DOT MATRIX LED USING MICROCONTROLLER

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Bachelor of Mechatronics Engineering
May 2010

"I hereby declared that I have read through this report entitle "**Dot Matrix LED Display Using Microcontroller**" and found that it has comply the partial fulfillment for awarding the Bachelor of Mechatronic Engineering."

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Date : 12/5/2010

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This Report is Submitted in Partial Fulfillment of Requirements for Bachelor of Mechatronic Engineering.

Faculty of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MAY 2010

"I declare that this report entitle "**Dot Matrix LED Display Using Microcontroller**" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree."

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ABSTRACT

This project is about to built up an electronic display system to display useful information such as message and graphical sign on the dot matrix LED block. The system may be use in the popular tourist location, airport or sign board of location direction. The proposed of this project is to display the message on 8 * 8 or 7 * 5 dot matrix LED block. The displayed message will be programmed by using microprocessor-based system. It can display the curvatures alphabets and numerals as what been written. The displayed message will be presented in some animation like, scrolling and static which may attract the reader attention. The intensity of LED light and speed movement will be adjustable due to the condition or requirement of the displayed type. The system will be interface by using keypad or keyboard to implement the task.

ABSTRAK

Projek Sarjana Muda ini berkenaan dengan membina satu elektronik system yang dapat mempaparkan mesej dan tanda grafik pada dot matrix blok. Sistem ini dicadangkan menempat pada lokasi pelancongan yang popular, lapangan kapal terbang ataupun papan tanda. Cadangan untuk projek ini adalah mempaparkan mesej pada 8 * 8 or 7 * 5 dot matrix LED blok. Paparan mesej diprogram dengan menggunakan "microproseccor-based" sistem. Mesej yang dipaparkan dapat mempaparkan nombor dan abjad yang berlengkungan seperti yang dituliskan dengan tangan serta bersama dengan animasi seperti berkelip-kelip supaya dapat menarik perhatian pembaca. Keamatan LED dan kelajuan pergerakan abjad dapat dikawal atas kehendak yang berbeza. Keyboard digunakan untuk berinteraksi dengan sistem supaya dapat melaksanakan perintah pengguna.

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ABBREVIATION

A/D	-	Analog/Digital
ASCII	-	**A**merican **S**tandard **C**ode for **I**nformation **I**nterchange
BCD	-	Binary Coded Decimal
COM	-	Communication
FYP 1	-	Final Year Project 1
FYP 2	-	Final Year Project 2
i.e	-	In Example
I/O	-	Input/Output
K	-	kilo ($x10^3$)
KL	-	Kuala Lumpur
KLIA	-	Kuala Lumpur International Airport
LCCT	-	Low Cost Carrier Terminal
LED	-	Light Emitted Diode
mA	-	miliAmpere
MHz	-	Mega Hertz
PC	-	Personnel Computer
PCB	-	Printed Circuit Board
PIC	-	Peripheral Interface Controller
RGB	-	Red-Green-Blue
USART	-	Universal Synchronous Asynchronous Receiver Transmitter
UTeM	-	Universiti Teknikal Malaysia Melaka

CHAPTER 1

INTRODUCTION

This chapter will introduce the objective, problem statement and scope of the project of *Dot Matrix LED Display Using Microcontroller*. This project is categorized to three main parts which are included electric circuit, mechanical design and microcontroller programming.

The main objective of this project is to design and develop a dot matrix LED display system. The purpose of this project is to display the useful message and information with some animate effect, i.e.: blink, scrolling left/right, and moves up/down.

The concept of this project is using microcontroller as the programming to display the message. When the message or information key in through the keyboard to the HyperTerminal, the microchip will received the data and recall the alphabet in the library. As the result the dot matrix LED display can be able to display the message and information. Figure 1.1 shows the illustration of the overall system.

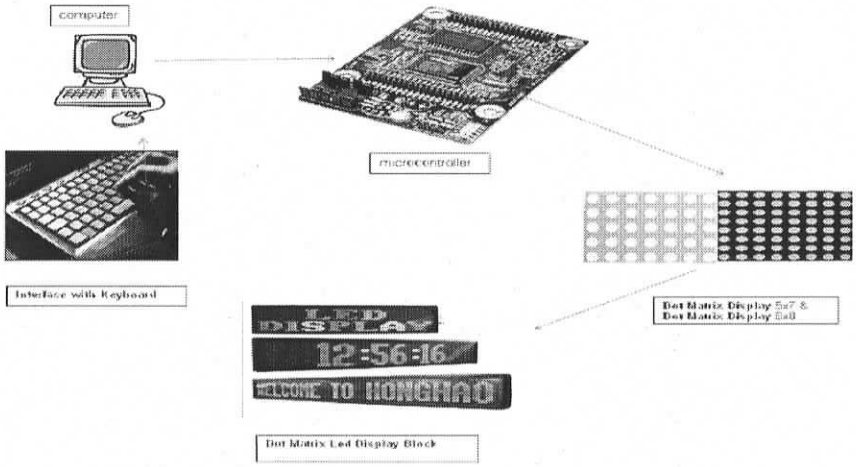

Figure 1.1: Illustration of the overall system

1.1 Project Objectives

The main objective of this project is to design and implement the display system of the message and information in dot matrix led display block by using microcontroller. In order to achieve the goal of the project, there have some basic knowledge of MikroC programming, PIC functioning circuit and the microchip features had to determine. The project also divides into more specific objective as following:

- To design and develop a Dot Matrix LED Display system
- To display the message and information on the LED display using microcontroller software
- To make the displayed information in some animate effect, eg : scrolling, static and specific character display.
- To control the speed of movement of display message.
- To display the message using a keypad.

1.2Project Scope

The scope of this project is to design and develop a dot matrix led display system to displayed message and information. This project divides into three main parts which are, mechanical structure, electrical circuit and microcontroller programming.

The mechanical structure will be designed and establish for the dot matrix led display chasing. The structures will able to fit in the 7 pieces of 8 * 8 dot matrix led block and PIC board. There will be having a place for the power supply to plug in for supplied.

The electrical circuit is build up by the PIC board, Decoder and Microcontroller. The microcontroller programming will be using C-language and will be downloaded into PIC 16F628A microchip. The microcontroller will able to receive the signal from keyboard and output a command to matrix led block display for message and information.

1.3 Problem Statement

Nowadays, most of the buildings are using the signboard as the medium to display the message and information for the incomer. This is no exception for KLIA, LCCT, KL central railway station and some tourist location like historic city Malacca and Penang. The display signboard will become huge if the information is a lot. The huge signboard is not practically for used in the place that mentioned earlier. As the alternative way, the huge sign board can be able replace by a smaller led dot matrix block displayed. It will save a lot place and the information can be changeable due to the updated information or requirement based on the different situation.

Previously, the Penang's state government have some quarrel in the road name signboard display system. They have the arguing on the language that use in the signboard. Since the Penang Malacca and Klang valley is the popular tourist location of our country. There will be millions of tourist visit our country by year. They came from every corner of the world and having different language education background. If the signboard is using mono language, it will confuse them. By replacing dot matrix led display, there can be able to display the information in multi language and direction of the tourist location. The following illustration is the main concept on the convention the signboard to the dot matrix LED display. The figure 1.2 shows the illustration of the problem statement.

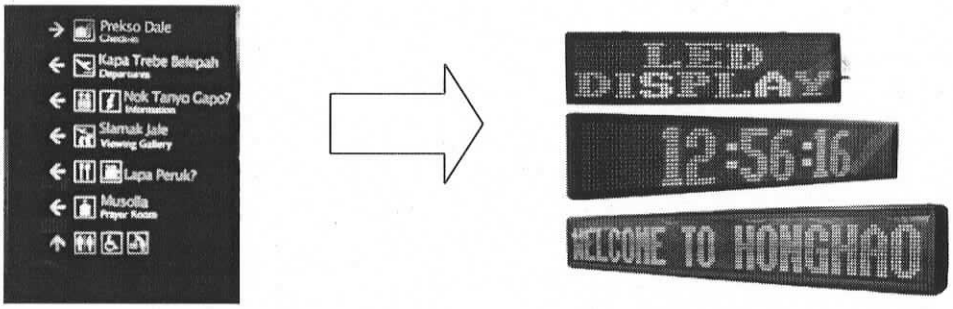

Figure 1.2: The Illustration of the Problem Statement

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is the summary of the literature review of the article that holds the concept approach in use of the dot matrix led display. These articles give the overall concept on dot matrix led display system in different language or system and example on implementing a dot matrix led display system.

2.2 First Review: A MICROPROCESSOR-BASED DOT MATRIX DISPLAY SYSTEM FOR JAPANESE HIRAGANA SYLLABLES [1]

This article is the effort of W.L. Goh and K.T.Lau from School of Electrical and Electronic Engineering at Nanyang Technological Institute Singapore, February 89. In this article they presented the layouts of Japanese Hiragana syllables on 5 * 7 dot matrix led block. A dot matrix approach is chosen because it can display syllables with curvatures that resembles hand-written ones. It should be noted that due to the curvature of the syllables, a segmented approach (**14** or **16** segments) does not satisfactorily give readable syllables. For displaying Japanese Hiragana syllables using standard 5x7 dot matrix blocks, the Romanized phonetic representation is input via a keyboard to the microprocessor. Each character in the string is presented as a 7-bit ASCII code to the microprocessor. A program compares the character string that is input and selects the appropriate Hiragana syllables for display from a look-up table of bit patterns stored in memory. As each Hiragana syllable requires 5x7= 35 dots (or bits), 5 bytes of data are used to represent one syllable, ignoring the last bit of each byte. In order to represent the full **68** Hiragana syllables, a total of **68x5** = **340** bytes of memory locations are required. The figure 2.1 and 2.2 show the display system and the dot

matrix layout of the Hiragana syllables. The table 2.1 is illustrated the all Hiragana syllables character.

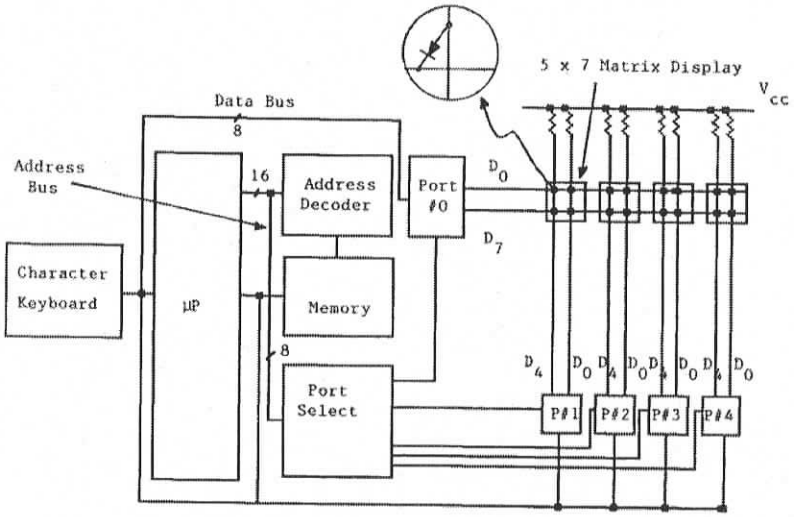

Figure 2.1: Display System for Hiragana Syllables

Table 2.1: Hiragana Syllables Chart

あ a	か ka	が ga	さ sa	ざ za	た ta	だ da	な na	は ha	ば ba	ぱ pa	ま ma	ら ra	わ wa	ん n
い i	き ki	ぎ gi	し shi	じ ji	ち chi	ぢ ji	に ni	ひ hi	び bi	ぴ pi	み mi	り ri		
う u	く ku	ぐ gu	す su	ず zu	つ tsu	づ zu	ぬ nu	ふ fu	ぶ bu	ぷ pu	む mu	る ru		
え e	け ke	げ ge	せ se	ぜ ze	て te	で de	ね ne	へ he	べ be	ぺ pe	め me	れ re		
お o	こ ko	ご go	そ so	ぞ zo	と to	ど do	の no	ほ ho	ぼ bo	ぽ po	も mo	ろ ro		を o

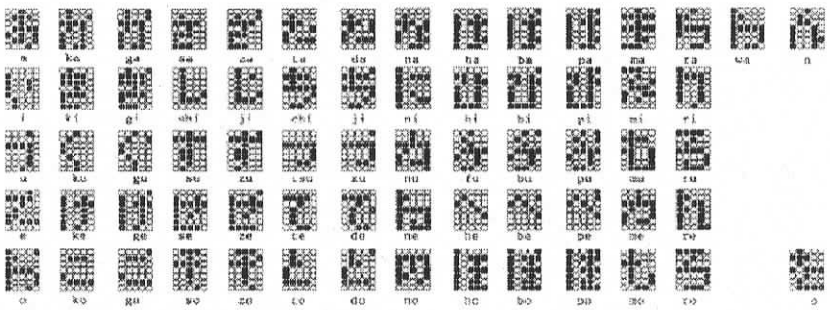

Figure 2.2: Dot Matrix Layout of Hiragana Syllables

A column approach is proposed, i.e.: 7 dots (comprising one column) are displayed at a time. With proper multiplexing, the display of each syllable is completed in **5** steps. **A** complete Hiragana 'word' typically comprises one to four syllables. **A** four-syllable (i.e. four 5x7 dot matrix displays) display system is therefore proposed. The Hiragana syllables can be displayed on this matrix by selective illumination of the dots. The filled dots indicate those nodes that will light up when these syllables are displayed. The display **is** obtained by selective illumination of dots in each column. **A** multiplexed approach is used in which columns are enabled consecutively at a frequency just fast enough to remove flickering. Five columns constitute one syllable, giving rise to a total of 5x4= **20** columns. The overall flow diagram of this journal shown in figure 2.3

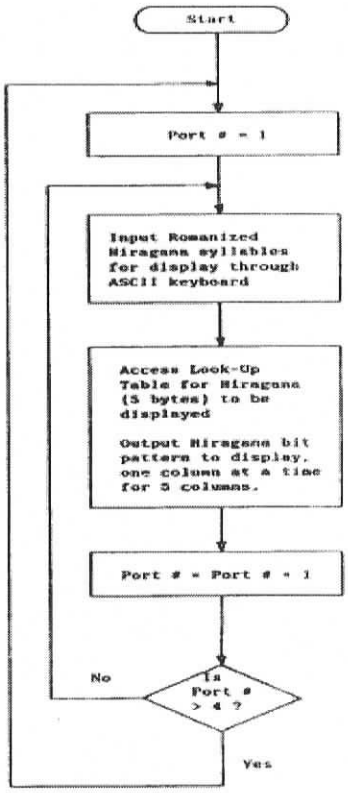

Figure 2.3: Simplified flow chart of the displayed system

2.3 Second Review : DOT MATRIX DISPLAY SYSTEM FOR KOREAN NUMERALS [2]

This article also is the effort of W.L. Goh and K.T.Lau from School of Electrical and Electronic Engineering at Nanyang Technological Institute Singapore, November 91. In this article, they presented the layouts for Korean numerals on 10 * 7 (2 pieces of 5 * 7) dot matrix. A microprocessor-based display system for a single Korean numeral is discussed.

For displaying the Korean numerals on a 10x7 dot matrix, the microprocessor accepts the input numerals 0-9 through a keyboard. A program then compares the input and selects the appropriate Korean numeral for display from a look-up table of bit patterns stored in memory. As each numeral requires 10x7 = 70 dots (or bits), 10 bytes of data are required for each numeral, with the last bit of each byte ignored.

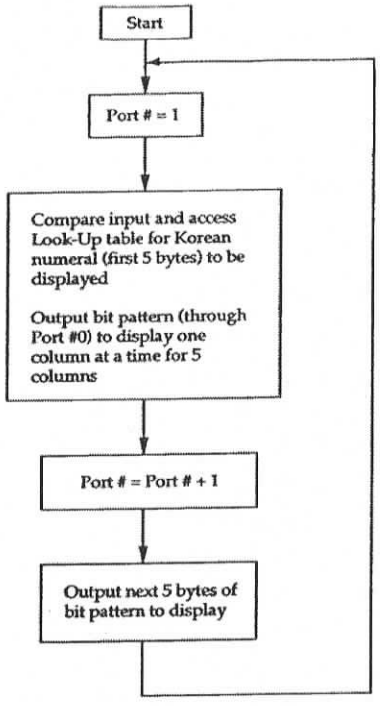

Figure 2.4 : Simplified flow chart of the displayed system

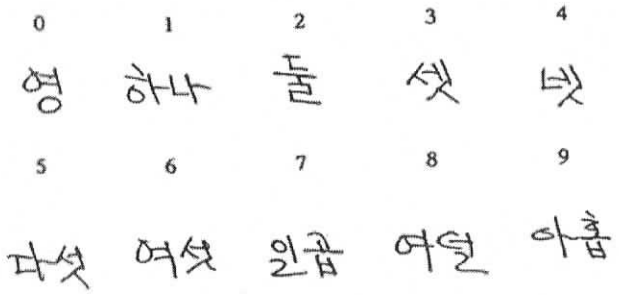

Figure 2.5 : the korean numeral

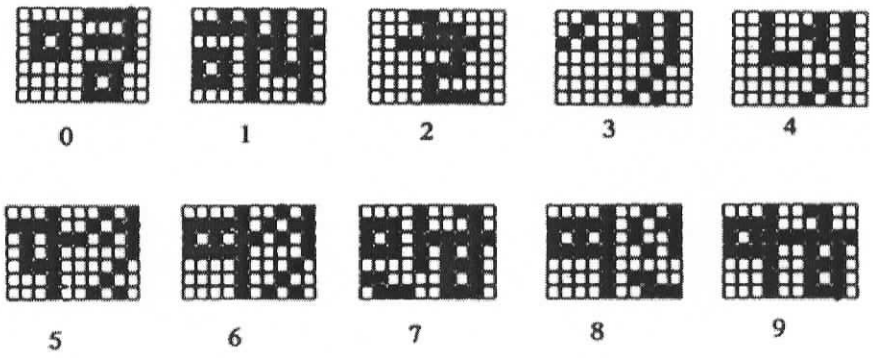

Figure 2.6: Dot matrix layout of Korean Numeral

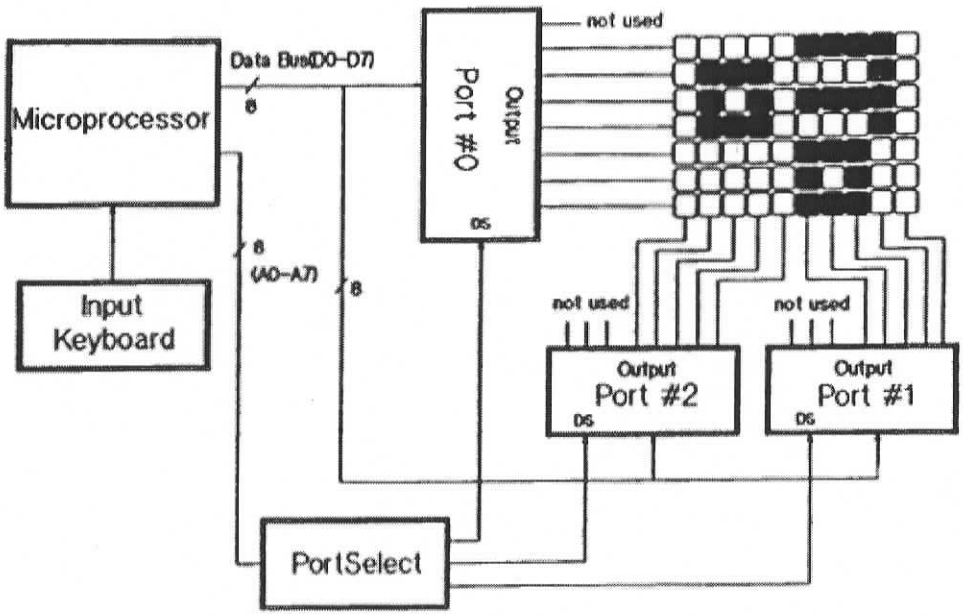

Figure 2.7: Displayed system of Korean Numeral

Table 2.2: Bit pattern of the Korean Numeral "0"

	D_6	D_5	D_4	D_3	D_2	D_1	D_0
Column 0	0	0	0	0	0	0	0
1	1	1	1	1	0	0	0
2	1	0	1	0	1	1	1
3	1	0	1	0	1	0	1
4	1	0	1	0	1	1	1
5	0	0	1	0	0	0	0
6	0	1	1	1	0	0	0
7	0	1	0	1	0	0	0
8	0	1	1	1	0	0	0
9	0	0	0	0	0	0	0

1 = LED on

0 = LED off

2.4 Third Review: MULTINUMERIC DECODER FOR DOT MATRIX DISPLAYS [3]

This article is the effort of K. Balasubramanian from the Dept. of Electrical and Electronics Engg, Faculty of Engineering and Architecture Cuku rova University 01330 Adana, Turkey. This article is discussed about a simple and self controlled multinumeric decoder-driver for dot matrix displays. **A** multinumeric display system using this decoder displays the decimal digit of the BCD input in any one form of eight different languages. A single multinumeric decoder accepts four BCD inputs and driving four dot matrix display devices as outputs. The literature review of this article is more primarily focus on the schematic circuit diagram of the proposed multinumeric display system. The conceptual of display the different language simultaneous is the main idea of my FYP. This is because the system is using two EPROMS as the data storage. The method to recall the data from library is important for the large program which exceeds the memory storage of microchip.1K EPROMS provide the look up table for the decoded data of the numerals of various languages. EPROMS storing up to eight bits in each location are widely available in practice and therefore two EPROM chips are used to store the 10-bit column-drive-data needed for the dot matrix display. The 1K memory space of the EPROM is to have eight pages of 128 locations