# SMART DATA RECOGNITION SYSTEM FOR SEVEN SEGMENT LED DISPLAY

ONG CHAI TENG

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**PROJEK SARJANA MUDA II**

**Tajuk Projek**　　:　　SMART DATA RECOGNITION SYSTEM FOR SEVEN

SEGMENT LED DISPLAY

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Supervisor's Name       : DR. SYSFEEZA BT. AHMAD RADZI

Date                            : 12$^{TH}$ JUNE 2016

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# ABSTRACT

An automatic data capturing system gives an alternative and effective way of data collection instead of manual data collection in the laboratory especially for the experiment that needs to be carrying out in a long period of time. It is able to solve the common mistakes made by human like misread or mistype the data. Thus, a new smart data recognition system for seven segment LED display is developed to make the whole process of data collection more systematic and accurate. An image is captured and saved automatically in an image file, and then it is processed through MATLAB software to identify the digits displayed on the LED display. Once the image is pre-processed, image analyzed, and image recognized, the final output values obtained are transferred to the exciting Excel file for further process depends on the user.

# ABSTRAK

Pengumpulan data secara manual dapat digantikan dengan sistem penangkapan data automatik yang alternatif terutama bagi makmal yang perlu menjalankan eksperimen dalam jangka masa yang panjang. Sistem ini dapat menyelesaikan dan mengelakkan kesilapan yang dilakukan oleh manusia seperti kesilapan membaca atau kesilapan memasukkan data dalam sistem komputer. Dengan ini, satu sistem pengiktirafan yang baru telah dicipta untuk mengenali nombor digit dalam bentuk 7 segmen yang ditunjuk atas paparan LED. Sistem ini dapat mempercepatkan proses pengumpulan data dengan sistematik dan tepat. Dalam sistem ini, gambar paparan LED akan ditangkap dan disimpan dalam fail secara automatic dengan menggunakan webcam. Selepas itu, gambar akan diproseskan dengan MATLAB untuk mengenali nombor digit atas paparan LED. Akhirnya, selepas semua proses telah dijalankan oleh MATLAB, nilai yang dapat dari proses pengiktirafan akan dipindah serta disimpan dalam fail Excel yang sedia ada untuk proses yang seterusnya.

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| | |
|---|---|
| LED | Light Emitting Diode |
| OCR | Optical Character Recognition |
| GUI | Graphical User Interface |
| CBP | Component Block Projections |
| USB | Universal Serial Bus |
| PC | Personal Computer |
| DE | Differential Evolution |

# CHAPTER 1

# INTRODUCTION

In this chapter, the project background is discussed. This is followed by the structure of the project, problem statement, objectives, scope and the importance of the project. All the contents are explained in this chapter.

## 1.1    Project Background

An automatic data capture is the modern method used to get graphical data and transformed into an efficient and editable digital format. It identifies the objects, then collects the data and enters it directly into the computer system for further usage where the whole process is without the involvement of human. It gives an alternative and effective way of data collection instead of the manual data collection.

There are many types of automatic data capture system where typically technologies considered. One of it was the Optical Character Recognition (OCR). The data capture system has first obtained the external data through the capture of an image. Then the image needs to undergo some processes before the data can be retrieved or recognized by OCR. The processes involve are image preprocessing and image analysis where all these processes will be run by using MATLAB software with the algorithm implemented.

Thus, the aim of this project is to develop an automated seven segment data

capturing system that is used to capture the image of the LED display and process the image to recognize the seven segments shown on the LED display. The process of capturing the image is done by using a webcam. To make the whole system to be done automatically, the webcam is set to capture the LED display continuously at a specific time. Then, the image captured will be saved in an image file of the computer system by applying the algorithm of image processing followed by the recognition of digit numbers. Once the recognition of the digit numbers completes without any errors, then the values obtained will be transferred and saved automatically into the Excel file for further usage.



Figure 1.1: The overview of the system flow.
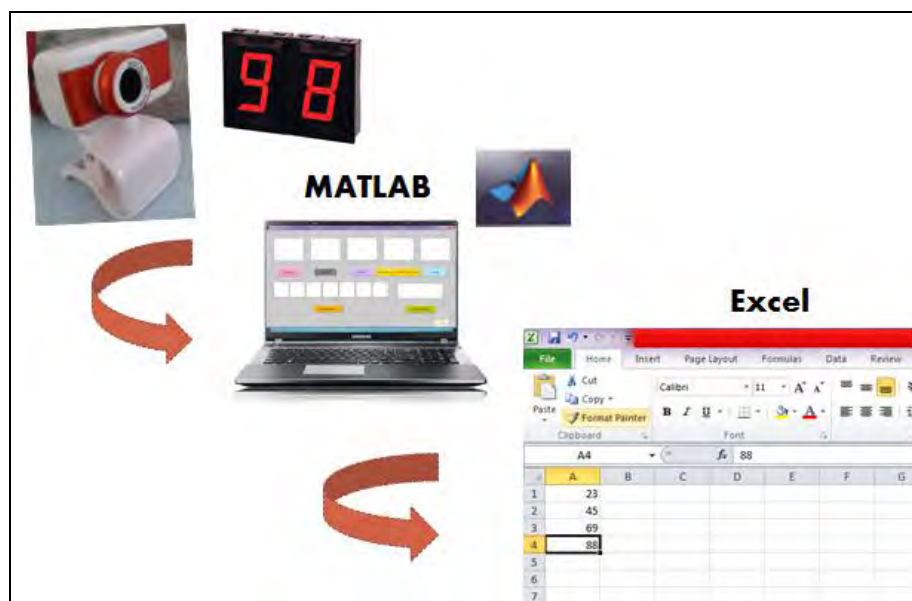
## 1.2    Project Objectives

The objectives to be achieved at the end of this project are as below:

- To construct a simple seven segment LED display circuit with webcam.
- To formulate a MATLAB algorithm in image processing and recognition of the seven segments on the LED display of an image.
- To identify the method used to transfer and save the data from MATLAB to Excel.

## 1.3    Problem Statement

Data is playing an important role in linking us to the world we study, especially in all applications of the scientific method and other fields that rely on the data. Hence, the quality of data has always been the major objective in a project. Especially in the industry, as the data will be further used and analyzed. Hence, if the data collected is wrong, it will lead to errors or other serious cases.

As can be noticed, most of the major losses in the operations are affected by the accuracy of data and information. This is primarily due to the common mistake made by human in the data collecting and recording process like mistype or misread the data. Just like a technician that handling hundreds of tubes, loading samples, and labeling samples can and do make mistakes.

Besides, most of the data are still typed into the databases in a manual way by people through various forms or interfaces which is time consuming, labour intensive, slow and expensive. Through the development of an automatic data capturing system, it is able to eliminate wasted space and saves time in collecting, keeping, and filing. Besides, it also helps to reduce the expenses on storage rentals and the cost of manpower.

## 1.4    Scope of Work

The scope of work of this project is to develop an application which is used for recognition of seven segments without dot shown on the LED display through an image which is a whole number instead of a decimal number. This application will be developed by using MATLAB. A simple LED display circuit is constructed with the implement of webcam to enable the automatic image capturing purpose. The whole process will be completed with the recognized data being transferred and saved in the exciting Excel file for further usage.

## 1.5    Importance of the Project

The importance of this project is that the system becomes effective and systematic where the whole data collection or data entry process is becoming

automatic and fast. Besides, it is reliable in the sense that the data is now producing the high accuracy with the elimination of human involvement. The system is also commercially where it can be used in science, business, and industry that rely on data.

## 1.6    Report Overview

In this report, there are a total of five chapters which included the introduction, literature review, methodology, result and discussion, and conclusion of the project.

CHAPTER 1 is the introduction of the project. The project background and details on the objectives, scope, and importance are discussed within this chapter.

CHAPTER 2 is presented by the literature survey of all the relevant papers and journals to the project on the theoretical background and reviews on current existing and previous work.

CHAPTER 3 is explained on the method used to work on the project. All the steps and flows take to develop the project are discussed in details in this chapter.

CHAPTER 4 is discussed and explained on the result with the comparison to the expected result.

CHAPTER 5 is about the final conclusion of the project with the suggestions and recommendations for future work.

# CHAPTER 2

# LITERATURE REVIEW

This chapter will present the literature survey from the relevant papers and journals on the theoretical background and reviews on current existing and previous work.

## 2.1 Data Capturing System

Data is the only thing that is able to form the connection between us and the world we study. As a consequence, they hold an important role in all applications of the scientific method and also progress in science, business, industry that rely on the data. Hence, the quality and accuracy of data has always been the major objective in a project.

Thus, data capturing system is implemented to collect the data in an automatic way so that the quality of the data can be improved in the accuracy. There are very wide ranges of data capturing system can be found in the growth of technology now.

One of the data capturing system which is invented by Claudio R. Ballard and Lloyd Harbor have been named as the Data Treasury System, where the system is related to the documents and electronic data automated processing from different applications. The system is used in central management, storage and report

generation of remotely captured paper transactions from documents and receipts comprising. It retrieves transaction data at one or more distant locations, encrypts the data, transmits and transforms the data into a usable form, generates the informative reports from the data and transmits to remote locations [8].

The next invention which invented by Anderson and Gerald is the system where enables the free-definition and re-definition of the format of document forms without requiring any reprogramming of the data processors. The system can straight away capture and use the data on the completed forms. It applies the techniques on the character recognition where the information is scanned in the document form and derived into an editable digital format which is able to process automatically. But, there is some weakness of the system where the arrangement and order of the name and number on the forms are changed [9].

## 2.2 Image Processing

Digital image processing is a new development, starting in the Sixties when third generation computers made their appearance. A large quantity of information can be found in an image. So, because of the computer is able to progress in the high storage of capacity and calculation speed, it could be used in developing the algorithms for processing a large numbers of applications.

One of the first fields that use digital processing to enhance the images is space research in 1964 at the Jet Propulsion Laboratory in Pasadena, California. It is used to correct camera distortion in the images of the lunar surface and transmitted back to Earth from the Ranger 7 probes by a computer. After that, many techniques of image enhancement and restoration are started to develop in the connection with the Surveyor, Mariner and Apollo missions.

Besides, there are further applications up coming next, ranging from medical diagnostics to visual recognition by computer in robotics and artificial intelligence fields. It also includes the automatic recognition of text in handwriting, and shapes of objects by a machine to replace the use of the human eye [2].

With the rapid development of information technology, digital technology and microelectronic technology for digital image processing are becoming more and more advances with the new methods developed. It gathered the image information acquisition, transmission, storage, transformation, and understanding the content like reality and the discipline system in order to form the richest in the professional field where the digital image processing is divided into three levels which included the image pre-processing, image analysis and image understanding [3].

Image pre-processing is the operation that uses to improve the image data from the lowest level of abstraction or enhances some image features which is important for further processing. But at the same time, it will not increase the information content in an image [13].

For image analysis, the steps involved are image segmentation, feature extraction, and classification where it is the process used to extract useful information from an image. Image segmentation divides an image into multiple segments, so that the image is then easier in further analysing.

The most general software used by engineers and scientists in both industry and academia is MATLAB where it is used to perform numerical computations, develop and test mathematical algorithms and image processing with related usages. It is very easy to write mathematical programs in a fast and simple way. The data is also displayed in a wide range of different development work. While the image processing application is the greatest one and therefore MATLAB offers a lot of different image modifications [10].

One of the common image pre-processing applications that developed by using MATLAB is the car license plate extraction system. One of it is written by P.V. Suryanarayana. The image pre-processing algorithm used in this paper is Morphology based technique. It operated on the pre-processed, edge image of the vehicles. The edge image is generated by performing Sobel edge detection operation on the gray scale image. Characteristic features such as license plate width and height, character height and spacing are considered in defining structural elements for Morphological operations. Connected component analysis is used to select the band containing license plate from the selected segment. Besides, the research paper also shows the dependency of structuring element on the accuracy of the system [16].

C. Nelson Kennedy Babu has also proposed an application regarding the license plate localization using Morphology technique. It is based on the combination of Morphological operation that sensitive to specific shapes in the input image with a good threshold value by which the license plate is located. To detect vertical edges in the input image, the technique used is the edge features for the license plates and characters. The resultant binary image is produced by counting the number of ON pixels in each row of the image array. The row which contained the highest values is treated as the license plate region. The Morphological operations such as dilation and erosion are then processed to remove the unwanted regions and enhance the wanted region. The enhanced region is then extracted [17].

Recently, there are a lot of researches that are done in the field of the image segmentation process. There are many algorithms which can perform image segmentation where each is slightly different from one another. The image segmentation approach is divided into two categories based on the properties of the image which are:

i.  Discontinuities based
    Subdivision of images is carried out on the basis of unexpected changes in the intensity of gray levels of an image. For example, edge detection.
ii. Similarities based
    Subdivision of images is carried out on the basis of similarities in intensity of gray levels of an image. For examples, thresholding, region growing, region splitting and, merging [14].

In the study of various image segmentation algorithms for different types of images by Krishna Kant Singh, some specific segmentation algorithms were analysed with the consideration of the type of input images like colour image, gray scale image and text image. Besides, some segmentation algorithms used for text detection based on difference and similarity features were also discussed. All the algorithms have their own strengths and weaknesses. Some cannot be used on samples that having similar background and foreground while the others cannot be used due to the instability. Lastly, the study is concluded that, based on the input images, the algorithm should be chosen to get the best final output result [19].

Besides, there is a regularly used method which is Otsu's method. It selects the threshold value by maximizing the between-class variance. A paper written by

Kumar, Pant, and Ray which is related to the embedded of the Differential Evolution (DE) using Otsu's method to select an optimized threshold value [24]. This method is then tested on a set of images and also the results of the effectiveness of the proposed technique.

In addition, the other paper which is written by Gautam and Ahmed regarding the fuzzy based edge detection using Successive Otsu's method. In this paper, the algorithm of this method is described and utilized in grouping image histogram into different partitions. The algorithm developed is used to provide the threshold parameter to classical Sobel Operation in order to enhance its edge detection capability using the fuzzy logic [25]. The final results are then compared with the Canny Edge Detector.