UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT OF ASSISTIVE MOBILE APPLICATION FOR VISUALLY IMPAIRED USING MACHINE LEARNING

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Computer Engineering Technology (Computer System) with Honours.

by

NUR ALIAH BINTI MOHAMAD NAPIAH
B071610525
971025016610

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING TECHNOLOGY

2019

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: Design and Development of Assistive Mobile Application for Visually Impaired Using Machine Learning

Sesi Pengajian: 2019

Saya **NUR ALIAH BINTI MOHAMAD NAPIAH** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.

2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.

3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.

4. **Sila tandakan (X)

☒   SULIT*   Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

i

☐ TERHAD*   Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

☒ TIDAK TERHAD

Yang benar,   Disahkan oleh penyelia:

....
NUR ALIAH BINTI MOHAMAD NAPIAH
                                                   EN NOOR MOHD ARIFF BIN BRAHIN
Alamat Tetap: Cop Rasmi Penyelia
No 30, Jalan Canggung 19,
Taman Pasir Putih, 81700
Pasir Gudang, Johor

Tarikh: Tarikh:

DECLARATION

I hereby, declared this report entitled Design and Development of Assistive Mobile Application for Visually Impaired Using Machine Learning is the results of my own research except as cited in references.

Signature: …………………………………

Author :   NUR ALIAH BINTI MOHAMAD NAPIAH

Date:

APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Computer Engineering Technology (Computer System) with Honours. The member of the supervisory is as follow:

Signature: …………………………………………….

Supervisor   EN NOOR MOHD ARIFF BIN BRAHIN

ABSTRAK

Projek ini adalah mengenai pembangunan aplikasi mudah alih bantuan untuk orang cacat penglihatan menggunakan pembelajaran mesin. Projek ini terutamanya tertumpu pada orang cacat penglihatan kerana mereka menghadapi masalah mobiliti sosial dalam rutin harian mereka. Walaupun terdapat beberapa alat teknologi bantuan untuk orang cacat penglihatan, keperluan mereka belum dipenuhi. Oleh itu, aplikasi mudah alih bantuan berdasarkan pembelajaran mesin dibangunkan untuk membantu pengguna dengan mengeluarkan bunyi untuk menyebut nama objek apabila kamera menangkap imej objek. Objek yang difokuskan dalam projek ini adalah wang, pakaian dan perkara asas penggunaan cacat penglihatan dalam setiap hari. Projek ini berfungsi dengan menangkap imej masa nyata dan aplikasi mengandungi Pemrograman Aplikasi Objek TensorFlow (API) yang menggunakan Single Shot Detector (SSD) dengan model pra terlatih yang dilatih menggunakan model MobileNet V2 yang dibangunkan di dataset Google. Imej yang ditangkap akan dibandingkan dengan dataset imej pramuat untuk menentukan output projek. Objek yang dikesan dengan skor lebih besar daripada 0.5 akan dipaparkan. Antaramuka aplikasi akan memberikan skor nama objek dan percent objek yand telah dikesan.

ABSTRACT

This project is about the development of assistive mobile application for visually impaired people using machine learning. The project is mainly focused on visually impaired people as they face problems of social mobility in their daily routine. Even though there are several of assistive technology tools for visually impaired people, their needs have not yet been fulfilled. Accordingly, an assistive mobile application based on machine learning is developed to help the user with sound output with the name of the object when the camera captures the object's image. Objects focused in this project are money, cloths and basic things of visually impaired use in their daily basis. This project works by capturing real-time images and the application is contained TensorFlow Object Application Programming Interface (API) that uses Single Shot Detector (SSD) with a pre-trained model trained using MobileNet V2 model developed at Google dataset. The captured image will be compared to the preloaded image dataset to determine the project output. Objects that have been detected with a score greater than 0.5 will be displayed. The application interface will provide object names and confidence scores.

DEDICATION

I would like to dedicate this project to my supervisor En Noor Mohd Ariff Bin Brahin who have guided me throughout this project process. Moreover, special thank you to my family Mohamad Napiah Bin Ismail, my father and Noraizah Binti Mohd Saat, my mother who always give supports and always encourage me to finish this project. Without their prayers I could not able to finish this project in time and their unconditional love make me become more motivated also not easily give up. Also, not to forget I would like to dedicate this work to Universiti Teknikal Malaysia Melaka (UTeM) and Faculty of Electrical and Electronic Engineering Technology that gives me opportunity to complete my study here. Also, I would like to dedicate my friends who always surround me with positive vibes and always be beside me through thick and thin especially Wan Nur Amalina, Nur Aqilah, Nur Syamimi and Nurul Najwa.

Thank You.

ACKNOLEDGEMENTS

Firstly, I would like to express my gratitude to Allah S.W.T that without His approval I might not complete my bachelor's degree project.

Next, the most important person that play role in helping me to complete my project, I would like to express my sincere gratitude to my supervisor En Noor Mohd Ariff Bin Brahin. He patiently guides me and gives me support until this project completely done. Without him all of these would not even possible to be done on time.

Lastly but not least, to all lectures in FTKEE that shares knowledge to me. Also, a special thanks to my family members for giving me all the support and give me strength to keep going in order to finish this project. I would like to thank to anyone who indirectly and directly involve to this project, only Allah can repay all your kindness and May Allah shower us with his blessing.

TABLE OF CONTENTS

LIST OF TABLES

TABLE	TITLE	PAGE

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

AdaBoost	Adaptive Boosting Machine Learning
ADT	Android Development Tools
API	Application Program Interface
APK	Android Package Kit
CNN	Convolutional Neural Network
FAST Detector	Features from Accelerated Segment Test
GUI	Graphical User Interface
IEEE	Institute of Electrical and Electronics Engineers
MIT Application	Massachusetts Institute of Technology
OCR	Optical Character Recognition
OpenCV	Open Source Computer Version
RGB	Red, Green, Blue
SIFT Feature	Scale-Invariant Feature Transform
SURF Feature	Speeded up Robust Feature
XML	Extensible Markup Language

CHAPTER 1

INTRODUCTION

1.1   Introduction

This chapter explains the overview of the study and the main purpose of the project. The chapter includes background of the study, problem statement of the project that wanted to build, objectives that goal at the end of the project and the scope of the study that will be conducted.

1.2   Background Study

Nowadays many visually impaired uses technology to perform tasks in their daily life. There are many assistive technology that help visually impaired in the market but they difficult to carry it around and many mobile application that have difficult interface technologies that consist of electronic devices that contain sensors and processors have ability to make smart decision to help them. For visually impaired to bring many devices to help them will make them difficult to move. The development of this application will make them easy to use without carry any bulk devices as 90% of visually impaired use a smart phone (Lee et al. 2018). Even though the visually impaired can do many chores by themselves but the visually impaired people still have limitations in doing their daily life. As example, they cannot see the colour of the object.

One of the members in the society of the blind in Melaka had stated that they are difficult to find their things and to know the currency of the money. Most of the society

1

members are self-employed as they open the reflexology centre to gain income. They told that sometimes they had been cheated by the customer because they are difficult to differentiate the currency of the money especially RM10 and RM20 whereas the braille codes are hardly noticeable by the blind people. Furthermore, they also stated the colour of their current outfit plays an important role of their daily life. With known colour of what they are wearing will substantially increase their self-confidence.

Figure 1.1: Visiting to Society of the Blind at Melaka

This project focuses on assistive features that use a camera on the phone as their input. Their limitations can be resolved by using the principle of computer vision system which will improves the blind life quality. In order to track and recognise the complex visual recognition, the technology of object detection and recognition is used. The detection process is using machine learning with the assistance of Convolutional Neural Network (CNN) to identify pictures that be represented. The classification model image will be trained as to predict the picture represents. Machine learning is replacing a classical technique in classifying and detecting the objects.

2

1.3   Problem Statement

Human has five senses which vision seems to be the most important because without vision there are limitations to see the world. World Health Organization in 2018 estimated that approximately 285 billion people live with some form of impairment and 39 million people are totally blind and low vision is 246 billion (Ngah et al. 2018). In order to keep survive they will rely on guidance to help them perform their tasks. In the past year, there are many devices that can be used as sighted guidance. The device that usually used in daily life by the visually impaired is the walking stick. The device has been upgraded from year to year.

Vision is important to help people see and does their daily task such as walk, read, choose their cloth, finding missing object and so on. As blind person must depend on others for their day to day life so often in our society, that people consider them as a burden. Usually they have better sensitivity for other sense. Even though they can speak, smell and touch the object but they can see the colour and shape of the object. Moreover, the visual impaired has disability to recognize the paper texture and the size between the different categories (Semary et al. 2016). That's why this application can help the blind people to know the colour of the object, detect the currency note value and make them feel safety and confidence in the financial dealings.

There are many devices that dedicated to the visually impaired such navigation devices, colour detector readers, object detection etc. However, this device is expensive as they use many sensor and hardware to develop it (Parkhi et al. 2016). Other than that, the blind people need to carry all the devices separately based on specific function.

The purpose of this project is to create an assistive mobile application for visually impaired by using machine learning. This project mainly engaged on visually impaired person as they confront with difficulties while doing their daily activities. Hence this application will help them to detect and recognise colour of the object as the user move around their Smartphone using the camera. In addition, this application can also detect the money and notify the user about the currency. The data that been captured by the camera will be compared with the data that have been trained and a voice notification will notify the user. A simple user interface will be designed as to make the user easy to use this application.

1.4 Objectives

The main objective for this project is to design detection and recognition colour of the object and currency note value application for visually impaired using camera of smart phone. This project carried out on the following objectives:

    i.   To study TensorFlow machine learning platform for image classification.

    ii.   To design and develop the assistive mobile application for visually impaired by using machine learning.

    iii.   To evaluate the accuracy of detected object colour and currency note value in TensorFlow API.

4

1.5   Scope of Work

This project will concentrate on how assistive features that use camera on the phone as the input. This assistive system that use Smartphone's camera is built using machine learning with the assistance of Convolutional Neural Network (CNN). The camera will track and detect the object image through the learning process using TensorFlow API. The process of recognise the pictures is comparison between the data that been taken with data that been trained and it will notify the user with voice notification. The main features involve in this application are detect currency note and colour of the object. The detection of object and colour is focussed more in basic things that used by the visually impaired such as key, cloth, shoe etc. The colour and currency note will be notified to the user with the audio output. This assistive mobile application for visually impaired is to focus on neural network usage.

1.6   Organization

In this chapter one, the background of the project, problem statement and scope the project is discussed. In the other hand, the existing method that been implemented on the past related project is reviewed in chapter two by analyse from the article, journal and website that are authorized. The advantages and disadvantages of the project will be compared and presented in the table. Furthermore, the flow of the project and the method that been use as to complete this project will be discussed in chapter three. After that, the project analysis will be analysed in chapter four. The project conclusion and future recommendation will be discussed in chapter five.

5

1.7 Summary

In conclusion, this chapter discussed the introduction of this project. It begins with project background where the explanation of the background system used. Then, the problem statement that usually happens to system and environment is briefing. The objectives to develop this project and scope of work also discussed in this chapter.

6

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is an important part before starting any project. This chapter will be concentrated on past and current project works. Many of the application and related reviews have been studied and all the analysis was identified with the point. This chapter will show the summary for each of the research that has done especially the system operation that been implemented in previous project.

2.2 Past Related Research

This chapter will be discussed more in the previous and current research to build up this project. The source of these inquiries must be satisfactory in the system format which comes from articles, journals, books and websites that are authorized.

2.3 Android Application Development

(Singh et al. 2016) state that mobile hardware can be more useful and friendly-user as the application code can be writing easily on android developers. Google was bought android which an open source Operating System (OS) in 2005. After that, in 2007, Android was revealed by software, hardware and telecommunication companies in

7

that determined to improve open standard for mobile devices. Based on statistic in in Google Play store website there are over 1 million application was published. Through many years, there are many of Android version have been released. The first version of android was released in 2008 which is Android 1.0 and the latest version of Android is Pie (9.0). Since android is open source and some of the tools are free it allows the developer to use this software with the less effort. This makes the use of Android software increases along with features of Android upgraded year by year said (KOCAKOYUN et al. 2017).

Android architecture contains many layers which are application layer, libraries layer and Linux Kernel Layer. The android application framework has an easy accessed and the framework easy to modify by the developers according to their needs. Android contains two main libraries which are Android Runtime and Android Library. The footprint memory can be minimal as it made up from a Core Java Libraries and the Dalvik virtual machine that will execute file in the Dalvik Executable (dex). The Android Studio libraries can be used by many different elements in the Android system as the system libraries cover up C or C++ language instead of only JAVA language.

Linux Kernel is the last layer in the Android architecture. The internal storage, internet protocol, management process, and the other core are provided in the kernel system operation. Kernel system also reflex to all the Linux things such as huge array of device drivers and networking which the process of taking out the burden of interfacing to peripheral hardware.

© Universiti Teknikal Malaysia Melaka