REMOVAL OF OBJECT'S SHADOW

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To my beloved wife, my son , my mother and father,
my mother and father in law
for their encouragement, support and ‘doa’.

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ABSTRACT

During bright day light or under strong lighting condition, shadows will appear and be part of an object in image. Object' shadow in images may cause problem to several important algorithm in the fields of image processing such as object recognition, segmentation and object tracking. Removing the shadows can greatly improve the result of the image processing. To tackle this problem then, this project is divided into three parts; eliminating the surrounding objects of object interest, detecting shadows region and removing the object's shadow. This project used moving object images to distinguish between object focusing and objects will be eliminated in image. Support Vector Machine (SVM) was used to classify the image into shadow and non-shadow region based on texture features. Then, the image of detected shadow region was differentiated with original image to remove the shadow. In this project, Matlab and Image Processing Toolbox were utilized and OSU-SVM was used as interface SVM to the Matlab environment.

ABSTRAK

Semasa cahaya hari terang atau disebabkan pengcahayaan yang kuat, baying akan kelihatan dan menjadi sebahagian daraipada objek di dalam imej. Bayang objek yang berada di dalam imej ini boleh menimbulkan masalah terhadap algorithm-algorithm di dalam bidang pemprosesan imej seperti pengiktirafan terhadap objek, segment terhadap imej and menjejaki objek. Dengan menghilangkan bayang tersebut, ia dapat memberikan keputusan yang baik terhadap pemprosesan imej. Dalam menyelesaikan masalah ini, projek ini telah dibahagikan kepada tiga bahagian; menghilangkan objek di sekitar objek yang difokus, mengesan bahagian bayang dalam imej dan menghilangkan bayang tersebut. Di dalam projek ini, imej dari objek yang bergerak digunakan untuk membezakan antara objek yang difokus dengan objek yang perlu dilenyapkan. Support Vector Machine (SVM) pula digunakan untuk mengesan bayang dengan mengkelaskan imej kepada bahagian bayang dengan bahagian bukan bayang berdasarkan tekstur pada image tersebut. Kemudian, imej bayang yang telah dikesan akan dibandingkan dengan imej asal bertujuan menghilangkan bayang tersebut. Di dalam projek ini perisian Matlab dan perkakas pemprosesan imej digunakan. Manakala OSU-SVM digunakan sebagai pengantara SVM dengan persekitaran perisian Matlab.

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n	-	The dimension of the classified vector, i.e. the number of features
$h(x, w)$	-	set of continuous classifying function
$P(x, y)$	-	cumulative probability distribution
R_{emp}	-	the empirical risk for misclassification in the test set
R	-	the risk for misclassification in the test set
d	-	the VC dimension
M	-	the number of the training samples
η	-	the bound for risk of misclassification holds with probability 1 . $\eta, 0 \leq \eta \leq 1$
$x \in R^n$	-	a learning rate of a linear learning machine
$w \in R^n$	-	a weight vector
b	-	a bias of the separating hyperplane
$f(\mathbf{x})$	-	the function defining a separating hyperplane
y_i	-	a label for a sample vector $\mathbf{x}_i$, $y = +1$ or $y = -1$
x^+	-	a sample belonging to positive class
x^-	-	a sample belonging to negative class
x^0	-	a sample on a separating hyperplane
γ	-	the geometrical margin between positive and negative class
L	-	Lagrange function
W	-	a cost function in the dual representation of the Lagrange optimization problem
$\alpha = (\alpha_1, ., \alpha_M)^T$	-	Lagrange multipliers for all samples
$\#SV$	-	the number of support vectors
C	-	the upper bound for elements of$\boldsymbol{\alpha}$, error penalty for SVM training

$K(x_i, x_j)$	-	Kernel function
$\sum_i \sum_j P_d(i,j)$	-	Matrix of image
α_i	-	Langrage multiplier
E	-	Brightness of pointed object

LIST OF ABBREVIATIONS

IDM	Inverse Difference Moment
PCNN	Pulse Coupled Neural Network
SVM	Support Vector Machine
VC	Vapnik-Chervonenkis

CHAPTER 1

INTRODUCTION

1.1 Overview

Shadows are physical phenomena occur when object direct light projected, and appear in image during bright day light or under strong lighting condition and any sources of illumination. Shadow is always classified as an object which is normally connected together with the object. The patterns of shadow rely on size of objects and the angles of lighting source. In this project the aim is to remove the shadow of object of interest. In object recognition, shadows cause difficulty in differentiating and classifying object of interest. In this project, object of interest are moving objects obtained from frame differencing. Therefore, any static objects will be ignored. Hence, the main purpose to remove the shadow of these moving objects is to overcome the problem of object recognition and object classification.

1.2 Scope of Project

Even though the goal of this project is to remove shadow fro moving objects, the input image used will be image frames rather than video. The image differencing process is not covered in this project and thus input image will consist only of the object of interest plus the shadows. These image may be in color (24 bits) or grayscale (8 bits).

This project is mainly a software based and thus the software tool used through out this project is has been Matlab. As for the classifier, Support Vector Machine (SVM) has been employed. To be precise OSU-SVM developed by Junshui Ma and Yi Zhou was used.

1.3 Methodology

This project will be divided into three parts. Figure 1.1 shows the flow of the project that start with eliminating the surrounding object which aims to focusing the main object. The next stage, image is processed to detect the object's shadow by using Support Vector Machine. Lastly, after object's shadow detected, shadow will be removed.

In the first part, there are two frame are captured from the video file. These two frames will then undergo frame differencing process to obtain moving objects. Before the images are processed, they must be filtered so as to get clear images. The next part is the detection of the object's shadow. In this part each object will be classified into either

the shadow region or the non-shadow region. Only the shadow region will be produced by the classifier.

SVM is a classifier used in this project. It involves two main components; training component and testing component. In the training component, data samples of data are used similar to concept of machine learning based approach [1]. Basically, this is applied to many classifiers such as neural network and bayes classifier.

In the testing component, there are samples used are different from samples data that used during the training part. Testing component is an experiment session where the performance of the classifier is analyzed based on the data and parameter obtained fro the training session.. This part is discussed detail in Chapter 4 for the methodology of SVM and chapter 5 of the application of SVM in this project.

The last part is the process to remove the shadow. The procedure used is similar to the first part where there the two image will be subtracted to each other. In this part the image are from output of the SVM and input of the SVM. The result will be only object with their shadows have been removed. The process of subtracting and filtering of images are discussed in detailed in Chapter 4.

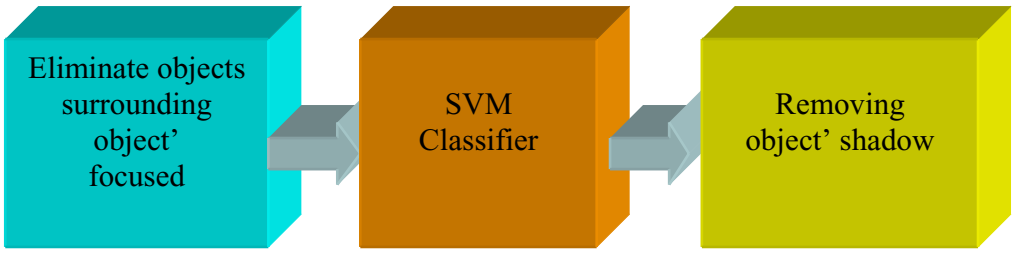

Figure 1.1: Methodology of project

1.4 Thesis Organization

This thesis is divided into seven chapters. Chapters 1 explained the objective, scope of this project and project methodology. Chapter 2 gives of the literature review of removing the shadow. There are several approaches how the shadow can be removed introduced and mostly focusing on tackling the problem of identifying the shadow in image. In this chapter also there is literature review on the Support Vector Machine (SVM) which used to classify the interest region in image. In this project SVM was used to classify shadow and non shadow region.

In Chapter 3 the processing of image is discussed. There are two processes involves; subtracting process and sharpening process. Subtracting process is an operation to obtain the differencing between two frame images. In this project the differencing frame is differentiated the moving object and the static object. The sharpening process is an operation to obtain the quality image.

Chapter 4 discussed the fundamentals of Support Vector Machine that is applied in this project for classifying the region of shadow and non-shadow. In Chapter 5 is discussed how the SVM implemented used OSU-SVM toolbox. Features of texture are used as data to train the SVM where extracted by gray level co-occurrence (GLCM). Chapter 6 is the result of the project, and Chapter 7 is conclusion of the project and future proposed.

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