DESIGN AND ANALYSIS OF AUTOMATED OPTICAL MARK RECOGNITION (OMR) SYSTEM USING IMAGE PROCESSING TECHNIQUE

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DEDICATION

To my beloved parents, family, and friends.

ABSTRACT

Optical Mark Recognition (OMR) technology has changed much in recent years. There are many way to test student knowledge in education such as objective, subjective and essays. Now the main component is the OMR software. It was proposed to be a replacement for the costly OMR machine. It also was proposed as the examiners in Malaysia still choose manual way to mark objective paper instead of using automated marking but the thing is, manual marking is inefficiency, inaccurate and time consuming since examiners have to mark first before manually key in the marks in Excel spreadsheet. Therefore, the objective of this project is to design an OMR system to mark and transfer the data to Excel spreadsheet. This OMR system is built by using MATLAB R2017a software. In this project, the position of the marked bubbles which already marked by the students will be identified and automatically be classified. Once the classification process is complete whether the students are pass or fail, the converted data will be saved and export into Microsoft Excel spreadsheet. The accuracy of this system also is calculated to be compared with other researchers' OMR system. Finally, the system can be concluded that it is able to contribute as data extraction system for educational purpose.

ABSTRAK

Teknologi Pengiktirafan Tanda Optik (OMR) telah berubah banyak sejak beberapa tahun kebelakangan ini. Terdapat pelbagai cara untuk menguji ilmu pengetahuan pelajar dalam pendidikan seperti objektif, subjektif dan esai. Komponen utama pada masa kini adalah perisian OMR. Ia dicadangkan untuk menjadi pengganti mesin OMR yang mahal. Ia juga dicadangkan kerana pemeriksa kertas jawapan di Malaysia masih memilih cara manual untuk menanda kertas dan bukannya menggunakan cara automatik untuk menanda, tetapi masalah sekarang adalah, tanda manual tidak cekap, tidak tepat dan memakan masa yang lama memandangkan pemeriksa perlu menanda terlebih dahulu sebelum memasukkan maklumat secara manual di dalam Excel. Oleh itu, objektif projek ini adalah untuk merekabentuk sistem OMR untuk menandakan dan memindahkan data ke Excel. Sistem OMR ini dibina dengan menggunakan perisian MATLAB R2017a. Dalam projek ini, kedudukan bulat yang telah ditanda oleh pelajar akan dikenalpasti dan secara automatik diklasifikasikan. Apabila proses klasifikasi tamat sama ada pelajar lulus atau gagal, data yang ditukar akan disimpan dan dieksport ke Microsoft Excel. Ketepatan sistem ini juga dikira untuk dibandingkan dengan sistem OMR penyelidik lain. Akhirnya, sistem dapat

disimpulkan bahawa ia dapat menyumbang sebagai sistem pengekstrakan data untuk tujuan pendidikan.

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I also want to take this opportunity to express a deep sense of gratitude to Universiti Teknikal Malaysia Melaka (UTeM) for giving me a chance to do Final Year Project as partial fulfilment for my degree programme. UTeM provides students with good environment and facilities to complete this project.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS AND ABBREVIATIONS

For examples:

OMR	:	Optical Mark Recognition
MCQ	:	Multiple Choice Questions
ROI	:	Region of Interest
UPSR	:	Primary School Achievement
PT3	:	Lower Secondary Assessment
SPM	:	Malaysian Certificate of Education
STAM	:	*Sijil Tinggi Agama Malaysia*
STPM	:	Malaysian Higher School Certificate
MES	:	Malaysian Examination Syndicate
ASCII	:	American Standard Code for Information Interchange
OCR	:	Optical Character Recognition
FPGA	:	Field Programmable Gate Array
RGB	:	Red, Green, Blue
PSM1	:	*Projek Sarjana Muda 1*
PSM2	:	*Projek Sarjana Muda 2*

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

This Chapter will discuss about the project background, objectives of the project, problem statement, scope of work, importance and significance, and thesis organization.

1.1 Project Background

Optical Mark Recognition (OMR) technology has changed much for a few years back. Now, instead of OMR machine, we focusing on OMR software. It is a replacement for the costly OMR machine. Usually for data collection and analysis, international companies and schools will use optical mark recognition. Examination are conducted using OMR solution sheet checking system because the conduction of exam is getting much easier, powerful and cheap [1]. OMR is the process of capturing human-marked data from document forms such as surveys and tests, also for responses

to a questionnaire or feedback form [2], [3]. OMR is also process of capturing data from the preparation form by recognizing the reflectance of patterns from the marked positions on the piece of paper [4]. The aims of this project is to develop OMR sheet scanning system using image processing technique.

Some of international examination have objective section which consists of Multiple Choice Questions (MCQ). The MCQ is common method chosen because in a short period of time, it facilitates the assessment of a broad range of learner knowledge. It is widely used in assessment because they can contain a large amount of questions, they are quick to administer, they are straightforward to mark, and they do not involve interpretation of answers that leads to teacher bias [5]. Basically students need to color the right box for appropriate answer based on the respective questions on the answer sheets by using 2B pencil. Normally a stencil is made by the examiners in Malaysia to determine the right answer to the question during the examining phase. This is a manual template matching process and counting mistake may occur [1]. Hence, to overcome this problem, OMR system is developed. Basically the designed software is to check the answer sheet and automatic display the results [2].

In this system we do not need to buy any specialized scanner because by using any scanner, we can do the required task. This project is designed to make the system very user friendly. Previously OMR system already developed by a team from Department of Electrical and Electronics Engineering, Maharashtra Institute of Technology, Aurangabad in India during February 2015. They developed a simpler OMR system for the examiner because they designed it for their own institute [2]. The details of their project will be included in Chapter 2.

OMR technology have three generation of technology up until today before entering Industrial Revolution 4.0 [6]. Thermal imaging technique used by the first generation where the thermal light is spread on OMR sheet. This technique will decide whether the bubble is marked or not based on captured reflectance. The size, cost and customized OMR sheets have become a major drawbacks for thermal imaging technique.

The task for the second generation was divided into two parts which are scanning the OMR sheet and identifying the marked bubble on it. They used traditional scanner to acquire image of the OMR sheet where a computer or hardware devices is needed [7], [8], [9], [10]. This methodology achieved more than 98% accuracy [7], [8], [10]. This technology is some sort of solution and have more advantages compared to the first generation.

Unfortunately, the OMR sheets still needs to be brought to a central place where the scanning hardware is available which shows it is highly centralized. The OMR sheets still needs to be brought to a central place where the scanning hardware is available. The answer sheets is then processed batch by batch. The expenses will increases and overall cost shoots up tremendously when monetary value of the proprietary software and hardware is added. Furthermore, the examiners need to wait to process the answer sheets by batch at the central place. It is only for big examination where they have a large number of students which seat for the examination.

Mobile technology based is the third generation OMR engineering. Camera of a smart phone or a web-cam is used for capturing task. The image is transferred, processed and then the processed result is extracted on a smart phone, laptop or a high end server. Homography methods is used to detect the region of interest (ROI). Next, to separate the foreground and the background, image correction techniques are

applied. Ambient light conditions, skewness, angle of rotation, camera resolution, and background affected the system accuracy. Accuracy of correct detection deteriorates as the skew and the angle of rotation increases.

From the third generation OMR methods, the idea to overcome all the disadvantages appeared. The solution is develop a system which automate the task of checking OMR response sheets. The aim is to solve the third generation OMR technology.

Actually, the extraction of ROI by using homography is computationally expensive. However, largest contour is used in an image which is computationally cheaper. The robust is proposed to deals with images that having irregular background, poor illumination, skewness, and rotation. Moreover, it is computationally efficient as compared to homography based schemes [6].

1.2 Objectives

The objectives of this projects is:

1. To design image processing technique for Optical Mark Recognition (OMR) system that will detect the black mark of multiple choices questions' answer bubbles from answer sheets.
2. To classify the marks by detecting the presence or absence of a mark in a predeterminal position.
3. To validate and analyze the performance of the system based on existing system.