

DEVELOPMENT OF LCD DISPLAY DATA CAPTURING SYSTEM FOR
INDUSTRIAL PURPOSE

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Tajuk Projek : DEVELOPMENT OF LCD DISPLAY DATA
CAPTURING SYSTEM FOR INDUSTRIAL PURPOSES

Sesi Pengajian :

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DECLARATION

"I hereby declare that the work in this project is my own except for summaries and quotations which have been duly acknowledge."

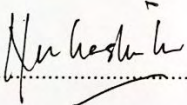
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APPROVAL

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DEDICATION

To my lovely parents and friends.

ACKNOWLEDGEMENT

Firstly, I would like to express my sincere gratitude to my supervisor Dr. Norhashimah binti Mohd Saad from Faculty of Electronic and Computer Engineering for her constant guidance and continuous support of my final year project. Without her insightful advice and encouragement, this project would not be possible completed within a year, because she always provide me her precious advice to improve the project and pushed me to finish this project in time. Besides, a special thanks goes to the engineers and staffs from TechSource System Company for providing training sessions and useful advices to me for completing this project successfully. Finally, I must also acknowledge my dear parents for their financial support to complete my Degree studies and their mentally support and encouragement when I am stressed and full with negative thinking in my mind.

ABSTRACT

Nowadays, the use of digital instruments in industries is rapidly increasing. This is because digital instruments are usually more accurate than the analogue instruments, and easier to be read as they are hooked up with an LCD display. Since users can directly obtain the readings in digit form, these digital instruments are free from parallax and approximation errors. In process control industry, a monitoring system is very important system in the process of supervision about the state of the process. Mostly, the process parameters can be measured by using digital instrument, the obtained results will be recorded. In this project, an LCD display data capture system using optical character recognition (OCR) approach has been implemented. A Graphic User Interface (GUI) for the system by using MATLAB software is achieved. The system is interfaced with an IP webcam to capture the video frames from the LCD display. In this project, a smartphone is used as an IP webcam. Then, the system will pre-process all the video frames, the pre-processed video frames are then proceeded to the next step, which is data extraction using neural network and the extracted as data will be logged out to Microsoft Excel spreadsheet. 90% accuracy have been achieved by the system for 50 sample images of different LCD display. Finally, the system can be concluded that it is able to contribute as data extraction system for industrial purpose.

ABSTRAK

Pada masa kini, penggunaan instrumen digital dalam industri semakin meningkat dengan pesat. Ini disebabkan bacaan dari instrumen digital lebih tepat berbanding dengan instrumen analog, dan lebih mudah untuk dibaca kerana ia dihubungkan dengan paparan LCD. Oleh itu, pengguna boleh terus mendapatkan bacaan dalam bentuk angka, instrumen digital bebas daripada paralaks dan kesilapan manusia. Dalam industri kawalan proses, sistem pemantauan adalah sistem yang sangat penting dalam proses penyeliaan. Kebanyakannya, parameter proses boleh diukur dengan menggunakan instrumen digital, bacaan-bacaan yang diperolehi akan direkodkan. Supaya penyelia proses boleh diberitahu mengenai keadaan proses pada setiap masa. Dalam projek ini, sistem pengumpulan data paparan LCD dengan menggunakan kaedah pengecaman aksara optik (OCR) telah dilaksanakan. Antara Muka Pengguna Grafik (GUI) untuk sistem ini telah direka dengan menggunakan MATLAB versi perisian R2016A. Sistem ini akan berhubung dengan webcam IP untuk menangkap gambaran video dari paparan LCD. Dalam projek ini, telefon pintar telah digunakan sebagai webcam IP. Kemudian, sistem ini akan pra-proseskan semua gambaran video, gambaran-gambaran video akan dipra-proses dan kemudiannya meneruskan ke langkah seterusnya, iaitu pengekstrakan data menggunakan rangkaian neural. 90% ketepatan telah dicapai untuk 50 imej sampel paparan LCD yang berbeza. Akhir sekali, tujuh angka segmen akan diekstrak sebagai data dan kemudian diilog keluar ke Microsoft Excel.

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LIST OF ABBREVIATION

LCD	-	Liquid Crystal Display
OCR	-	Optical Character Recognition
IP	-	Internet Protocol
GUI	-	Graphical User Interface
ROI	-	Region of Interest
LED	-	Light-emitting Diode
CCD	-	Charge Coupled Device
USB	-	Universal Serial Bus
RGB	-	Red, Green and Blue

CHAPTER 1

INTRODUCTION

This Chapter will discuss about the project background, objectives of the project, scope and thesis organization.

1.1 Project Background

Nowadays, the use of digital instruments in industries is rapidly increasing [1]. This is because digital instruments are usually more accurate than the analogue instruments, and easier to read as they are hooked up with a LCD display. Since users can directly obtain the readings in digit form, these digital instruments are free from parallax and approximation errors.

In process control industry, a monitoring system is very important system in the process of supervision. Mostly, the process parameters can be measured by using digital instrument, the obtained results will be recorded. So that the process supervisor can be informed about the state of the process at all the times. In this project, a LCD display data capture system using optical character recognition (OCR) approach has been implemented [4].

The system will be interfaced with an IP webcam to capture the video frames from a LCD display. Then, the system will pre-process all the video frames, the pre-process video frames are then proceeded to the next step, which is data extraction using neural network. Finally, the seven segment digits will be extracted as data and to be logged out to Microsoft Excel spreadsheet. This paper mainly explains about the algorithms used in the system design. A significant advantage of this system is that it

can be used as a real time system for wide variety of digital instruments with LCD display.

1.2 Problem Statement

In process control industries, digital instruments is used to measure various process parameter, such as temperature, voltage, pressure, current, etc. The measured values is mostly recorded manually by operators and technicians. However, manual data entry is time-consuming, labour-intensive, slow and less accuracy. Some process parameter need to be monitored for long term duration, the operators have to work overtime to monitor and record the measured values. Hence, company have to pay extra for the operators. Besides, there are possibilities of human error and the may not accurate. Moreover, the speed and accuracy at which information can be fed into a system can seriously affect the process of production. This setup can be used in real time systems employing a wide variety of digital display instruments, with high accuracy [1].

There is an existing instrument which hook up with a built-in data logger with non-volatile memory. This device costs high due to its high technology performance. Hence, it may not affordable by some small and medium industries. However, the main challenge for an industry is to reduce costs. Some industries does not need such high technology device for their industrial purpose. Since this project is only involve a software system and a web camera, so it is suitable for industries purpose, especially for small and medium industries.

1.3 Objective

The objective of this project is:

- To identify the digit shown in LCD display by using image pre-processing techniques and neural network pattern recognition approach.
- To design a system for data extraction from LCD display.
- To analyse performance of the built system.

1.4 Scope of Project

This project is using a digital multimeter as an experimental setting. A video of LCD display will be taken in real time by using a smartphone as an IP webcam. An android application known as 'IP webcam' is installed in smartphone. So that, the smartphone can be functioned as an IP webcam. The smartphone is attached on a stand, and the digital Multimeter is placed at a fixed position. So that, the region of interest can be fixed. The project is functioned as a real time system. Image processing toolbox in MATLAB is used to pre-process the video frames, while neural network pattern recognition toolbox is used to classify the digits [3]. The complete real time system is built in G.U.I, it require user to input the IP address of their IP webcam, assign the region of interest (R.O.I) to be recognized, as well as the unwanted region to be removed for only one time at the initial stage. After that, the system will run automatically based on the initial settings set by user until user stop it. Figure 1.1



Figure 1.1: Sample image from LCD display of a multimeter

1.5 Thesis Organization

This report contains five chapters. The summary of each chapter will be explained as follow:

- Chapter 1: Describe about the project background including the introduction of advantage of digital instrument, process of supervision, and general explanation about the project. Followed by problem statement, objective of the project, and scope of work.
- Chapter 2: Summarize all the review on previous findings and research done by other researcher. Also including the related knowledges learnt from educational magazine and books. Various approaches and techniques have been reviewed.
- Chapter 3: Explanations about the methods and procedures to carry out the project. Digital Image Processing Techniques, MATLAB Image Processing Toolbox, MATLAB G.U.I will be discussed and applied in this project.
- Chapter 4: Explanations about the simulation result by using test data, testing result of the system built. Next, the results are analysed.
- Chapter 5: Shows overall conclusion of the project. Some issues is discussed, and some recommendations for the project are stated in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Seven Segments Display Digit

The seven segment digits is a common format for displaying numbers or alphabetical characters. Mostly, the seven segment digit display will be utilized in LCD or LED electronics, such as LCD display or LED display. The Figure 2.1 below shows the seven segments digits for '0' to '9'. While Figure 2.2 shows the digital instruments hooked up with LCD display.

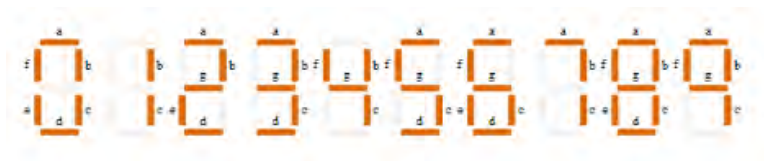


Figure 2.1: Seven segment digits



Figure 2.2: Digital instruments with LCD display

2.2 Image Processing Task

Image processing includes modifying the original image in order to enhance its graphical information for human or computer interpretation and make it more simple and uncluttered, so that it is suitable for autonomous machine perception [4]. It is mostly done by using computer system. The flow of the process is shown as below:

- **Image acquisition:** A digital image is captured as input for further processing and analysis. This can be done using either a camera device or a scanner.
- **Pre-processing:** Essential preparation step before the “major” image processing task. This step may include contrast enhancement, noise filtering, or identifying region of interest (R.O.I).
- **Segmentation.** Here is where to extract a single character from the image which need to be classified. This is because most recognizing methods can only identify single character.
- **Recognition and interpretation:** This is step for assigning a definition label to each objects based on their descriptors and assigning meanings to those labels. So the particular objects can be recognized based on the assigned labels.

2.2.1 Image acquisition

Image acquisition is the action to obtain an image from some source, it is the first task in image processing. Usually a camera device is used to acquire an image or video, such as CCD camera, Webcam, IP camera and etc. [4].

- **CCD camera:** A silicon electronic devices which the voltage output is proportional to the input intensity of light falling on it. As it is interfaced to a PC, information from the photo is then exported to a storage medium [4].
- **Webcam:** A webcam is a video camera that feeds or streams video and capture image in real time through a computer to computer network. It is generally connected by a USB cable to computer hardware [4].
- **IP camera:** An Internet protocol camera which connects using Ethernet or Wi-Fi, is a type of digital video camera that can send and receive data via a computer network and the Internet [4].

How to make smartphone as an IP webcam:

1. An Android application 'IP Webcam' is installed in smartphone.
2. Resolution of the image can be set in the smartphone.
3. Start the server in smartphone.
4. Note the 'url' will be shown at the bottom of the screen of the smartphone.
5. MATLAB is opened, then the 'url' shown in smartphone and the code as Figure 2.3 below is typed in the command window.

```
url = 'http://<ip address>/shot.jpg';
ss = imread(url);

fh = image(ss);
while(1)
    ss = imread(url);
    set(fh,'CData',ss);
    drawnow;
end
```

Figure 2.3: Source code for streaming live video from IP webcam [5]

6. Run the code, and then a window as shown in Figure 2.4 below will pop out in MATLAB.

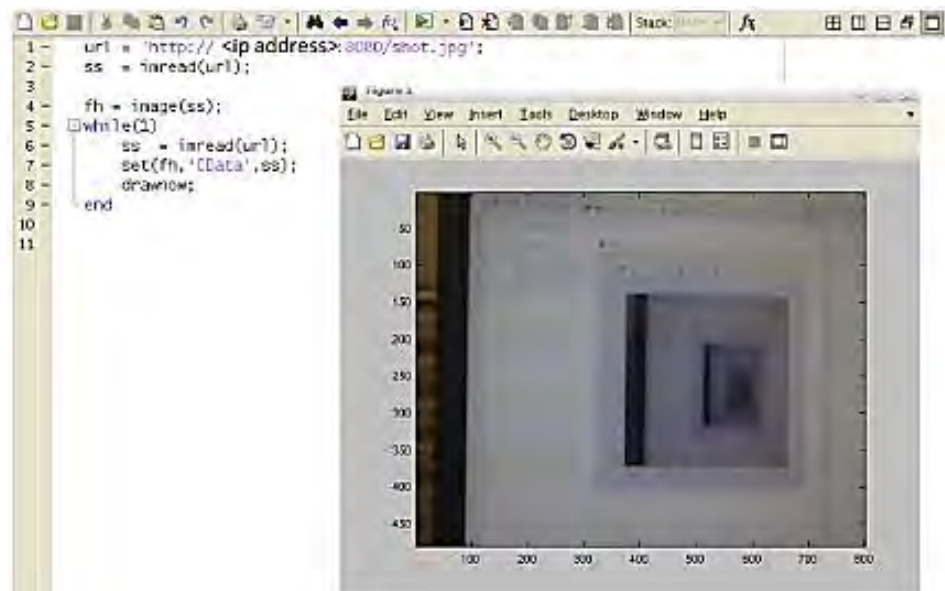


Figure 2.4: Video player window in MATLAB [5]

2.2.2 Pre-processing

2.2.2.1 Grayscale

Grayscale images is also known as intensity images, which including a matrix represents the light intensity of image. The colour input image is converted into grayscale image. Figure 2.5 below shows a RGB images are converted to grayscale image by forming a weighted sum of the R, G, and B components:

$$0.2989 * R + 0.5870 * G + 0.1140 * B \quad (2.1)$$



Figure 2.5: (Left) Original image, (Right) Grayscale image [6]

2.2.3 Identify Region of Interest (R.O.I)

Several researchers had worked on the algorithm to detect the R.O.I of the image. However, the algorithm may not work in real time as the type of the display changes. Hence, a generic user-friendly solution is preferred to be implemented. Firstly, the instrument is fixed at a static location, then the user is asked to select the R.O.I by themselves for just once at the initial stage. The system will then record the coordinates of the R.O.I selected by the user, and the following input images will be cropped automatically based on the recorded coordinates in the system [1].

In MATLAB, mostly the command ‘imrect’ is an interactive syntax that used to create a cross sign when the pointer is moved over the image [7]. User can use it to draw a rectangle over the R.O.I and adjust its size and position using the mouse. The Figure 2.6 shows an example by using ‘imrect’.