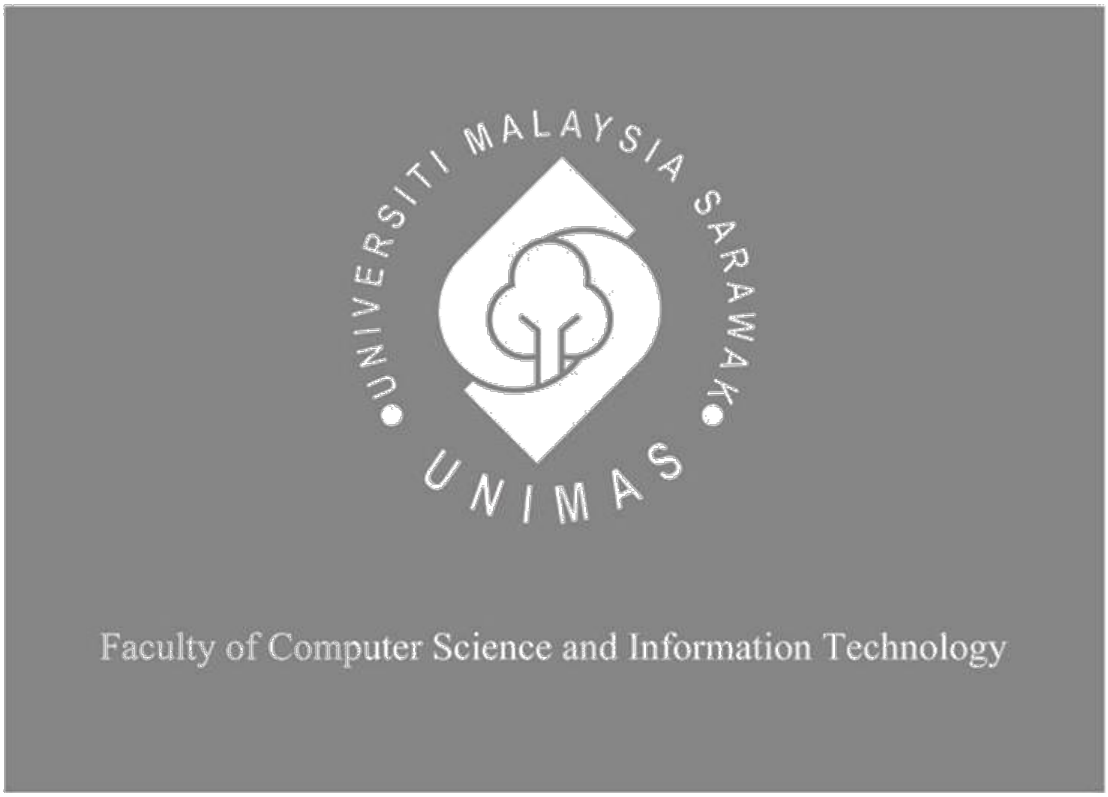

AGE AND GENDER RECOGNITION MOBILE APP

WEE QUO LUNG

Bachelor of Computer Science with Honours
(Computational Science)

2023

AGE AND GENDER RECOGNITION MOBILE APP

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This project is submitted in partial fulfilment of the

requirements for the degree of

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WQLUNG

……

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Abstract

Through reviewing and evaluate the existing age and gender recognition mobile apps and their deep learning algorithm, the study found the number of existing age and gender recognition mobile app is very less. This indicates that only a few developers focusing on developing the age and gender recognition mobile app. In addition, the User Interface (UI) of the existing mobile app is unappealing. Therefore, this study aimed to develop age and gender recognition mobile application using deep learning algorithm. After reviewing existing age and gender recognition mobile app, Convolutional Neural Network (CNN), one of the deep learning algorithms is implement in this proposed system. The CNN model is trained by using UTKFace face dataset which contains 20,000 face images with annotations of age, gender, and ethnicity. In addition, the app utilizes CNN to analyse facial features and other visual cues to make its predictions. The functionality of this proposed mobile app is to allow user to upload photo from gallery. The user simply needs select one image from the gallery, and the app will predict and display the age and gender of the person in the image.

Abstrak

Melalui menyemak dan menilai aplikasi pengecaman umur dan jantina sedia ada serta algoritma pembelajaran mendalam, kajian mendapati bilangan aplikasi mudah alih pengecaman umur dan jantina sedia ada adalah sangat kurang. Ini menunjukkan bahawa hanya beberapa pembangun yang menumpukan pada membangunkan aplikasi mudah alih pengiktirafan umur dan jantina. Sebagai tambahan, antaramuka pengguna aplikasi mudah alih yang wujud tidak cantik. Oleh itu, kajian ini bertujuan untuk membangunkan aplikasi mudah alih pengecaman umur dan jantina menggunakan algoritma pembelajaran mendalam. Selepas menyemak apl mudah alih pengecaman umur dan jantina sedia ada, Convolutional Neural Network (CNN), salah satu algoritma pembelajaran mendalam dilaksanakan dalam sistem yang dicadangkan ini. Model CNN dilatih dengan menggunakan set data muka UTKFace yang mengandungi 20,000 imej muka dengan anotasi umur, jantina dan etnik. Selain itu, aplikasi itu menggunakan CNN untuk menganalisis ciri muka dan isyarat visual lain untuk membuat ramalannya. Fungsi aplikasi yang dicadangkan ini adalah untuk membolehkan pengguna memuat naik foto daripada galeri. Pengguna hanya memilih satu gambar daripada galeri, dan aplikasi akan meramalkan serta memaparkan umur dan jantina orang dalam imej itu.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

In these recent years, facial analysis using Artificial Intelligence (AI) have been the trending research topics (Agbo-Ajala & Viriri, 2020). Agbo-Ajala and Viriri (2020) also stated facial analysis has gained much recognition in the computer vision community in the recently. The identity, age, gender, emotions, and the ethnicity of people can be determined by the features of human's face, among these features, age and gender identification can be especially significant in several real-world applications (Agbo-Ajala & Viriri, 2020). Organisations and Companies in several fields such as insurance, retails, marketing, etc are actively searching for ways to utilize the age and gender recognition applications technology (Huynh & Nguyen, 2020). Huynh and Nguyen (2020) stated a lot of interests can be gained as it allows company to easily to classify their customer demographics. According to Huynh and Nguyen, by possessing such tools with the ability to gather massive amount of data, company can increase their revenues and benefits significantly, easily surpass their competitors and dominate the corresponding market. Numerous of researchers have produced remarkable results by using several approached. However, certain issues in age and gender classification are still open problems. Therefore, this proposed project's objectives are study age and gender recognition using deep learning, develop a mobile app for age and gender recognition based on face image and evaluate the developed mobile app. Popular deep learning framework – Tensorflow, UTKFace dataset, deep learning model – Convolution Neural Network (CNN) and mobile app framework – Flutter will be use in this project.

1.2 Problem Statement:

Salihbasic and Orehovački (2019) mentions that the performance of the mobile device itself can impact the performance of age and gender recognition algorithms. This refers to the fact that the processing power and memory of the mobile device play a crucial role in the speed and accuracy of the recognition system. A mobile device with limited processing power or insufficient memory may struggle to handle the computational requirements of the recognition algorithms, leading to slower performance or reduced accuracy (Salihbasic & Orehovački, 2019). Besides, the number of age and gender recognition mobile app is insufficient (Ming Yang & Kai Yu, 2011). This indicates that only a few developers focusing on developing the age and gender recognition mobile app. Promising potentials of the age and gender recognition mobile app, such as automated data collection and enhance User Experience (UX) are neglected.

1.3 Scope:

In this proposed project, the facial recognition function will be limited to age and gender of the user. The user consists of Asian and using real life image only. The age recognition will be restricted to the range of 10 – 80 years old while the gender recognition will be restricted to male and female only. In addition, only one user's face will be recognized in this project.

1.4 Aim and Objectives:

In this project, an age and gender recognition mobile app is proposed. The objectives of this proposed system are:

- To study age and gender recognition using Convolutional Neural Network (CNN), one of the deep learning algorithms, by evaluate the whole process of model training and the outcome of the trained model.
- To design and develop a mobile app for age and gender recognition based on face image.
- To evaluate the developed mobile app by assessing accuracy of the predicted outcome.

1.5 Brief Methodology:

In this proposed project, Rapid application development (RAD) software methodology will be used. Popular deep learning framework Keras will be used to predict and classify user age and gender from images of UTKFace dataset. The probability of the prediction on age and gender will be indicated after detecting the user face. The architectures for image classification will consist of distinct parameters. Convolutional Neural Network (CNN) model will be used as deep learning model. React Native will be used to design the User Interface (UI) of the mobile app. The UI of the mobile will be very simple, which consists of one image, one text field and two buttons. User can upload image from the “Choose a photo” button and predict the user age and gender from “Predict age and gender” button. The predicted result is shown in the text field after the mobile app successfully predict the user age and gender.

1.6 Significance of project:

Execution of this project will be able to increase the number of the age and gender recognition mobile app. Besides, comparison between the developed mobile app with the existing mobile app can be conducted. Moreover, the method of model implementation on mobile app can be studied in this project.

1.7 Project schedule

GANTT CHART

	Task Mode	Task Name	Duration	Start	Finish	Predec
1		Brief Proposal Submission to Supervisor	8 days	Mon 17/10/22	Wed 26/10/22	
2		Feedback and Comment from Supervisor	2 days	Wed 26/10/22	Thu 27/10/22	
3		Resubmission of Approved Brief Proposal	2 days	Thu 27/10/22	Fri 28/10/22	
4		Full Proposal Submission	12 days	Fri 28/10/22	Mon 14/11/22	
5		Chapter 1	6 days	Mon 14/11/22	Mon 21/11/22	
6		Submission of Chapter 2	15 days	Mon 21/11/22	Fri 9/12/22	
7		Submission of Chapter 3	16 days	Fri 9/12/22	Fri 30/12/22	
8		Doing FYP Final Report	10 days	Fri 30/12/22	Thu 12/1/23	
9		Amendment and Modification Period for FYP	22 days	Thu 12/1/23	Fri 10/2/23	
10		Submission of Final Report	7 days	Fri 10/2/23	Sun 19/2/23	
11		Submission of revised structure of FYP report	7 days	Thu 30/3/23	Fri 7/4/23	
12		Submission of first draft of Chapter 4	27 days	Fri 7/4/23	Mon 15/5/23	
13		Submission of first draft of Chapter 5, 6 & Abstract of paper	11 days	Mon 15/5/23	Mon 29/5/23	
14		Submission of First Draft of FYP Report & Paper	11 days	Mon 29/5/23	Sat 10/6/23	
15		Submission of Final Report, source code, installation kits, user manual and Paper for Assessment	12 days	Sat 10/6/23	Sat 24/6/23	
16		Symposium FYP	6 days	Sat 24/6/23	Fri 30/6/23	
17		Amendment and modification period for FYP	17 days	Fri 30/6/23	Mon 24/7/23	
18		Submission of Final Report	6 days	Mon 24/7/23	Sun 30/7/23	

Figure 1.1 Gantt Chart

1.8 Expected Outcomes:

The expected outcomes from this proposed project are successfully develop age and gender recognition's mobile app using Convolutional Neural Network (CNN), one of the deep learning algorithms. The trained model is able to implement into the mobile app. The developed mobile app able to predict and show the age and gender of the user's face.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In this chapter, three different types of deep learning algorithms, face dataset, deep learning framework, and existing mobile app will be reviewed. This chapter focused on three deep learning algorithms, VGG19, Convolutional Neural Network (CNN), and ResNet50. The architectures and performance of these deep learning algorithms in age and gender recognition tasks are evaluated. In addition, the MORPH-II Dataset, Adience Dataset, and UTKFace Dataset are selected and reviewed. The dataset's image properties, such as angle, label, and colour, are examined. Furthermore, three deep learning frameworks, Tensorflow, Keras, and Caffe, are selected and reviewed. The comparison of these frameworks will be done in table form. Finally, this chapter will also review three existing age and gender recognition mobile apps that were chosen from a research article. The performance in terms of age and gender recognition accuracy, strengths and weaknesses of these mobile apps are examined.

2.2 Age and Gender prediction algorithm and dataset

2.2.1 VGG19 and MORPH-II Dataset

VGG19 is a DNN architecture consist of 19 number of weight of layers in the network, which is developed by Karen Simonyan and Andrew Zisserman of the Visual Geometry Group at Oxford (Smith & Chen, 2018). Trivedi and N (2020) stated the VGG16 was considered as the most accurate architecture in 2014's ImageNet competition and was correlated with InceptionNet. However, Smith and Chen (2018) mentioned there have been cases where VGG19's additional hidden layer has assisted it produce more precise results than VGG16. Smith and Chen stated five stacks of convolutional layers, each followed by a max pooling layer, make up the original VGG designs. Smith and Chen also stated two fully connected layers, each of size 4096 with 50% dropout, and a fully connected softmax layer, each of size 1000, make up the top layers, which are the same for all VGG designs. MORPH-II Dataset is applied to train and test the designed model (Smith &Chen, 2018). Smith and Chen stated most of the taken images are of the individuals' heads positioned in front of grey background as to assist eliminate background noise. In addition to age labels, the individuals' race, gender, and unique identifier are all given. However, a visual examination of the photos indicates some noisy variance. The heads of the people are angled differently and may be at differing distances from the camera. Most photographs show noticeable pixelations, and some of them have radically varied tints. The collection includes 55,134 photos with subjects ranging in age from 16 to 77. The sample contains 84.6% men and 77.22% black people (Smith &Chen, 2018).

2.2.2 Convolutional Neural Networks (CNN) and Adience Dataset

Levi and Hassncer (2015) proposed network architecture consists of three convolutional layers, each followed by a rectified linear operation and pooling layer. Levi and Hassncer stated the first two layers applied local response normalization for normalizing. Levi and Hassncer also stated the first convolutional layer has 96 filters that are 7×7 pixels, the second layer has 256 filters that are 5x5 pixels, and the third and final layer has 384 filters that are 3x3 pixels. Two more fully connected layers with 512 neurons each are added in the end. Levi and Hassncer also applied the Adience dataset to test the designed CCN accuracy. Images from smart phone devices that were automatically posted to Flickr make up the Adience collection. The viewing circumstances in these photographs are incredibly unrestricted because the photographs were uploaded without any prior manual screening, as is frequently the case on media webpages or social websites, which reflects many of the real-world difficulties associated with faces appearing in internet images. Approximately 26K pictures of 2,284 subjects make up the whole Adience collection (Levi & Hassncer 2015).

2.2.3 ResNet-50 and UTKFace Dataset

Meghana (2020) stated Residual Network is a deep learning model referred as ResNet. In order to facilitate cross-layer communication, ResNet established shortcut connections inside layers that, in contrast to the gates of the highway network, are data independent and parameter free (Trivedi & N, 2020). Trivedi and N stated when a gated shortcut is closed in a highway network, the non-residual functions are observed from the layers. Meghana stated ResNet-50 performs well for huge datasets which contain more than 1000 images. It's deep network model with 50 layers and roughly 23 million

training parameters is used. Meghana also stated the training models AlexNet, GoogleNet, and VGG19 share certain similarities while ResNet-50 has the advantage of having identical connections. Meghana also stated this model comprises five stages and three-layer convolutions in each of the residual blocks. Similar to the conventional NN, this network's remaining blocks pass output from one layer to the next and also pass it on to layers 2-3 below it. This process is label as identity connections (Meghana 2020). Meghana applied UTKFace dataset for training the model. Meghaba stated the UTKFace dataset consists of more than 10,000 images and various images with life spans ranging from 0 to 100. Each image contains distinct face characteristics that are close-up, as well as expressions, various poses, and different image resolutions. For more accurate feature recognition, this dataset offers the original photos in a cropped format. The age, gender, and landmarks of each photograph are all indicated (Meghana 2020). Age is the first label on each image in the collection, followed by gender, race, and the time and date when the image was taken and added to the UTKFace dataset.

2.3 Deep learning framework

2.3.1 Tensorflow

Pang, Nijkamp, and Wu (2019) stated TensorFlow is a versatile and scalable software library for numerical computations using dataflow graphs. Pang et al. (2019) also stated users may effectively develop, train, and deploy neural network and other machine learning models in production using this library and associated tools. Pang et al. (2019) also stated TensorFlow's primary algorithms are written in C++ and CUDA (Compute Unified Device Architecture), a parallel computing platform and API developed by NVIDIA. It offers APIs in a few different languages. The most extensive and reliable API is Python. JavaScript, C, Java, Go, and Swift are some of the additional languages that are officially supported. For other languages, including C# and Ruby, third-party packages are available (Pang et al., 2019). Pang et al. also stated "TensorFlow program consists of two sections: building a graph of computations (construction phase) and running the computational graph (execution phase)." (pp. 8). Besides, Pang et al. also stated TensorFlow provides users a visualization tool, TensorBoard which assists users to visualize model's computation graph, training metrics and parameter values. The Tensorboard interface is shown as Figure 2.

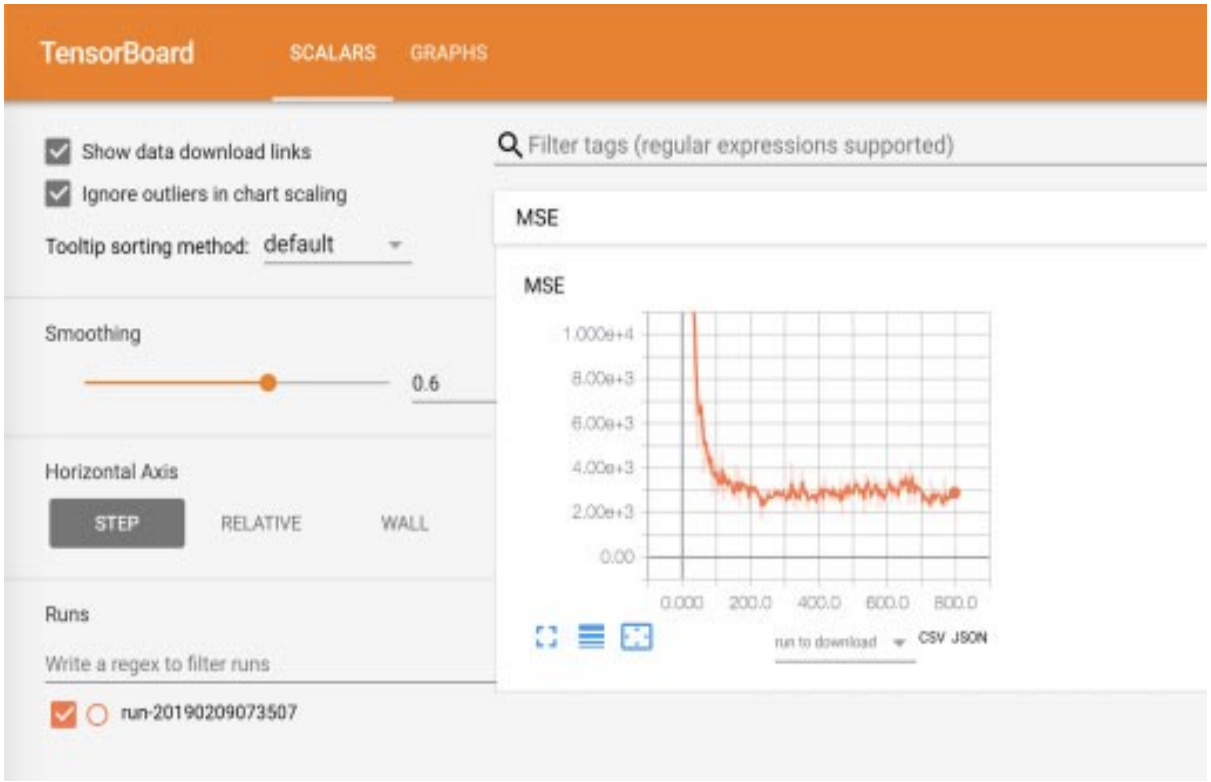

Figure 2.2 Tensorboard, (Pang et al., 2019)

2.3.2 Keras

Moolayil (2018) stated a highly optimized deep learning model can be developed using Keras, a high-level neural network API built in Python, within 15 lines of codes. Moolavil also stated Keras is developed in Python, enable users to use it at ease and has a larger community of users and supporters. Since Keras is incredibly flexible and fast at developing DL models while still being a high-level API, it is simple to utilize. As a result, working with Keras is a unique framework. Moolavil also stated Keras also offers versatility as it supports a variety of alternative frameworks as a back end, allowing users to utilize a different low-level API for a particular use case if necessary (i.e., Keras as a high-level DL API and TensorFlow as its low-level API back end). Janahiraman and Subramaniam (2019) stated Project Openended Neuro-Electronic Intelligent Robot Operating System (ONEIROS) research contributed to the

creation of Keras. Janahiraman and Subramaniam also stated the objective of Keras is to enable users to conduct experiments quickly and obtain the preferred outcome. On either CPU-based or GPU-based hardware, Keras can run both convolutional neural networks and recurrent networks (Janahiraman & Subramaniam, 2019). Researchers are able to perform experiments easily as Keras is user-friendly and simple to add new modules to.

2.3.3 Caffe

According to Cengil, Cinar, and Ozbay (2017), deep architectures can be accessed freely thanks to the entirely open-source Caffe library. Cengil et al. also stated Caffe is written in C++ which is developed by Y. Jia, BVLC centre. Caffe is also implemented with Python and Matlab. Cengil et al. also stated Caffe provides unit tests based on the best practises of software engineering for accuracy, experimental rigour, and installation speed. Cengil et al. also stated due to its flexibility and clear separation of the network concept from the actual implementation, the code is also well suited for research usage. Without writing any code, models and optimizations may be built and no noticeable difference between the CPU and GPU (Cengil et al., 2017). Cengil et al. also stated the image classification issue, which demands for processing with millions of images, can benefit from using Caffe because of the fast-processing speed.

2.3.4 Deep learning framework comparison

Table 2.1 Deep learning framework comparison

Deep learning framework	TensorFlow	Keras	Caffe
Similarity	• Open-source framework • Can be used for image processing. • Support python • Able to use the trained model on android		
Differences	• Low level deep learning framework • Work well on images and sequences	• High level deep learning framework • Best for building deep neural network.	• Low level deep learning framework • Work well on images except sequences and recurrent network