



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF PATIENT TRAINING SYSTEM USING
IMAGE PROCESSING TECHNIQUE**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

by

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DECLARATION

I hereby, declared this report entitled “Development of Patient Training System Using Image Processing Technique” is the results of my own research except as cited in references.

Signature :

Author’s Name :

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours. The member of the supervisory is as follow:

.....
(Saleha Binti Mohamad Saleh)

ABSTRAK

Dalam projek ini, satu percubaaan telah dilakukan untuk mereka bentuk prototaip mengenai papan latihan pesakit yang menggunakan teknik pemprosesan imej sebagai alat bantuan proses pemulihan. Prototaip ini akan digunakan sebagai pengantian kepada sistem menyelia manual dengan sistem automatik yang mesra pengguna dan dapat mengurangkan beban kerja penyelia pesakit. Pemulihan ini difokuskan kepada individu-individu yang tidak berada dalam keadaan normal dari segi kesihatan seperti pesakit strok yang mengalami kecacatan fizikal dan upaya. Papan latihan yang melambangkan persekitaran kerja mereka akan digunakan sebagai rawatan untuk meningkatkan reaksi dan ketepatan mereka. Semasa proses latihan dijalankan, penyelia harus fokus dan tepat dalam kedua-dua memerhati dan merekod data secara manual. Berikutan dengan itu, data tidak akan direkodkan secara tepat pada setiap masa dan ini akan menyebabkan kesilapan dan kesalahan dalam perkembangan keseluruhan proses tersebut. Dorongan disebalik projek ini adalah untuk mencuba dan mengurangkan kesalahan serta kesilapan dengan menggunakan teknologi ini. Teknik pemprosesan imej digunakan dalam cadangan kerja untuk mencipta satu sistem yang akan digunakan untuk mengecam hasil keluaran dengan mengesan LED pada papan latihan tersebut selepas tamat sesi latihan. Papan latihan tersebut dibina berdasarkan sistem penyalan lampu LED mengikut corak yang ditetapkan. Pengesanan tersebut berlaku melalui dua kaedah pemprosesan imej iaitu pengesanan pigmen dan pengambangan. Imej tersebut akan ditangkap menggunakan sebuah webcam yang disambungkan kepada komputer dan ditempatkan di bahagian belakang papan latihan. Sejurus sebuah imej ditangkap, proses pengesanan pigmen akan berlaku dengan penggunaan MATLAB untuk mengumpul data dan informasi. Seterusnya, data dan informasi tersebut menjadi hasil keluaran daripada GUI. Akhir sekali, data hasil keluaran akan direkodkan lalu dapat digunakan sebagai data.

ABSTRACT

In this work an attempt is made for designing a prototype which is a patient training board that uses image processing technique as aid for the rehabilitation process. This project would be used as a substitute for the manual data recording system with an automated system which is user friendly, reduces the work load of the person who are in charge for supervising the patient. Rehabilitation is mainly focuses on individuals that are not in the normal conditions in terms of health such as stroke patients who experiences physical impairments and disabilities. The training boards which represents their working environment would be used in as a treatment for them to improve their reaction and accuracy. During the training process, the supervisor should be very focused and precise in both observing and record the data manually. In certain condition, the user would be left alone during the training session and it would be difficult to identify whether the users complete the training according to the given pattern instruction or not. Motivation behind this work is to try and reduce such deficiency and errors by using technology. Image processing technique is used in proposed work to create a system which would be used to identify the output by detecting the lighted up LEDs on the training board at the end of the training session. The prototype plays its role to determine the accuracy of the training system user as it was designed to be LED pattern system where the LED lights up only when the correct sequence of input was pressed. The detection takes place by using in two methods of image processing which are color detection and also detection using thresholding method. The images are captured using a webcam which is connected to a computer and placed behind the training board. Once the image is captured, the image processing would take place using MATLAB to acquire the data and information which would be then given as an output by GUI. Finally, the output data could be recorded directly from the GUI and be used as the data of the rehabilitation process.

DEDICATION

To my beloved parents (Mr Suresh S/O C. P. Krishnan and Mrs Daivayany D/O Velayudhan), family members (Sajeevan Nair S/O Suresh, Dinesh Nair S/O Suresh and Rishi Nair S/O Suresh).

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

| | | |
|-------|---|---------------------------------|
| RGB | - | Red, Green, Blue |
| HSI | - | Hue, Saturation, Intensity |
| HSL | - | Hue, Saturation, Lightness |
| CAD | - | Computer Aided Design |
| GUI | - | Graphical user interface |
| C-Y | - | Cyan, Yellow |
| ROI | - | Region of interest |
| IR | - | Infrared |
| LED | - | Light emitting diode |
| PIC | - | Programmable integrated circuit |
| uint8 | - | Unsigned integer of 8-bit |

CHAPTER 1

INTRODUCTION

1.0 Project Background

The rehabilitation system nowadays is considered as one of the important system in the human life as it helps the related individuals to overcome their medical errors and issues. There are many types of rehabilitation system available such as using training boards, physiotherapy and also by using technologies in exercise machines. Although it is good, but most of the systems have some problems which effects the process in one way or another.

In the field of imaging science, image processing method plays an important role. Image processing is a method used to solve the errors, problems and also obtain important information that are related with an image. In this method, the input is usually an image while the output maybe an image or information that are extracted from the input image. There are three basic steps in image processing which are importing the image via image acquisition tools, analyzing and manipulating the image and also the output in which result can be altered image or report that is based on image analysis.

Color detection is one the techniques in image processing. Usually it is used together with edge detection to detect or analyze an image by its color and identify it. One of the method is which the detection of the color occurs the data would read accordingly. The other one, is which the edge of the image would be read and the data is recorded.

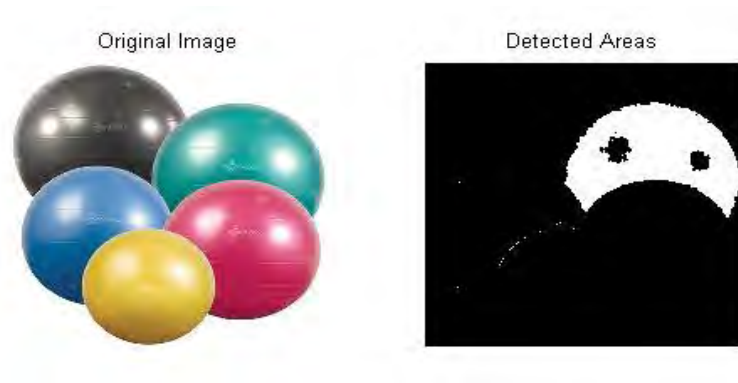


Figure 1.0 Example of color detection

Besides that, thresholding method is known as a simplest and easiest method in image processing for image segmentation. It turns the greyscale image to binary image. Binarization process occurs during this conversion. This process is the important process in sending faxes as the image would be read as the pixel and sends the information. First, the image captured is converted to greyscale. Then, the threshold is applied using cluster algorithm to set fix or adaptive.

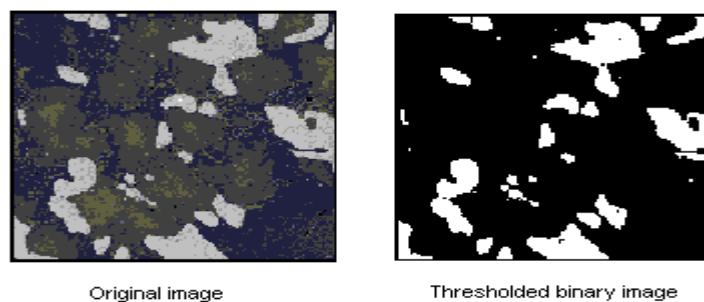


Figure 1.1: Example of image before and after threshold

Furthermore, this project focuses on image processing technique that uses color detection and thresholding method in analyzing the image. This method was chosen because of its simplicity and key features. Thus, the main aim of the project is to develop a training board system by using image processing technique.

1.1 Problem Statement

The current available training board system in the rehabilitation field needs a supervisor to supervise the patient manually. Based on manual supervision and data recording, three problems occurs. The results would not be recorded accurately according to the patients training while time taken for data collection would be usually longer. Besides that, if the supervisor left the training area during the training session, it would be difficult to identify whether the users complete the training according to the given pattern instruction or not. According to that, the result of the training process would be not accurate. Therefore, the design of the training board system and image processing focuses on detecting the correct pattern and data acquisition.

1.2 Objective

Due to the problem statement above, the objectives of the project are:

- i. To design a monitoring and data acquiring system for patient training board.
- ii. To develop patient training board system and data acquisition method using image processing technique.
- iii. To test and compare the two methods used for data acquisition.

1.3 Scopes of work

The scopes of work for the project include the following areas:

- i. A webcam would be used to capture the image from the training system.
- ii. All data signal would be analyzed using MATLAB.
- iii. Various Image processing technique such as color detection and thresholding method would be used for comparison.
- iv. Prototype design using SolidWork

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter focuses on the theory and information related to the scope of this project. Besides that, information and methods used in previous research are reviewed. According to the project, rehabilitation system, image capturing, color detection and image thresholding in image processing are related to this chapter. There are many past researches that uses image processing method via MATLAB software.

2.1 Theory

2.1.1 Medical Rehabilitation

Rehabilitation of people with disabilities is a process for empowering them to reach and keep up their ideal physical, sensory, intellectual, psychological and social functional levels. Rehabilitation provides disabled people with the tools they need to attain independence and self-determination. Access to rehabilitation can diminish the outcomes of disease or injury, improve health and quality of life and reduce the use of health services [1]. There are many types of rehabilitation system used during this modern period. A standout amongst the most generally utilized rehabilitation technique is physical rehabilitation which the training system is based on the technology.



Figure 2.1: Rehabilitation training system using technology

2.1.2 Image Processing

Image processing is a technique, which transforms an image from analog to digital form. Once it is done, some process would take place for image enhancement and to recover essential information or data from it. There are three general steps in image processing. Firstly, capture and record image with using suitable devices such as camera or laptops. Secondly, analyse and manipulate the recorded image, which includes the process of data compression, enhancing and pattern recognizing that is difficult to spot by normal human vision. Lastly, the image output, which is the outcome from the second step, image analysis. There are five purpose for this technique, which are visualization, image sharpening, image retrieval, pattern measuring and image recognition [2].



Figure 2.2: Image processing technique

2.1.3 Types of Image Processing

Analog and digital image processing is the two methods used in this technique. Analogue image processing usually used for hard copies like printout papers or photographs. Image analyst uses them for interpretation. On the other hand, digital image processing is used for manipulation using devices such as computers or other technology devices. The three general step for this method are pre-process, enhancement and display of the image [3].

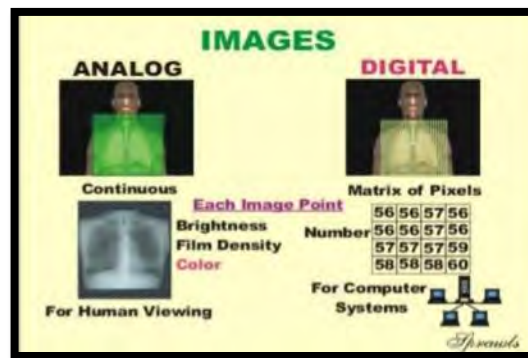


Figure 2.3: Example of analog and digital image

Table 2.1: Comparison between the analog image processing method and digital image processing method.

| METHODS | ADVANTAGES | DISADVANTAGES |
|--------------------------|---|---|
| Analog Image Processing | <ul style="list-style-type: none"> - infinite amount of signal resolution - high density - achieve simply than digital | <ul style="list-style-type: none"> - make noise |
| Digital Image Processing | <ul style="list-style-type: none"> - faster and more cost effective - easy and quality of image stays good | <ul style="list-style-type: none"> -lack of qualified professional - time consuming |

2.1.4 Techniques of Image Processing

There are few methods of image processing as shown in Figure 2.4 can be used to provide an effective visualisation and analysis.

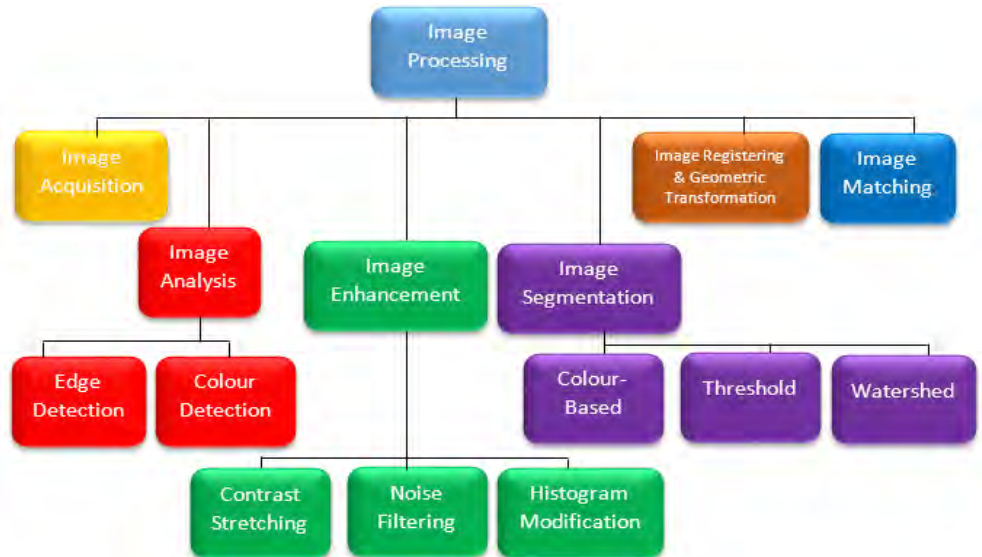


Figure 2.4 Image processing techniques

a) Image Acquisition

It helps us to visualise, analyse and process the images in numerous data types. This method utilizes images and videos generated by camera, webcam and other image capturing devices. Image processing applications can be used to explore and find different algorithmic approaches. Segmentation an image based on various color and manipulation in different types of shapes can be done via threshold [4].

b) Image Analysis

Image analysis is the process of conversion of an image into a component to obtain information. Various tasks such as shape finding, edge

detecting, noise removing, objects counting and measuring image properties of an object is included in this technique.

i) Edge Detection

Edge detection is one of the method used in image analysis. Edges are local changes of intensity in an image. The edges are located on the boundary between two regions of an image. The methods of edge detection consists of four steps. The first is smoothing, where the noise of the image is reduced. The second step is enhancement, which sharpens the image. Thirdly, determining the edge pixels by using methods such as thresholding. Finally, the localization step would be used locate the exact position of an edge [4].



Figure 2.5: Example image of edge detection

ii) Color Detection

The color detection method is as a part of image analysis which would be used in selecting an objects based on their features, which focuses on color. For example as shown in Figure 2.6, to process an image based on only one selected color which is red, color detection process would take place and sends binary image of the red color as white while the rest would be black [4].



Figure 2.6: Color detection process of the red circle

c) **Image Enhancement**

Image modification by adjusting the values of brightness of the pixel to improve its visual features is known as image enhancement. There are many techniques available to enhance and image. The enhancement would be used to make the features of the image to an even better and nice image which suited for humans and machine interpretation. For example, the satellite images and digital camera images lack in brightness and contrast because of the noise during image capturing.

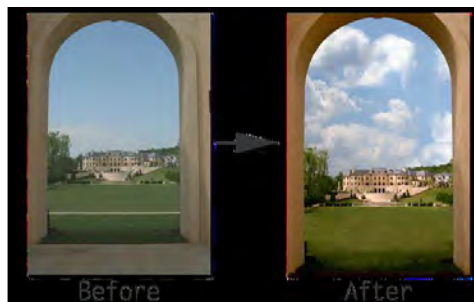


Figure 2.7: Example image for image enhancement

For example, enhancement includes contrast and edge enhancement, pseudo-coloring, noise filtering, sharpening, and magnifying. Image enhancement plays an important role in feature acquiring, image analyse and display. Some of the enhancements are:-