

DEVELOPMENT OF ALGORITHM OF CLASSIFICATION BETWEEN
HUMAN AND NON-HUMAN

RAMIZA MOHD YUNUS

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43500 Semenyih,
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Signature :
Supervisor's Name : Masrullizam bin Mat Ibrahim
Date :

For beloved Mama and Papa.

APPRECIATION

Endless gratitude towards the Almighty Allah for His grace I have completed Bachelor's Degree project. I would like to take this opportunity to express my gratitude to all who have helped me throughout the completion of this project. Especially to my supervisor, Encik Masrullizam Mat Ibrahim for his support and guidance. Not to forget to my family, lecturers and friends, thanks for being supportive and helpful, may God will return your good deeds.

ABSTRACT

Human detection has widely used in computer vision development. Classifying a moving object as a human or non-human has a practical value to apply in many areas for example security surveillance. This paper discussed the development of algorithm of classification between human and non-human using Support Vector Machine (SVM) to classify an image as a human or non-human. The software development using Support Vector Machine algorithm in MATLAB will be trained and tested to sets of images. Support Vector Machine is a set of related supervised learning methods for classification and regression. The images are evaluated using the algorithm which will construct separating hyperplane which maximize the margin between two data sets. The tested algorithm thus will process image input and decide which class the new image belongs to. This developed algorithm based on Support Vector Machine thus classifies the object in an image between human and non-human.

ABSTRAK

Aplikasi untuk mengesan kehadiran manusia banyak digunakan dalam pembangunan visual komputer. Penentuan sesuatu objek sebagai manusia atau tidak mempunyai nilai praktikal yang boleh diaplikasikan dipelbagai bidang contohnya sistem kawalan keselamatan. Kertas projek ini membincangkan pembangunan algoritma untuk pengklasifikasian imej sebagai manusia atau tidak menggunakan algoritma *Support Vector Machine (SVM)*. Pembangunan perisian menggunakan *Support Vector Machine* dalam perisian MATLAB dilatih dan diuji dengan set-set berlainan imej. *Support Vector Machine* adalah satu set cara-cara pembelajaran yang dipantau untuk pengklasifikasian dan regresi. Algoritma tersebut akan mengevaluasi imej-imej kemudian membina *hyperplane* yang memaksimumkan marjin antara dua set data. Algoritma yg diuji kemudian akan memproses masukan imej dan kemudian memutuskan imej tersebut tergolong di sesebuah kumpulan. Algoritma yang dibangunkan berdasarkan *Support Vector Machine* akan mengklasifikasikan sesuatu objek di dalam imej sebagai manusia atau tidak.

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LIST OF ABBREVIATION

SVM	–	Support Vector Machine
IPT	–	Image Processing Tool
PC	–	Personal Computer

CHAPTER I

INTRODUCTION

1.1 Project Background

An innovation of the present security system, the goal of the project is to develop an algorithm for a classification between human and non-human. Using suitable software, an algorithm will be developed for implementation of classifying an image. This project is to develop the algorithm based on related supervised learning methods which can be implemented on classification and regression where those are the base of this algorithm development. The image that has been captured can be processed and then classify the object either as human or non-human. This algorithm is one of the security and safety criteria that could be implemented in smart security camera or safety equipment onward.

1.2 Problem Statement

Physical security and safety system nowadays is very crucial. Since the present security and safety tool is very manually intensive to monitor, the carelessness of human nature can lead to undesired accidents.

Based on the system itself, there are many aspects that need to be improved. The present system is more likely PC-based, which gathers the videos to be monitored, which also relies on a network between the system, the cameras, and the people who monitor. So the speed of the system may be slow for the effectiveness of the system. More cameras mean more video footage to be monitored, which will lead to the issue of the watcher's concentration. Furthermore, more manpower is needed to monitor these systems as it leads to cost issues, trust issues, and concentration.

According to the above, a better or more sophisticated system needs to be developed, as it will help to enhance the present system to work far better. Not only applying to the security system, which are widely used, but also as an add-on to the safety system for upgrading the safety issue in human life.

1.3 Objectives

Below is the predefined objective and main purpose of this project. This objective outlines the needs in this project, which is important in ensuring the development and success of the project.

The project aims to develop an algorithm of classification. This algorithm is developed based on a set of related supervised learning methods. The goal of this

algorithm is to classify an input image as human or non-human. This provides analysis to the output to ensure the effectiveness of the algorithm.

1.4 Scope of Work

This project is solely concentrates in developing the classification algorithm. The algorithm is built in the MATLAB software environment which is one the efficient software in dealing with matrix, calculation and computation algorithm. The algorithm will set in the parameters in different hyperplanes separated by a margin to verify the object in an image as a human or non-human.

In the system algorithm, the parameters are determined from a set of training data to constructs a classifier. Then it will assign new data to one of the categorical levels of the response. The training data is a set of data gathered by the programmer which will train the classifier to classify the object given is human or non-human. Thus, the algorithm will be tested with other set of data to verify the algorithm's classifier. Finally, image input will be inserted in order to test the effectiveness of the algorithm.

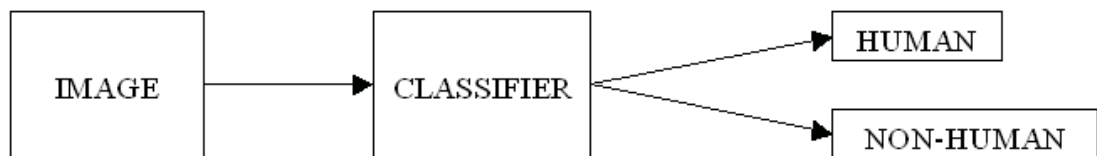


Figure 1.1 System Block Diagram

Figure 1.1 shows the overall system block diagram. The image input will be processes by the classifier which had been constructed earlier. The classifier then will classify the image as a human or non-human.

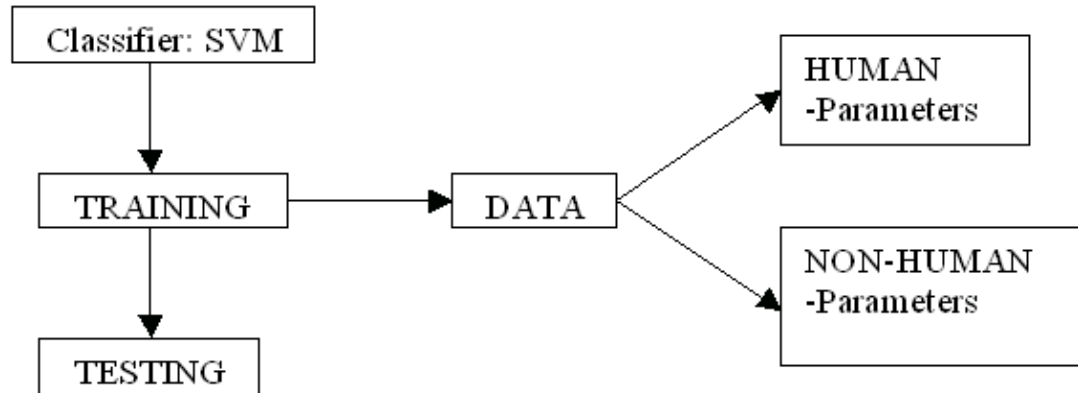


Figure 1.2 Classifier Block Diagram

Figure 1.2 shows the classifier block diagram. Using Support Vector Machine algorithm, the classifier is trained with set of training data. These data will insert the parameters of human to construct the classifier. The classifier then will be tested using a set of testing data to verify the constructed classifier.

1.5 Brief Methodology

Methodology discusses the steps of work engaged in developing the project. It started with gathering information and research that is related to this project. Based on information gathered, MATLAB was chosen as the platform to develop this algorithm. Thus, the algorithm developed was trained and tested before inserting image data that are different from the sets of training and testing data. Finally, the outputs are discussed and analyze to check the function and effectiveness of the algorithm.

1.6 Report Structure

This report discusses overall the development of the algorithm of classification between human and non-human. This report is consisting of five chapters, which will cover all the matter that should be discussed in developing this project.

Chapter I give out the information of the introduction to this project. It is including the project background, objectives to achieve from this project, the project problem statement, scope of work and project methodology.

Chapter II contains literature review. It discusses the literature review of the background that is needed in this project. It is about all the study that has been made for this project. It will explain the techniques used in gathering the information, the theory and the case study of previous projects. The literature review will produce a work concept to show the connection between the project with theory and concept.

Chapter III is about project methodology. It will explain the implementation and solution in doing this project. It consist the overall system and the algorithms needed in the system. Methods used in this project are clearly pointed out such as data collection, data process and analysis, system model, flowchart and et cetera. Factors that were weighed out in selecting the methods and the advantages are also pointed out.

Chapter IV presents the result of this project. This chapter also includes the analysis of this algorithm development. This chapter will discuss the result accordingly to the objective stated earlier in this project.

Chapter V, is the final chapter which summaries the research findings. This chapter also identifies problems and obstacles throughout this research. Some suggestions for future work is discussed which might be useful for further development and improvement to the algorithm and also the implementation of the algorithm.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter concludes all the techniques used for research and fact finding. Sources are obtained from various media by including keywords such as “classification between human and non-human”, “classifier”, “Support Vector Machine”, “MATLAB” and “human detection”. From these, information is gathered from previous projects. Relevant case studies are essential to carry out the similar yet a better system. Previous projects, studies and et cetera help in analyze, compare and providing guidelines in producing this project. Theories and concepts that are related to the project development are also being studied here in order to petition for wise idea on construction of this project for a better outcome. Based on the review of the various supervised learning methods, the advantages and disadvantages of each approach and technique are discussed.

2.2 Fact-findings and Research

In this section, various method of fact finding is covered in collecting relevant information that has been used in project development. The significant and contributions of conducting research on the related survey areas are also outlined.

2.2.1 Fact-finding techniques

In system development, all the previous similar systems should be review and study. Sampling of documentation or article of existing similar system is a good start in knowing deeper to the core of the system. Research is carried out at this stage.

In research, any related information is collected using the fact finding techniques to collect information on the MATLAB abilities, image processing techniques, technique in detecting motion, system problem, opportunities and directives. This information is very important to verify the functional requirement of the system at the early phase of the project development.

Documentation or articles of previous studies are also searched via Internet. Most of the documents such as articles, white papers, thesis or journals were obtained from Institute of Electrical and Electronics Engineers (IEEE) website. This is helpful in gaining more information, solutions and idea that are relevant to this project.

2.2.2 The Important Of Research.

Research is very important in developing a system. Through research, all needed information can be study, analyze and compare in providing better system and develop its own criteria that will extinguish this project above others. Through research, all the impairments or the future study of the previous project should be consider in creating a similar system but better and has its own advantages.

2.3 Theory

There is always a theory lies behind every work that we do. Theory is the fundamental knowledge that should be learned in order to understand the application of the certain thing. This section will line out the theory that is fundamentals for this project.

2.3.1 Support Vector Machine

Support Vector Machines (SVM) is a set of related supervised learning methods used for classification and regression [1]. Viewing input data as two sets of vectors in an n -dimensional space, an SVM will construct a separating hyperplane in that space, one that maximizes the margin between the two data sets. Margin is defines as the width that the boundary could be increased by before hotting the data point [5]. To calculate the margin, two parallel hyperplanes are constructed, one on each side of the separating hyperplane, which are "pushed up against" the two data sets. Intuitively, a good separation is achieved by the hyperplane that has the largest distance to the neighboring data points of both classes, since in general the larger the margin the better the generalization error of the classifier.

Classifying data is a common need in machine learning. Suppose some given data points each belong to one of two classes, and the goal is to decide which class a new data point will be in. In the case of support vector machines, a data point is viewed as a p -dimensional vector (a list of p numbers), either it can be separated such points with a $p - 1$ -dimensional hyperplane. This is called a linear classifier.

Given some training data, a set of points of the form,

$$\mathcal{D} = \{(\mathbf{x}_i, c_i) | \mathbf{x}_i \in \mathbb{R}^p, c_i \in \{-1, 1\}\}_{i=1}^n \quad (2.1)$$

c_i is either 1 or -1 , indicating the class to which the point \mathbf{x}_i belongs. Each \mathbf{x}_i is a p -dimensional real vector. Maximum-margin hyperplane which divides the points having $c_i = 1$ from those having $c_i = -1$. This is show in Figure 2.1 below.

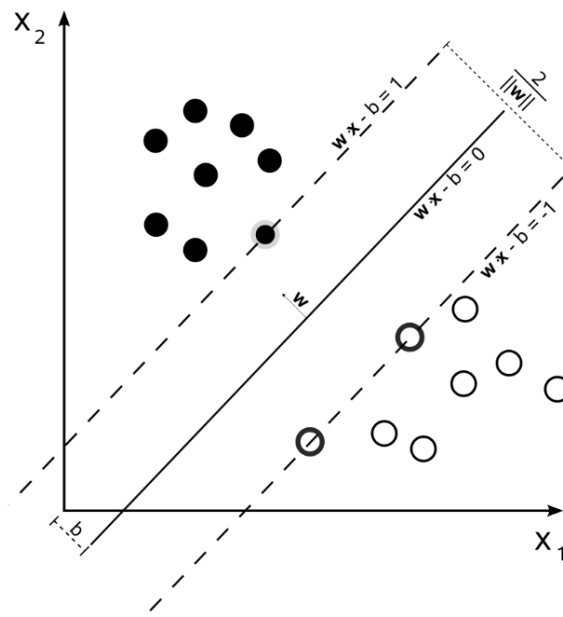


Figure 2.1 Margin Hyper plane

Maximum-margin hyperplane and margins for a SVM trained with samples from two classes. Samples on the margin are called the support vectors.

$$\mathbf{w} \cdot \mathbf{x} - b = 0. \quad (2.2)$$

The vector \mathbf{w} is a normal vector: it is perpendicular to the hyperplane. The parameter $\frac{b}{\|\mathbf{w}\|}$ determines the offset of the hyperplane from the origin along the normal vector \mathbf{w} .

\mathbf{w} and b is chosen to maximize the margin, or distance between the parallel hyperplanes that are as far apart as possible while still separating the data. These hyperplanes can be described by the equations

$$\mathbf{w} \cdot \mathbf{x} - b = 1 \text{ and} \quad (2.3)$$

$$\mathbf{w} \cdot \mathbf{x} - b = -1. \quad (2.4)$$

There are few reasons why to choose the maximum boundary. Firstly, intuitively is the safest. Secondly, if there is a small error made in the location of the boundary, it gives the least chance of causing a misclassification. Lastly, empirically, maximum margin works well [5].

There are several feedbacks about Support Vector Machine. It is said to be work very well in several studies [3] [5]. It is also said is easier to handle than neural network, another learning method for classification and regression [3].