinabatangan, Sabah, Malaysia Borne* https://www.wildlife.gov.my/images/document/penerbitan/kertas_maklumat/elephant.pdf

Marc Ancrenaz, Felicity Oram, Nardiyono Nardiyono, Muhammad Silmi, Marcie E. M. Jopony, Maria Voigt, Dave J. I. Seaman, Julie Sherman, Isabelle Lackman, Carl Traeholt, Serge A. Wich, Truly Santika, Matthew J. Struebig, Erik Meijaard (2021) *Importance of small forest fragments in agricultural landscapes for maintaining orangutan Metapopulations.* (n.d.). https://www.frontiersin.org/articles/10.3389/ffgc.2021.560944/full

Hayashi M, Kawakami F, Roslan R, Hapiszudin N, Dharmalingam S. (2018). Behavioral studies and veterinary management of orangutans at Bukit Merah Orang Utan Island, Perak, Malaysia. https://link.springer.com/article/10.1007%2Fs10329-018-0650-2

Andrew B.Davies, FelicityOram, MarcAncrenaz, Gregory P.Asner. (n.d.). Combining behavioural and LiDAR data to reveal relationships between canopy structure and orangutan nest site selection in disturbed forests. ScienceDirect.com | Science, health and medical journals, full text articles and books. https://www.sciencedirect.com/science/article/abs/pii/S0006320718312576

MOHAMAD, M., YAWAH, D., MAGINTAN, D., TRAEHOLT, C., & JEMALI, N. J. N. (2019).

HABITAT UTILIZATION OF A TRANSLOCATED MALAYAN TAPIR IN SENALING INAS FOREST RESERVE, NEGERI SEMBILAN. Journal of Sustainability Science and Management, 14(4), 65-70.

Auliah, N. L., Maulana, M. I., & Onrizal, O. (2021, June).

Habitat fragmentation effect on the characteristics of orangutan nest tree selection. In IOP Conference Series: Earth and Environmental Science (Vol. 782, No. 3, p. 032016). IOP Publishing.

Hwang, M.-H., M. A. Ditmer, S.-D. Teo, S. T. Wong, and D. L. Garshelis. 2021.

Sun bears use 14-year-oldpreviously logged forest more than primary forest in Sabah, Malaysia. Ecosphere 12(10):e03769.

https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.3769

Muhammad Izzat-Husna, Mohammad Saiful Mansor, Noor Nabilah, Kamaruddin Zainul Abidin, Zubaidah Kamarudin, Rahmat Topani, Shukor Md Nor. (2021).

Behavior patterns of captive malayan sun bears (Helarctos malayanus) at a rehabilitation center in peninsular Malaysia. ScienceDirect.com | Science, health and medical journals, full text articles and books.

https://www.sciencedirect.com/science/article/pii/S1558787821000186

David C. Lee, Victoria J. Powell, Jeremy A. Lindsell. (2019).

Understanding landscape and plot-scale habitat utilisation by malayan sun bear (Helarctos malayanus) in degraded lowland forest. ScienceDirect.com | Science, health and medical journals, full text articles and books.

https://www.sciencedirect.com/science/article/abs/pii/S1146609X18303023

Eric Mohrman. (n.d.).

The habitat of the mustache monkey. Pets on Mom.com.

https://animals.mom.com/habitat-mustache-monkey-1802.html

El-Jaafari, H.A., Panandam, J.M., Idris, I.B., & Siraj, S.S. (2008).

RAPD Analysis of Three Deer Species in Malaysia. Asian-australasian Journal of Animal Sciences, 21, 1233-1237.

https://www.semanticscholar.org/paper/RAPD-Analysis-of-Three-Deer-Species-in-Malaysia-El-Jaafari-Panandam/01c30d3b340b64ba0f5473321840b5a47a4975fa

Fumo, D. (2017, August 17).
Types of machine learning algorithms you should know. Medium.
https://towardsdatascience.com/types-of-machine-learning-algorithms-you-should-know-953a08248861

Expert.ai. (2021, May 26).
What is the definition of machine learning?
https://www.expert.ai/blog/machine-learning-definition/

Rungta, K. (2021, October 6).
Unsupervised machine learning: What is, algorithms, example. Meet Guru99 - Free Training Tutorials & Video for IT Courses.
https://www.guru99.com/unsupervised-machine-learning.html

Mary K. Pratt. (2020, July 8).
What is unsupervised learning? SearchEnterpriseAI.
https://searchenterpriseai.techtarget.com/definition/unsupervised-learning

Błażej Osiński, Konrad Budek. (2021, January 5). What is reinforcement learning? The complete guide. deepsense.ai. https://deepsense.ai/what-is-reinforcement-learning-the-complete-guide/

Boesch, G. (2021, August 24).
A complete guide to image classification in 2021. viso.ai.
https://viso.ai/computer-vision/image-classification/

Ganesh, P. (2019, October 7).
Object detection: Simplified. Medium.
https://towardsdatascience.com/object-detection-simplified-e07aa3830954

Vadapalli, P. (2021, December 8).
Top 10 deep learning techniques you should know about. upGrad blog. https://www.upgrad.com/blog/top-deep-learning-techniques-you-should-know-about/

Christopher Thomas BSc Hons. MIAP. (2019, May 27).
An introduction to Convolutional neural networks. Medium. https://towardsdatascience.com/an-introduction-to-convolutional-neural-networks-eb0b60b58fd7

SearchMobileComputing. (2018, October 9).*What is Android studio? – Definition from WhatIs.com.*
https://searchmobilecomputing.techtarget.com/definition/Android-Studio

Thomas, G. (2021, July 9). *What is flutter and why you should learn it in 2020*. freeCodeCamp.org. https://www.freecodecamp.org/news/what-is-flutter-and-why-you-should-learn-it-in-2020/

S.A., N. (n.d.). *What is react native? Complex guide for 2021*. Custom Software Development | Netguru.
https://www.netguru.com/glossary/react-native

Yegulalp, S. (n.d.). *What is TensorFlow? The machine learning library explained*. InfoWorld. https://www.infoworld.com/article/3278008/what-is-tensorflow-the-machine-learning-library-explained.html

Andrei, M. (2021, January 29). *The difference between a species and a subspecies - according to science*. ZME Science. https://www.zmescience.com/other/feature-post/difference-species-subspecies/#:~:text=What%20a%20species%20is&text=Now%2C%20something%20as%20fundamentally%20important,the%20offspring%20are%20typically%20sterile

Ferreira, A. C. (2020, July 26). *Deep learning-based methods for individual recognition in small birds*. besjournals. https://besjournals.onlinelibrary.wiley.com/doi/10.1111/2041-210X.13436

Lynch, C. K. (2020, May 31). *Social distancing at the zoo*. Scientific American Blog Network. https://blogs.scientificamerican.com/observations/social-distancing-at-the-zoo/

Masyarakat perlu bertanggungjawab patuhi SOP. (2021, August 25). Berita Harian. https://www.bharian.com.my/berita/nasional/2021/08/855865/masyarakat-perlu-bertanggungjawab-patuhi-sop

Skarstein, T. H. (2020, January 15). *Curious children and knowledgeable adults – early childhood student-teachers' species identification skills and their views on the importance of species knowledge*. Taylor & Francis. https://tandfonline.com/doi/full/10.1080/09500693.2019.1710782

What is artificial intelligence (AI) and how does it work? - Definition from TechTarget. (2022, January 4). SearchEnterpriseAI. https://techtarget.com/searchenterpriseai/definition/AI-Artificial-Intelligence

APPENDIX 1

Gantt Charft

Week / Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Semester 5														
Mutual Acceptance Form Submission (F1)														
Chapter 1: Introduction														

Project Motivation Evaluation Form Submission (F2)														
Submission of Chapter 1														
Outline of Chapter 2														
Chapter 2 – Literature Review														
Submission of Chapter 2														
Literature Review Evaluation Form (F3)														

Chapter 3 - Methodology														
Submission of Chapter 3														
Methodology Evaluation Form (F4)														
Submission of Full Report														
Presentation of Final Proposal														
Plagiarism Checking														
Writing Proposal Report														