# CLASSIFICATION ABNORMALITIES OF EYES USING BAG OF FEATURES FOR MEDICAL PURPOSE

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**This report is submitted in partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering with Honours**

**Faculty of Electronic and Computer Engineering**
**Universiti Teknikal Malaysia Melaka**

**2019**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**
FAKULTI KEJUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

**BORANG PENGESAHAN STATUS LAPORAN**
**PROJEK SARJANA MUDA II**

Tajuk Projek : CLASSIFICATION ABNORMALITIES OF EYES USING BAG OF FEATURES FOR MEDICAL PURPOSE

Sesi Pengajian : 2018/2019

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# DEDICATION

Thank you to all family members, my supervisor and friends for supporting me and their dedicated partnership.

# ABSTRACT

Bag of Features (BoF) is a model used to classify the eye images whether it is normal or abnormal for this project. Abnormal eye image is specified with Corneal acrus (CA) which a deposition of lipid around iris when the level of cholesterol in body is at high level. Iridology is an alternative method to detect diseases using iris's pattern observation. Region of interest is vital because CA is appeared 0.1 to 1mm from limbus of iris. In order to get correct ROI, this project applied Daugman's Integro differential operator (IDO) for segmentation and Daugman rubber sheet model for normalization process. Speeded up robust features is used as features extractor and K-mean clustering is used to cluster the databases. This is an automated screening system which will not feel discomfort and painless to users and patients because it is a non-invasive method. The result of this project showed that the category of eye images used as the testing set. The entire process is develop using Matlab R2018B.

# ABSTRAK

*Ciri beg (BoF) ialah satu model yang digunakan untuk mengklasifikasikan data imej mata sama ada ia normal atau tidak normal. Imej mata yang tidak normal dispesifikkan hanya Corneal arcus (CA) dan penyakit ini akan menunjukkan gegelang putih di keliling iris mata oleh kerana tahap kolesterol dalam badan di paras yang tinggi. Iridology adalah satu kaedah alternative untuk mengesan penyakit berdasarkan menganalisis corak iris. Dalam usaha mendapatkan Kawasan kepentingan, projek ini menggunakan pengendalian pembezaan integro oleh Daugman untuk segmentasi dan model getah oleh Daugman untuk process normalisasi. Pengekstrakan ciri-ciri imej dilakukan menggunakan mempercepatkan ciri-ciri dan K-kluster digunkan untuk komplasi pangkalan data. Projeck in merepukan system pemeriksaan automatic yang tidak menyakitkan pengguna dan pesakit kerana ia adalah kaedah bukan invasive. Categori akan dinyatakan bagi imej mata yang digunakan untuk set ujian untuk bahagian keputusan. Seluruh proses dilakukan mengunakan Matlab R2018B*

# ACKNOWLEDGEMENTS

First and foremost, praise is to Almighty Allah for all his blessings for giving me patience and good health to finish my final year project.

I am very fortunate to have Ir. Ridza Ramlee Bin Azri as my supervisor. I am greatly indebted to his ideas, encouragement, assistance, support, solid guidance and in-depth discussions he shared with me and in the preparation of the thesis. Without him tireless assistance, leadership, and confidence in my abilities, this thesis would not come to its timely completion.

Love and warmest thanks for my dearest parents; Samsudin Bin Lodin and Rohana Binti Othman, for your never-ending, support and encouragements throughout my education years. I would like to express my special thanks of gratitude to all my friends who have helped me a lot throughout the duration to complete this project and thesis. All of you have been a source of confidence and inspiration for me.

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List of Symbols and Abbreviations

For examples:

| | | |
|---|---|---|
| BoF | : | Bag of features |
| CA | : | Corneal arcus |
| ROI | : | Region of interest |
| IDO | : | Integro-differential operator |
| SURF | : | Speeded up robust features |
| SVM | : | Support vector machine |
| CASIA | : | Chinese Academy of Sciences- Institute of Automation |
| RGB | : | Red, green, blue |
| MMU | : | Multimedia University |
| CHT | : | Circular Hough transform |
| GLCM | : | Gray-Level Co-Occurrence Matrix |
| ASM | : | Angular second moment |
| PCA | : | Principal component analysis |
| ELM | : | Exact Lagendre moment |
| GM | : | Geometric moment |
| PZM | : | Pseudo Zernike moment |
| DCT | : | Discrete cosine transforms |
| ClusBus | : | Clustering-Based under-sampling |
| TP | : | True positive |
| FP | : | False positive |
| TN | : | True negative |
| FN | : | False negative |

| | | |
|---|---|---|
| Acc | : | Accuracy |
| Se | : | Sensitivity |
| Sp | : | Specificity |
| PPV | : | Positive predictive value |
| NPV | : | Negative predictive value |

# LIST OF APPENDICES

# CHAPTER 1

# INTRODUCTION

This chapter will briefly explained about the introduction of the project for background, problem statements, objectives and scope of work.

## 1.1 Project Background

Corneal arcus or also called arcus adiposus, arcus lipoides corneae or arcus senilis, is a white, grey or blue opaque ring in the corneal margin (peripheral corneal opacity), or white ring in front of the periphery of the iris. This opaque ring around the iris is a formation of lipid that caused by excessive levels of lipids present in the blood vein. The corneal arcus (CA) is an eye problem frequently faced by some group of people which frequently found in older peoples.

However, it can also happen to young people who have high level of lipid. Lipid can be deposited on the iris because an eye contains blood veins that connect with the blood vessels in the entire human body [1]. Therefore, CA can be diagnosed by examination of the iris of the eye or known as iridology. Iridology is an alternative method to detect diseases by iris's pattern observation [2].

This thesis focuses on providing screening method in order to classify normal eyes and CA. The iris recognition system consists of three steps. First step is developing pre-processing from real eye images to region of interest. Pre-processing consists of three major steps; converts eye images into grayscale, segmentation and normalization. Segmentation of eye images is based on Daugman's Integro-differential Operator (IDO) while Daugman's Rubber Sheet Model is used in normalization process.

Image classification using Bag of Features model include three phase which are feature extraction, clustering and classification. Different process using different method. Features extraction using speeded-up robust features (SURF) while clustering using K-mean clustering to differentiate it into two groups; abnormal and normal. Last step is to classify whether the eye image is normal or abnormal in by using support vector machine (SVM) classifier.

## 1.2 Problem Statement

There are many techniques can be used to detect CA. One of the current techniques to detect CA is eye examination using microscope called slit lamp exam. The examination will start with dilated patient eyes with dilating drops that will

widen the pupil. A yellow dye eye drops which known as fluorescein and phenylephrine are used as dilating drops. These drops allow the doctor to inspect blood vessels at the back of the eye for signs of disease and a build-up of abnormal material in the cornea is seen during slit lamp exam.

The disadvantages of this examination are when eyes are dilated, vision will be blurry and highly sensitive to light for several hours. Pupil dilation tends to last longer in people with lighter colored eyes and occasionally a child's eyes may be dilated for longer than 24 hours. Nauseous or eye pain also may be the effects after slit lamp exam. Therefore, sunglasses are recommended after this examination. This exam is invasive method that cause discomfort and pain to patients.

Next, blood test is or known as lipoprotein protein, one of the tests used to detect lipid which involves certain procedures. Patients must fast few hours before. If blood drawn in the morning, patient must fast since the night before. Disadvantage of this test is some of patients may feel slightly faint or have some soreness at the skin that the blood was drawn. The worst case is patient with needle-phobia, which extremely afraid of needle. This is also an invasive method which causes pain amongst many patients and take a long period of time to complete the test from fasting to draw the blood.

For that reasons, this thesis focus on an alternative to improve the method currently used to classify abnormalities of eyes using screening method. This system is useful as a screening method which it is non-invasive and painless to patient compared to current methods used in medical field.

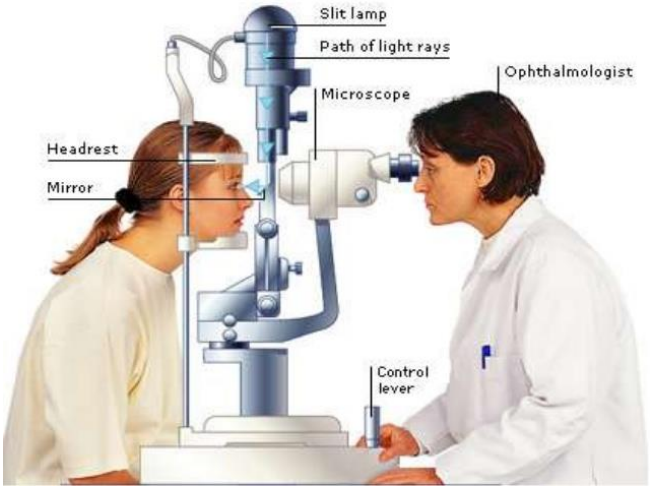


**Figure 1.1: Example of slit lamp examination**

## 1.3 Objective

The goal of this project is to construct a computer-aided-diagnosis system to classify normal and abnormal eyes. This system functions as a screening method that can be used in medical field.

The objectives of the project are:

1) To develop Pre-Processing from real image to region of image (ROI)

2) To produce segmentation and normalization of eye images using Daugman Rubber Sheet model.

3) To classify normal and abnormal image of eyes using Bag of Features Model

## 1.4 Scope of Project

The scope of the project will consist of three main parts, data acquisition, pre-processing and steps in BoF model.

- Data acquisition

There are two sets of data needed for the project which are database of the normal eye image and abnormal eye image. For normal eye images, database are obtained from Chinese Academy of Sciences- Institute of Automation (CASIA) [3]. Database for CA eye images are obtained from journal and medical website.

- Pre-processing

The aim for this step is to generate region of interest by undergo segmentation of eye image. Firstly, the real eye images are converted into grayscale. Image in grayscale have smaller pixel number as compared to red, green, blue (RGB) images. All images are converted to grayscale are to reduce complexity. Next step in pre-processing is segmentation. Segmentation is isolating the actual iris region in a digital eye image by cropping and eliminate the unwanted region. After all images are completely segmented, the last step in this process is to normalization. This step will transform iris region of all databases into a fixed dimension in order to allow comparisons.

- Feature Extraction and clustering

The normalized eye images of both categories, abnormal and normal will fed into the features extractor used. Next, number of centroids is obtained from clustering.

- Classification

All the databases that have been extracted and clustered will undergo classification. the category of the eye images will be classified when state the

filename of the eye image in the coding used.

## 1.5 Thesis Outline

Generally, the report consists of five chapters which explaining the introduction, literature review, methodology, results and analysis, and conclusion and future works respectively regarding this research.

In chapter 1, a brief introduction to the research project is introduced. It also contains the project background, problem statement, objectives of the project, and scope of the project that can give a basic understanding on what was the research's focus.

Chapter 2 will be discussing about the classification abnormalities of eyes using BoF in a more details manners. The basic principles are pre-processing, features extraction and classification. Data accusation, method used to obtain segmented image and region of interest. All of these are explained through literature review of journals and article gathered.

In chapter 3, the methodology of segmentation of eye image was presented. Parametric study of the parameter and an overview of the image segmentation, image normalization and feature extraction. More explanation on how classify works and performance evaluation is prepared to give the accuracy of this proposed method used.

Conclusion of the overall project and verification of objective are stated in chapter 5. Recommendation for future works is suggested as well in this chapter.

# CHAPTER 2

# BACKGROUND STUDY

## 2.1 Features of iris

Iris is a thin, circular structure in the eye that controls the pupil's diameter and allow certain amount of light before reaching the retina. Iris is an eye-contractile pigmented membrane suspended between the cornea and the lens. One of the features of iris is different iris contains different important body information [1]. Besides, this screening method to classify abnormalities of eyes can be used as pattern of iris can state one’s health [2]. Iris recognition can be trusted as there is no people in entire world would have the same iris pattern even though the identical twins [4].