

VERSATILE DOT MATRIX DISPLAY WITH TIME APPLICATION

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**This report is submitted in partial fulfillment of requirements for the award of
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**Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
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DEDICATION

I would like to take this opportunity to thank my supervisor, Mr Sani Irwan Bin Md Salim, who assist and guide me a lot in executing my project. I would also like to thank all my family members and course mates for their valuable opinion and moral supports.

ABSTRACT

This project is about designing a digital clock module using dot matrix display and real time clock chip. Microcontroller programs are developed to generate characters and graphics to for this module. This project consists of three major components, which are the real-time clock input, the microcontroller, and the LED dot matrix display. LED dot matrix displays are well known as an effective and economical means of data distribution to the masses. The real time chip (RTC) is used to provide the clock pulse to the microcontroller. This will eventually generate the clock sequence in better accuracy compare to normal delay methods. The encoded characters and graphics data are stored into the memory of microcontroller. During the process, the data are sent to the LED dot matrix for display. The advantages of this project are high visibility, low power consumption, relatively low hardware requirements and low cost.

ABSTRAK

Projek ini adalah berkenaan merekacipta sebuah modul jam digital menggunakan paparan dot matrik dan cip jam masa-nyata. Sebuah program pengawal-mikro akan dibangunkan untuk menghasilkan huruf dan grafik untuk modul ini. Projek ini mengandungi 3 komponen utama, iaitu input jam masa nyata, pengawal-mikro dan paparan dot matrik LED. Paparan dot matrik LED adalah alat yang berkesan dan ekonomi dalam penghantaran data untuk paparan umum. Cip masa nyata digunakan untuk menghasilkan denyutan masa kepada mikropengawal. In akan seterusnya menghasilkan denyutan masa dengan lebih tepat berbanding dengan cara lengah biasa. Data huruf dan grafik yang dikodkan akan disimpan ke dalam memori pengawal-mikro. Dalam proses ini, data akan dihantar ke dot matrik LED untuk paparan. Kelebihan projek ini ialah kebolehpaparan yang baik, penggunaan tenaga yang rendah, kurang penggunaan perkakasan dan juga harga yang rendah.

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LIST OF ABBREVIATION

LED	- Light-Emitting Diode
RTC	- Real-Time Clock
DIP	- Dual In-Line Package
IDE	- Integrated Development Environment
IC	- Integrated Circuit
AlGaAs	- Aluminum Gallium Arsenide
DIN	- Data Input
DOUT	- Data Output
CLK	- Clock
EEPROM	- Electrically Erasable Programmable Read-Only Memory
PCB	- Printed Circuit Boards
PC	- Personal Computer
ROM	- Read-Only Memory
PIC	- Peripheral Interface Controller
VLSI	- Very-Large-Scale Integration
CPU	- Central Processing Unit
ADC	- Analog-To-Digital Converter
I/O	- Input/Output
SRAM	- Static Random Access Memory
RISC	- Reduced Instruction Set Computer
PCI	- Peripheral Component Interconnect
USB	- Universal Serial Bus
CAN	- Controller Area Network
RAID	- Redundant Array Of Inexpensive Drives
RFID	- Radio-Frequency Identification
MCU	- Microcontroller
CMOS	- Complementary Metal–Oxide–Semiconductor
BIOS	- Basic Input/Output System
BCD	- Binary-coded decimal
DC	- Direct Current

RD	- Read
WR	- Write
LCD	- Liquid Crystal Display
PWM	- Pulse Width Modulation
GND	- Ground
MIPS	- Million Instructions Per Second
JTAG	- Joint Test Action Group

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Nowadays signboard displays are becoming more and more popular as an effective and economical means of data distribution to the masses. Text or even graphics can be easily conveyed to the public either during the daytime or midnight. However, previous signboards basically are produced in banner or poster type. This is an ineffective method to convey information that able to attract attention from the public especially during nighttime.

Banner or poster makes use of electric bulbs to lighten up their surface, although it helps improve the visibility of the information onboard but indirectly increase the maintenance cost including electricity. In contrast, LED dot matrixes consume less power and have longer life span which is more suitable to convey information compare to traditional methods.

The development of this project will prevent the limitation of current signboard display. The LED will turn ON once to display information for the whole day and the lifespan is much longer than bulb and others lighting source. Therefore it can save the cost of frequently changing the bulb, poster and also the energy used. Besides, this project also can increase the masses convey performance and will work more effectively in order to attract more people to read the messages. While the process of isolating the microcontroller for each programming time also can be skip for this project. Not only it can save the transferring time but the ESD protection is much better.

Software and hardware are the basic way to be applied in this project. The idea and knowledge that gained from research is developed in designing the dot matrix display control board. ATMEGA32 microcontroller is used to control the real-time clock IC and generate the display output to dot matrix. The ATMEGA32 program is developing using vision C compiler and AVR studio debugger. The message is downloaded in EEPROM through with JTAG interface with each byte corresponding to every column of dot matrix. Besides the current time, the system also can be used to display graphics, which generated using a Visual Basic program.

1.2 PROBLEM STATEMENT

Normal clock display system can easily be implemented using a microcontroller. The clock was generated by the program using looping technique to produces the approximate time delay. As a result, the output is inaccurate compare to the actual time. When the system is running for a long duration, errors can be identified easily. If this clock is applied to control a critical system, the errors could cause system break down and hazardous. Therefore, in this project, real-time IC is utilized to accommodate and overcome this problem

1.3 OBJECTIVE

The objectives of this project are:

- a) To construct a dot matrix display system
- b) To display the real time clock and graphic using microcontroller
- c) To implement real-time clock function

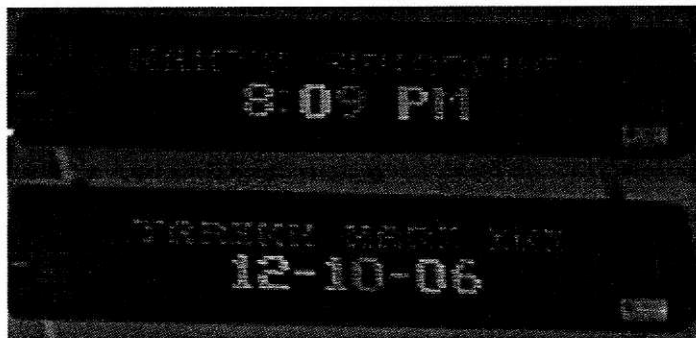


Figure 1.1: Example of LED Dot Matrix Display

1.4 SCOPES OF WORK

The scopes of works in this project are:

- a) To construct a ten unit of 8x8 dot matrix controlled by microcontroller.
- b) To study the implementation of real-time clock IC.
- c) To develop the program to generate character and graphic to dot matrix.

1.5 THESIS LAYOUT

The overall summary of this project is explained and divided into five main chapters. A brief description of the contents in each chapter is as below.

Chapter 1 is preview the background, project outline, aims and objective for the development of the project. The second chapter that is the literature review about the project title. In literature review, it includes some research on the existing implementation of the real-time clock display in dot matrix and LCD. Moreover, explore on different areas including the invention of real-time clock, virtue clock, and digital clock. The project methodology is elaborate in chapter 3. In this chapter, the method and the project block diagram has been explained in clearly.

Chapters 4 are discuss about the result of the project. The functional of each part of the project will explain briefly in this chapter. The last chapter is the conclusion for the whole project. From this chapter, it includes the conclusion and also the further improvement that can be made in future.

CHAPTER 2

LITERATURE REVIEW

2.1 BACKGROUND STUDY

Hardware development is very important towards the success of integrating both software and hardware. The hardware part consists of power supply, circuit for microcontroller, real time clock and buffer circuit for display. The application program is debugged and modified to ensure that it runs accordingly to the program algorithm. Integrating both hardware and software developed is the final step to the complete system.

2.2 REVIEW OF PREVIOUS STUDIES

2.2.1 Moving Message Display

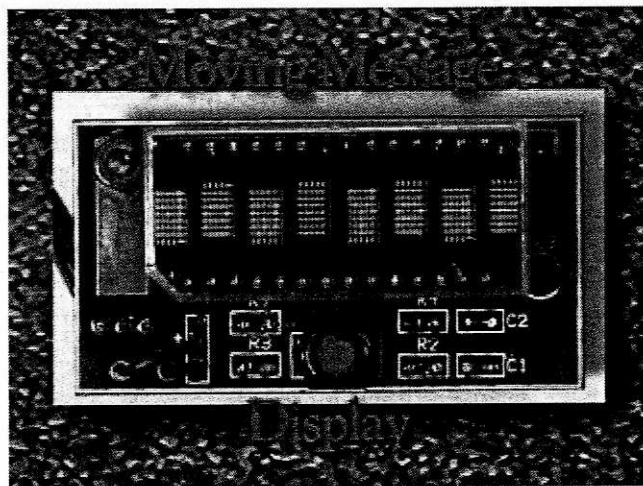


Figure 2.1 Moving Messages Display

This project uses the Phillips 87C750 microcontroller with an Agilent Technologies HDSP-2112, 8-Character, 5X7 dot matrix, Alphanumeric Programmable Display to create a marquee style moving message display. The custom message scrolls by from right to left facing the display.

The circuit board was designed with the microcontroller located on the back of the circuit board leaving just the display and reset button on the front. This lets the unit be mounted on a hat or shirt pocket. The message is hard coded into code space within the microcontroller.

Although the code for this particular project was written for the 87C750 microcontroller, it would be simple to modify for any microcontroller. The Atmel AT89C2051 would be a good choice since it's a FLASH based controller and would make it very easy to change the message.

2.2.2 The M1000

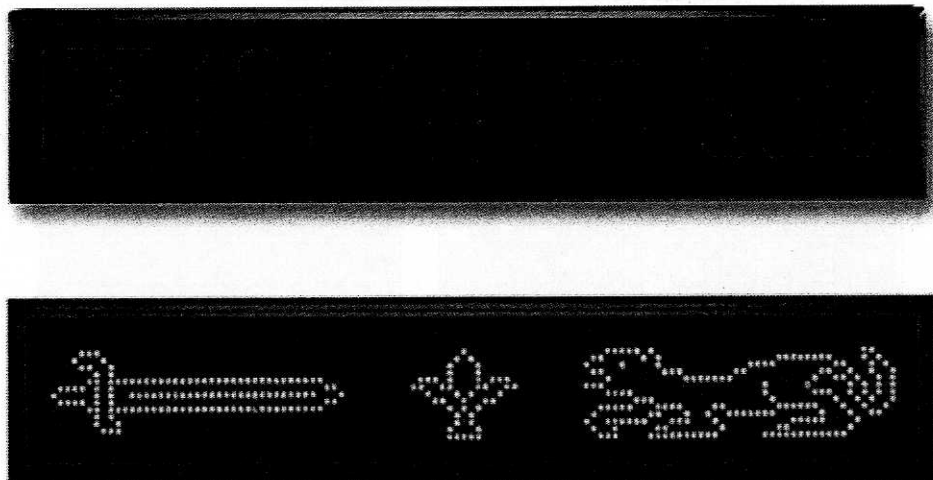


Figure 2.2 The M1000

Ease of use and powerful advanced features are combined to deliver a truly innovative marquee display. The M1000 display field is controlled by a hardware state machine resulting in a very stable and visually superior display. Simple yet powerful ASCII commands provide complete control over display functions and are designed for quick and easy integration. Standard optically isolated serial ports

enhance communication reliability and provide optimal electrical noise immunity even when data networks extend thousands of feet.[8]

- Inform, Alert and Motivate
- Deliver Key Production Information
- Rugged Industrial Display

Specifically designed for industrial applications, the M1000 gives the data display project the high visibility it deserves. State-of-the-art AlGaAs (Aluminum Gallium Arsenide) LEDs deliver vibrant 2" to 4.5" super-bright display characters that command attention even in the most demanding industrial environments. AlGaAs LEDs also feature very low power consumption resulting in a cooler running, more reliable display.

2.2.3 LED Moving Font

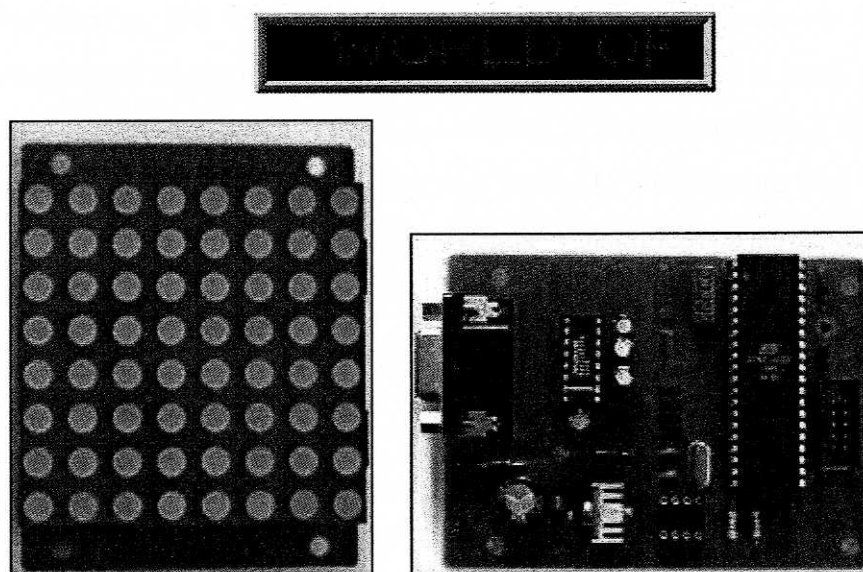


Figure 2.3: LED Moving Front

The “LED moving font” is built up of separate modules consisting of 64 LEDs each (8x8 matrix). The modules can be cascaded according to the desired size of the font. Each module is controlled by the LED display driver MAX7219 (or MAX7221) which can drive 64 LEDs. The display data is transferred serially to this display driver via the pins DIN, CLK and LOAD. The pin DOUT can be connected

to the input DIN of the following display driver, all CLK and all LOAD pins are connected together.

The modules are controlled by an 8051-compatible microcontroller AT89C51 or AT89C2051 from Atmel which provide 4 kB or 2kB flash memory on-chip. The LED display driver MAX 7219 CNG is available from Reichelt or Segor. The LED display driver is mounted together with a LED module (8x8 matrix) on the LED module PCB.

The display text is stored in a EEPROM. The text can be downloaded via a serial RS232 connection from a PC. From the PC a text file containing the text is sent. The baudrate can also be set to 600 Baud (via additional jumper), because some PCs have problems with hardware handshaking, which would be necessary at 1200 or 9600 Baud download speed. Dependent on the storage size of the EEPROM up to 2045 characters can be stored. It is also possible to store the text in the flash ROM of the microcontroller. But then it is necessary to reassemble the program code if the text is changed and to reprogram the flash ROM. If an EEPROM is used, changes of the text can be done easily via serial downloading. A maximum of 11 LED modules (each module consisting of 8x8 LEDs) can be used. The moving font is already working with 1 module. The selected value can be transmitted via serial interface and will be stored in a byte in EEPROM.

2.2.4 Alarm Clock

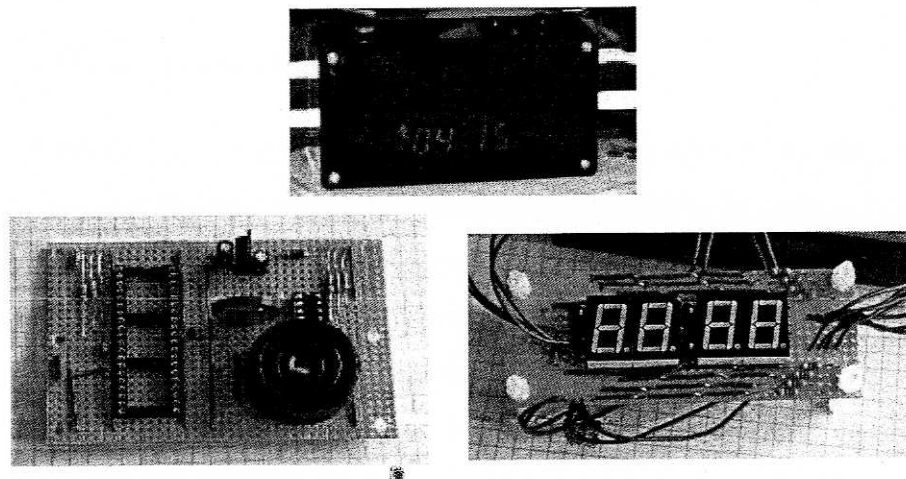


Figure 2.4: The Alarm Clock

The PIC microcontroller (16F74) is used and programmed to read the real-time clock using I2C serial communication several times a second and update the display. The PIC performs two other functions; it compares the time against the alarm settings to determine when it should go off and also handles time, date and alarm setting. The 16F74 has no EEPROM of its own so all the settings are stored in the DS1307 and read at power-on-reset. The numeric display is uses four red common anode seven segment displays. Each segment anode has its own 'select line' (RA0-RA3) and shares the eight cathode connections (RB0-RB7) to control the segments. An interrupt routine in the PIC updates each segment in turn for approximately 1/100 of a second and updates the state of the AM/PM and pulsing LEDs.