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ANALYSIS OF PARTIAL OCCLUSION ON HUMAN PEDESTRIAN DETECTION

SASINTHIRAN A/L THEVENDRAN

B011510322

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" I hereby declare that I have read through this report entitle **“Analysis of Partial Occlusion On Human Pedestrian Detection**" and found that it has comply the partial fulfilment for awarding the degree of Bachelor of Mechatronics Engineering”

Signature : .....

Supervisor's Name : .....

Date : .....

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ANALYSIS OF PARTIAL OCCLUSION ON HUMAN PEDESTRIAN DETECTION

SASINTHIRAN A/L THEVENDRAN

A **report submitted in partial fulfilment of the requirements for the degree**

Of Bachelor of Mechatronics Engineering

Faculty of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2018

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"I declare that this report entitle" **Analysis Of Partial Occlusion On Human Pedestrian Detection** "is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree"

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ABSTRACT

Over the last few years, recognizing human in pedestrian surveillance system video is crucial for diverse application area. For an example, it can overcome the terrorism, some general social problems and violence by providing surveillance to the pedestrians. This also ensures to keep them in a very close watch for a secured environment. However, the main difficulty in human recognition is the occlusion of human and the light intensity. The common problems that influence the performance of human recognition system is the light intensity, distance of the camera, colour of the shirt or different poses of human. Occlusion can be happen in different ways, human with human or human with objects. In this system, a Webcam camera is used to analyse the recognition when the occlusion happens. Python software, OpenCV library and Keras API are used to train the system to recognize the human. Haar Cascade is used to track humans and the Convolutional Neural Network is used to classify the human models. The webcam camera captures the image and recognizes the human that passes by it. The data is taken from the real time video of the system and is used to analyse the accuracy and performance of the system. The analysis proved that this system has high accuracy in recognizing human which is 97.35% of accuracy. It only has 2.65% rate of error. The occlusion analysis shows that the accuracy decreases as the occlusion increases. Then, the results clearly shows that moderate lighting is the perfect lighting for this system and when the distance increases the accuracy decreases. The distance problem maybe caused by the ability of the camera. So, this system performs very well in human recognition and it also has high accuracy.

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ABSTRAK

Kebelakangan ini, pengesanan manusia dalam video sistem pengawasan pejalan kaki amat penting untuk pelbagai aplikasi. Sebagai contoh, ia dapat mengatasi keganasan dan masalah sosial dengan mengawas pejalan kaki. Ini juga memastikan mereka sentiasa berada di bawah pantauan untuk persekitaran yang terjamin. Walaubagaimanapun, kesukaran utama dalam pengesanan manusia adalah oklusi manusia dan keamatan cahaya. Masalah umum yang mempengaruhi prestasi sistem pengesanan manusia adalah keamatan cahaya, jarak kamera, warna pakaian atau pose manusia yang berbeza. Oklusi boleh berlaku dengan pelbagai cara yang berbeza, manusia dengan manusia atau manusia dengan objek. Tujuan projek ini adalah untuk mengesan pejalan kaki dengan menggunakan kaedah Haar Cascade dan juga kaedah Convolutional Neural Network. Kemudian, objektif kedua sistem ini adalah untuk menganalisis prestasi sistem pengesanan manusia apabila berlakunya oklusi. Dalam sistem ini, kamera Webcam digunakan untuk menganalisis pengesanan manusia apabila oklusi berlaku. Perisian Python, OpenCV library dan Keras API digunakan untuk melatih sistem untuk mengesan manusia. Haar Cascade digunakan untuk mengesan manusia dan Convolutional Neural Network digunakan untuk mengklasifikasikan model manusia. Kamera webcam merakam imej dan mengenali manusia yang melaluinya. Data diambil dari video masa sebenar sistem dan digunakan untuk menganalisis ketepatan dan prestasi sistem. Analisis ini membuktikan bahawa sistem ini mempunyai ketepatan yang tinggi dalam mengiktiraf manusia iaitu sebanyak 97.35%. Ia hanya mempunyai kadar ralat sebanyak 2.65%. Analisis oklusi menunjukkan bahawa ketepatan semakin berkurang apabila oklusi semakin bertambah. Kemudian, hasilnya dengan jelas menunjukkan bahawa pencahayaan sederhana adalah pencahayaan yang sempurna untuk sistem ini dan apabila jarak kamera meningkat, ketepatannya menurun. Masalah jarak kamera mungkin disebabkan oleh keupayaan kamera. Oleh itu, sistem ini berfungsi dengan baik dalam mengesan manusia dan ia juga mempunyai ketepatan yang tinggi.

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LIST OF SYMBOLS

γ = Wavelength

C = Speed Of The Light

E = Energy

F = Frequency

H = Planck 's constant

$ii(x, y)$ = Integral Image

$\mathbf{i}(\mathbf{x}', \mathbf{y}')$ = Original Image

$s(x, y)$ = Cumulative Row Sum

X = Input Vector

H = Vector Of N Neurons

Y = Output Vector

w_{ki} = Weight

w'_{ij} = Weight between i^{th} Hidden Layer And j^{th} Output Layer

W1-Wk = Weight Vector

F =Nonlinear Function

Y = Scalar Output (Prediction)

F =Takes A Weighted Sum

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LIST OF ABBREVIATION

CNN = Convolutional Neural Network

SVM = Support Vector Machine

ROI = Region Of Interest

HOG = Histogram Oriented Gradient

DPM = Deformable Part Model (DPM)

TP = True Positive

TN = True Negative

FP = False Positive

FN = False Negative

API = Application Programming Interface

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CHAPTER 1

INTRODUCTION

1.1 Motivation

A pedestrian is a person who travels on the road either by walking or running. Nowadays, the highest rate of crimes happen mostly to pedestrians walking on the road especially at night. Such crimes include murder, robbery, theft and rape. Thus, the pedestrians themselves feel very insecure about their safety out there.

Based on a recent research, it was clearly stated that every year, more than 270000 [1] pedestrians become prey for such crimes mentioned above. News about these crimes are always being flashed in the newspaper, television and also social media daily. Based on the PDRM statistics, it can be clearly proven that these crimes are becoming more popular than before. The gang related crimes are becoming a trend nowadays and is increasing day by day. Besides, the pedestrians themselves also break the law of the roads. This leads to losing their valuable life. The carelessness of the people also affect the safety of others. Only few cases have been caught by the police but there are still many without the right proves. Figure 1.1 shows some cases that the police have caught.

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TYPE OF CRIMES EXPERIENCED	2012 to 2014 %	2005 to 2011 %
House theft	42.4	42.7
Snatch theft	76.4	70.8
Car theft	21.5	26.0
Theft in a taxi	9.0	4.2
Other theft	16.0	20.8
Physical assault	27.8	21.9
Rape	2.1	1.0
Other crime	16.0	8.3
Note: Only for those with direct experience of a crime		

Figure 1. 1: Statistic of crime cases in Malaysia 2005 – 2014 [1]

Apart of that, the children and women pedestrians are also becoming a main target for such crimes. Based on a statistic, it can be said that the child abduction is increasing drastically every year even when their parents are with them. The women pedestrians also feel very insecure about their safety while walking alone somewhere because of some criminals that take advantage of the women's weakness. Some of the victims of these cases have lost their life due to bad health condition after the abuse and also some by committing suicide. Figure 1.2 shows the statistic of children abduction in Malaysia.

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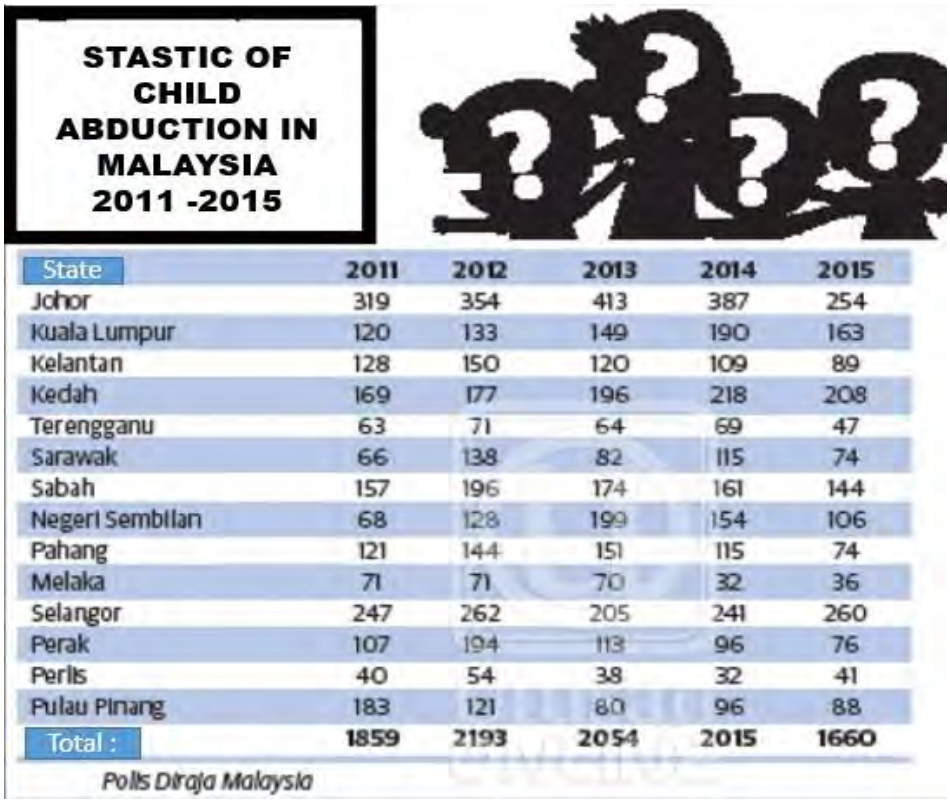

State	2011	2012	2013	2014	2015
Johor	319	354	413	387	254
Kuala Lumpur	120	133	149	190	163
Kelantan	128	150	120	109	89
Kedah	169	177	196	218	208
Terengganu	63	71	64	69	47
Sarawak	66	138	82	115	74
Sabah	157	196	174	161	144
Negeri Sembilan	68	128	199	154	106
Pahang	121	144	151	115	74
Melaka	71	71	70	32	36
Selangor	247	262	205	241	260
Perak	107	194	113	96	76
Perlis	40	54	38	32	41
Pulau Pinang	183	121	80	96	88
Total :	1859	2193	2054	2015	1660

Polis Diraja Malaysia

Figure 1. 2 : Statistic of child abduction in Malaysia [2]

So the researchers have found a solution to catch the criminals and also to reduce the rate of crimes in Malaysia at which the solution is “Human pedestrian recognition for surveillance system”. The researchers feels that it can reduce the crimes and also help the police by providing them with evidence to sentence the criminal. The most important outcome of this system is that the pedestrian themselves will feel very secure from the crimes.

All these points mentioned above shows the importance of the “pedestrian recognition system”. It also gives us prioritize in introducing this new system. This system surely can reduce the criminal activities happening to the pedestrians on the road. It can also be an effective way to reduce the feel of insecurity of pedestrians. To overcome the crime activity that being spread on the pedestrian walk or can be said the spread of the street crime, maybe this human recognition system can be the most suitable system to be used and this system also will improve the features of the current surveillance system.

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1.2 Introduction

Computer vision [3] is a field that focuses on how computers can understand the images or videos that are being recorded by the camera. The previous researches about image processing show the difficulties faced in the computer vision field. So currently, the researchers are mainly focusing on how to develop the computer vision field to become easier. There is a close relationship between the computer vision and pedestrian recognition system which is the image processing. The usage of the real time pedestrian recognition system has increased nowadays and it has also become a new innovative development for mankind. Besides, it is also a useful tool for research in detecting, tracking, analysing and counting the behaviour of an object in the video. There are a lot of variance that can influence the human recognition system. The researchers are still finding many ways to make the recognition system works easier and faster. The video and image analysis is becoming more popular and have high demand in market because of its wide applications with rapid growth in the technology of camera. This system has a new section for human recognition and also will help to track down the human. The human recognition system can be a way to analyse human behaviours, to count humans and the most important thing is it can be used for security purposes. Figure 1.3 shows an example on how human is detected when they pass by the camera.

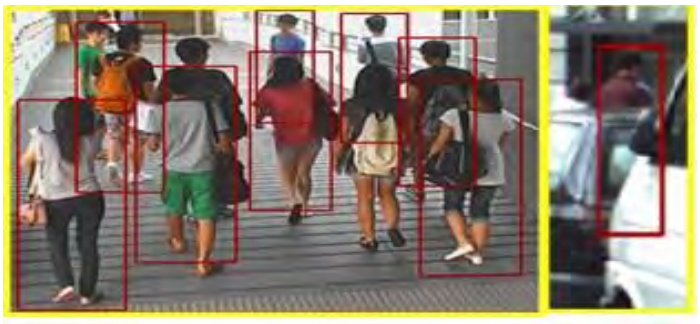

Figure 1. 3 : Human pedestrian detection system [5]

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The basic parts in this system are object detection, object segmentation and object recognition. Object detection is the process of finding entities of some real-world objects such as humans, faces, cars in the form of images or videos. This pedestrian recognition system should detect humans with a bounding box around each of them.

Object segmentation is also one of the part in image processing to build this system. Object segmentation is the process of extracting the target object from the videos or image sequences. The object that we want to focus is the human and the background of the image, therefore the segmentation should highlight the pedestrian in this system.

Lastly, object recognition is the most important part in this system. Object recognition is a very difficult part in computer vision and it requires more data to train or teach the computer. More time is required to train and analyse the computer. This system must detect the object and recognize it by comparing the object with the database whether it is person A or person B according to their face and body parts.

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1.3 Problem Statement

In today's world, the real time human pedestrian recognition system plays an important role in pedestrian safety purpose. The recognition system has the ability to recognize a person and store the information into the database for future usage. Each and every task in this human recognition system takes place automatically. This recognition system can be used for various applications such as sign board recognition, safety surveillance system, car manufacturing and etc. The recognition system actually works by enabling a computer to identify an object. The computer originally sees the objects in a form of big matrix of pixels and numbers of representations. Humans can easily classify any objects from an image or video through their eyes whereas the computers have no idea with what is in an image or video because it can only see numbers and matrices. Hence, the computer requires more data to calculate and extract the features so that the object can be identified.

Besides, to enable a computer to identify an object such as human, there are many problems to be faced. The very first problem is the viewpoint difference, which is the difference in heights of the humans that makes the computer less precise when it comes to recognition. Secondly, the distance between the camera and the human also influences the detection process where if the pedestrian is not within the range of detection, it might affect the camera detection. The third problem is the light intensity. It is also one of the biggest challenges in this system. Different lightings and environments increase the difficulty in detection of the camera to track human. Besides, human wear is also a problem in this system. When the human wears different types of clothes, colours and styles, it is hard to find the universal representation of a human. Apart from that, the recognition system must be able to handle the occlusion of humans as well. Occlusion can be happen in different ways, human with human or human with objects. So, Occlusion might affect the accuracy of the system.

Therefore, this recognition system requires more data of humans to improve the accuracy of the system as well as to handle the problems mentioned above. The higher the number of data, the higher the accuracy of the computer to learn and recognize human.

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1.4 Objectives

This project will embark on the following objectives:

1. To recognize the human pedestrian by using Haar Cascade and Convolutional Neural Network methods.
2. To analyse the performance of the human recognition system when occlusion happens.

1.5 Scope and Limitation

This project is mainly focuses on indoor pedestrian walk and twenty person's datasets are used for the training and testing of the system. The main parts in this system is detection and recognition. The webcam camera records the real time video and sends the recording data to the computer to display the video stream. The frame rate of the video stream is set constant at about 60 frame per second (FPS) by adjusting the coding. Besides, the computer vision techniques are done by using the Python software which is the easiest language. Then, the Haar Cascade and Convolutional Neural Network by Keras API methods are used to classify the features. Three experiments are conducted in this system by using twenty pedestrians and at four different places. The analysis or experiments are mainly focused on the performance of the system when the occlusion happens.

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CHAPTER 2

LITERATURE REVIEW

In this section, several studies have been conducted regarding “Human Pedestrian Detection and Recognition System”. The flow of studies started from techniques used, software used, effective methods used and algorithms used to detect and recognize the human in the real time video stream. Many studies have been conducted to find the best technique to detect and recognize human. This chapter will explain about all the studies from previous researches and also analyse their comparisons to find a very suitable method for this system.

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2.1 Theoretical Background

Human recognition is the most fundamental task in this project. This chapter will introduce several works and techniques that are related to the human pedestrian detection and recognition. There are several researches on successful detection and recognition of human and various methods are used to perform these detection tasks. This project mainly focuses on human pedestrian recognition which needs to be performed in real time video stream. The images or videos that have been captured by camera (vision system) must be able to detect human pedestrians and recognize each of those whom are passing by the camera. As all knowns, human exist in multiple size, heights and colours. In order to develop a system to recognize human, first step will be finding all the techniques and understanding the methods involved. So, all the researches are performed based on human recognition.

The fundamental knowledge that is needed to ensure the succession of project is the knowledge of machine vision and deep learning. Machine vision focuses on image processing whereas deep learning focuses more on artificial intelligence. Both studies are very important for this project because the methods in those studies will be used for this project to recognize human. Researches are needed when choosing suitable methods, software and libraries because the best selections can lead to the succession of the project and always works around the scope of the project. Besides, the data and information that are gathered from the previous researches might be able to improve the understanding in methods and techniques used and also able to find out the problems and solutions that the previous researchers have handled. Hence, from the studies conducted, this project can be prevented from any kind of problems that have been faced and handled by the previous researchers and also will be a way to improve the knowledge in human recognition system.

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