

OBJECT SEGMENTATION IN STILL IMAGES
USING TOPIC MODELLING METHOD

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*Specially dedicated
to my supervisor and family who encouraged
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ABSTRACT

One of the key components towards achieving high performance automated visual-based object recognition is the quasi-error free object segmentation process. Being an important integral part of many machine vision as well as computer vision systems, a tremendous amount of effort in object segmentation has been proposed in the literature. One of these approaches is the work that implements Probabilistic Graph Modelling (PGM) techniques. PGM is a rich framework for calculating probability and statistics in large given data sets and fields. One of the comprehensive methods in PGM is the Topic Modelling (TM) method introduced in the early 2000. TM has shown to be successful in classifying humongous information related to text and documents and has been implemented in many online search engines. Since image contains huge amount of information (in terms of pixels), segmentation of this information into meaningful region of interest (in this case objects) does fit into the framework of TM. The objectives of this project are to implement and analyze the capability and efficiency of TM in recognizing objects found in stationary images. TM is a process where it uses approximation technique to discover important segment or structure based on object classification. However, to proceed with object classification, object segmentation is firstly executed, making object segmentation as the most important part in the system. Through TM, the classification can be done by grouping the pixels (superpixels) accordingly in order to clearly represent the object of interest. In achieving this goals, Open Computer Vision (OpenCV) library will be fully utilized. It is expected that the proposed method will be able to perform object segmentation with high confident similar to state-of-the-art methods.

ABSTRAK

Salah satu komponen utama ke arah mencapai pengiktirafan objek berasaskan visual berprestasi tinggi adalah proses segmentasi objek bebas ralat. Sebagai bahagian integral dari banyak penglihatan mesin serta sistem penglihatan komputer, banyak usaha dalam segmentasi objek telah dicadangkan dalam literatur. Salah satu pendekatan ini adalah kerja yang menggunakan teknik Pemodelan Grafik Probabilistik (PGM). PGM adalah rangka kerja yang kaya untuk mengira kebarangkalian dan statistik dalam set data dan bidang yang besar. Salah satu kaedah komprehensif dalam PGM adalah kaedah Pemodelan Topik (TM) yang diperkenalkan pada awal tahun 2000. TM telah menunjukkan kejayaan dalam mengklasifikasikan maklumat beban besar yang berkaitan dengan teks dan dokumen dan telah dilaksanakan di banyak enjin carian dalam talian. Oleh kerana imej mengandungi sejumlah besar maklumat (dari segi piksel), segmentasi maklumat ini ke rantau kepentingan yang bermakna (dalam kes ini objek) tidak sesuai dengan kerangka TM. Objektif projek ini adalah untuk melaksanakan dan menganalisa keupayaan dan kecekapan TM dalam mengenal pasti objek yang terdapat dalam imej pegun. TM adalah proses di mana ia menggunakan teknik penentuan untuk menemui segmen penting atau struktur berdasarkan klasifikasi objek. Walau bagaimanapun, untuk meneruskan klasifikasi objek, segmentasi objek pertama dilaksanakan, dengan itu membuat segmen objek sebagai bahagian paling penting dalam sistem. Melalui TM, klasifikasi boleh dilakukan dengan mengelompokkan piksel (superpiksel) dengan sewajarnya agar dapat mewakili objek yang jelas. Dalam mencapai matlamat ini, perpustakaan Open Computer Vision (OpenCV) akan digunakan sepenuhnya. Diharapkan kaedah yang dicadangkan akan dapat melakukan segmentasi objek dengan kepercayaan tinggi yang serupa dengan kaedah canggih.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	x
	LIST OF FIGURES	xi
	LIST OF ABBREVIATIONS	xii
1	INTRODUCTION	1
	1.1 Introduction	1
	1.2 Problem Statement	2
	1.3 Objectives	3
	1.4 Scope of Project	3
2	LITERATURE REVIEW	5
	2.1 Introduction	5
	2.2 Topic Modelling	6
	2.3 Object Segmentation	9
	2.3.1 Superpixel Algorithms	11
	2.4 Image Classification	14
	2.5 Summary	17

3	METHODOLOGY	18
3.1	Introduction	18
3.2	The Conceptual Framework	18
3.3	The Theoretical Framework	20
3.3.1	Supapixel Extraction using SLIC Algorithm	23
3.3.2	Haralick Features Computation	24
3.3.3	Probability Computation	28
3.4	Planning and Execution	30
3.5	Summary	32
4	RESULTS AND DISCUSSIONS	33
4.1	Introduction	33
4.2	Supapixel Segmentation	33
4.3	Classification Outcome	35
4.4	TM Efficiency	42
4.5	Summary	43
5	CONCLUSIONS AND FUTURE WORKS	45
5.1	Introduction	45
5.2	Project Achievement	45
5.3	Future Works	46
	REFERENCES	47
	Appendices A	53-59

LIST OF TABLES

TABLE NO.	TITLE	PAGES
3.1	Each object class will have 13 Haralick feature vectors stored in CSV file as the training data	26
3.2	This table shows the output for one superpixel segment computed from the minimum distance. The highest occurrence for this particular segment is belongs to object class '21' which labelled as 'TREE_middle'	28
3.3	Research plan and milestones	31
4.1	Printed outcome for each superpixel segment	36
4.2	Output data for testing images	42

LIST OF FIGURES

FIGURE NO.	TITLE	PAGES
2.1	Five topics out of 50-topics that related to Science are computed by using LDA model [17]	7
2.2	The document-term matrix (DTM) [19]	7
2.3	The texture-topic assignment. Variation of colours differentiate the distribution of topics [21]	8
2.4	The overview of image processing [11]	9
2.5	Image on the left is the difference between healthy optic nerve and optic nerve with glaucoma, meanwhile on the right is the image of optic nerve with glaucoma has been segmented using superpixel [31]	11
2.6	Superpixel segmentation using Normalized-Cut [35]	12
2.7	Superpixel segmentation using Turbopixels method. The superpixel distribution is more uniform and regularly in shape [38]	13
2.8	Superpixel segmentation using Simple Linear Iterative Clustering (SLIC) algorithm. The upper part consists of images with high compactness factor meanwhile the bottom part consists of images with low compactness factor [43]	14
2.9	Problems with Color Histogram [48]	15
2.10	Haralick texture features [51]	16
3.1	The conceptual framework of Topic Modelling [51]	19
3.2	The theoretical framework of Topic Modelling in object segmentation using still images	20

3.3	The image on the left is the object presence in still images. These objects are divided into several patches of images for training purpose	21
3.4	The illustration of topic assignment. Each superpixel is assigned to the topics according to the similarity in terms of colour or texture	22
3.5	The first set of images is referring to the process of extracting a single pixel from an image meanwhile the second set of images is a process of extracting a superpixel from an image	23
3.6	The framework for GLCM matrix for an image [45]	25
3.7	Each object class will have 13 Haralick feature vectors stored in CSV file as the training data	26
3.8	The process of calculating minimum distance for each Haralick feature. This process will be repeated thirteen times for each superpixel segment	27
3.9	The illustration on how superpixel can be misinterpreted during topic assignment	29
3.10	The probability computation using TM method	30
4.1	The superpixel segmentation with different number of superpixel regions generated, N	34
4.2	The example outcome for tree	35
4.3	The expected output for each superpixel segment	36

LIST OF ABBREVIATIONS

PGM	-	Probabilistic Graph Modelling
TM	-	Topic Modelling
LDA	-	Latent Dirichlet Allocation
DTM	-	Document-Term Matrix
SLIC	-	Simple Linear Iterative Clustering
MSRC	-	Microsoft Research Cambridge

CHAPTER 1

INTRODUCTION

1.1 Introduction

'Quasi-error' free object segmentation process' is the key to achieve high performance automated visual-based object recognition. Probabilistic Graph Modelling (PGM) techniques is a rich framework for calculating probability and statistics in large given data sets and fields [1]. As mentioned previously, Topic Modelling (TM) is one of the methods in PGM. Topic Modelling (TM) has shown to be successful in classifying information related to text and documents and has been implemented in many online search engines [2].

Teks This project covers several key elements which are software design and object segmentation. First is on the software design where Open Computer Vision (OpenCV) is proposed to complete the project. OpenCV is a powerful open source computer vision library which can be written using a variation of language such as C++, C, Python, and Java. Python language is chosen because it has lots of references in OpenCV documentation [3]. Since the Python language is applied to the programming, the correct headers and libraries must be installed to ensure the current program can be compiled perfectly. Apart from that, OpenCV documentation also offers all sorts of templates, functions and interfaces which is very beneficial in the development of real-time project [4]. Since this project is all about object segmentation which will be based on an image, OpenCV therefore can be considered the best library

for this purpose. In addition, OpenCV also provides simplified version of modules and packages for the user to learn and understand the operation of OpenCV.

PGM is a method to analyze the information obtained from the object segmentation. One of the prominent method in PGM is called Topic Modelling (TM) method. TM is a process where it uses probability technique to discover important segment or structure based on object classification [5]. However, to proceed with object classification, object segmentation is firstly executed, thus making object segmentation as the most important part in the system.

The input image acts as the main source for the system, where the input image for the system will be a still image. These still images then will undergo object segmentation process. Each superpixel region in the segmented image will be addressed according to the topics (i.e. parts of objects) accordingly. The probability of superpixel distribution over the topics will be used to determine what object the superpixel belongs to. For that reason, through TM, the classification can be done by assigning each superpixel to the topics, where each topic will be assigned to the object of interest. In short, TM will compute and analyze the probability of superpixels to discover the topic in order to clearly represent the object of interest.

1.2 Problem Statement

The object segmentation should aim to have a very high accuracy with ‘quasi-error’ free so that other high level processing can be assisted such as recognizing the activities that are present in a given image. In object segmentation, the process is done by assigning every single pixels to the correct object.

However, accurate object segmentation is difficult to achieve since each pixel can be assigned to two or more objects including image background. According to [6], Topic Modelling (TM) has been applied in image segmentation where the texture

of each pixel is used. Every single pixel is analyzed in order to find a uniform texture-combinations [7]. Then, these texture-combinations will lead to the topic field which is recognized as segments.

TM is one of the approaches that uses probability in order to have more accurate and effective object recognition [8]. Therefore, TM can be applied in object segmentation where each pixel obtained from input image will be addressed, according to its similarity in term of colours and textures. In this project, the efficiency and capability of TM is improved by assigning superpixels to part of objects or segments, then the probability distribution will be computed in order to determine the object presence in a given image.

1.3 Objectives

In order to achieve high accuracy in object segmentation with low computational complexity, the objectives of this project are listed as below.

- (a) To utilize superpixels with Topic Modeling (TM) method in object segmentation.
- (b) To analyze the capability and efficiency of TM in recognizing objects found in still (stationary) images.

1.4 Scopes of Project

The scopes of project implies all the necessary and related works in completing this project.

- (a) The programming part will be done in Open Computer Vision (OpenCV).

- (b) Python language is chosen because it has lots of references in OpenCV documentation.
- (c) The input image for Topic Modelling (TM) method will be 'still images'.
- (d) Microsoft Research Cambridge (MSRC) Object Recognition Image Dataset is used.
- (e) Superpixels are generated by using Simple Linear Iterative Clustering (SLIC).
- (f) The Haralick texture feature is used to describe the texture of images.

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