SUPERVISOR APPROVER

"I / We admit that to have read this report and it has follow the scope and quality in Partial Fulfillment Of Requirements For The Degree Of Bachelor of Electronic Engineering (Industrial Electronic)"

Signature :

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Date : 18 March 2005

REAL TIME CLOCK DISPLAY (PART 1)

HA HEI KUAI

This Report is submitted in Partial Fulfillment of Requirements for the Bachelor Degree of Electronic Engineering (Industrial Electronic)

Faculty of Electronic Engineering & Computer Engineering
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18 March 2005

ACKNOWLEDGMENT

I treat as valid this report is doing by myself except summary and quotation in every part that I had clear source.

I would like to express our greatest gratitude and sincere thanks to my supervisor, Mr. Sani Irwan Bin Md. Salim, for his valuable advice and assistance in the supervision and consultation of this Final Year Project. In fact, he gave me guidance when obstacles arise throughout this period of time. Once again, I thank him for his tolerance and endeavors.

Thanks to Miss Toh Yen Yin, Mr. Hafizul, Mr. Lo Jin Kui and Miss Tan Lee Chin who had help me a lot of my project in progress.

Signature : 

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Date : 18 March 2005

DECLARATION

This Final Year Project contains information pertaining of Real Time Clock Display using LED Dot Matrix. This project comes under the subject BEKU4983 Project offered by Faculty of Electronic Engineering & Computer Engineering, KUTKM. This documentation report aims to provide the reader about the overall information techniques about this project. The focus of the project is on accuracy the real time clock display in LED dot matrix.

I admired that this is an original my own work with the exception which I have referenced them to explained sources.

ABSTRACT

Predominantly, the title of this project is Real Time Clock Display (Part I) for design circuit and troubleshooting. The project is about the design of a Real Time Clock / Timer circuit using microcontroller that would accept inputs from switches, set and display the current time, set multiple timers to activate a particular device connected to the circuit. This Application Note explains how to control the display of characters on a 5x7 LED matrix display using the microcontroller PIC16F877 MCU. A ten-unit 5x7 matrix display (350 LEDs) is controlled by microcontroller PIC16F877 (40 pins).

The clock operates in either the 24-hour or 12-hour format with AM/PM indicator. The RTC provided in this Application Note facilitate easy implementation for displaying clock on a 5x7 LED matrix. It has a display which is 50 columns wide, enabling 10 characters to be shown at any one time.

The characters in each message are stored in an EEPROM with one byte corresponding to one column of dots. Storing the characters in this way rather than as their ASCII codes has the advantage that, apart from being simpler to decode with the electronics, any character or graphic needed can be easily formed. The circuit runs from a 5V DC regulated supply and consumes around 300mA peak when at LEDs are lit. The display clock is more accurate with using real-time clock, RTC and control by PIC16F877.

ABSTRAK

Secara keseluruhannya, tajuk projek ini ialah Paparan Jam Dengan Masa Yang Tepat (Bahagian I) untuk rekabentuk litar dan penyelesaian masalah. Projek ini adalah berkenaan dengan rekabentuk jam dengan masa yang tepat / litar pengawasan masa menggunakan mikro-pengawal yang boleh menerima input-input daripada pembuka, set dan menunjukkan masa yang terkini, merangka pelbagai penetapan masa untuk mengaktifkan pelan tertentu yang disambung kepada litar. Nota aplikasi ini menerangkan cara untuk mengawal paparan aksara atas matriks LED 5x7 yang ditunjukkan dengan mikro-pengawalan PIC16F877 MCU. Sepuluh unit paparan matriks 5x7 (350 LEDs) dikawal oleh mikro-pengawal PIC16F877 (40 pin).

Format jam ini beroperasi sama ada secara 24-jam atau 12-jam dengan penunjuk AM/PM. RTC yang dibekalkan dalam nota aplikasi ini memudahkan pelaksanaan untuk memaparkan jam atas matriks 5x7 LED. Ia mempunyai paparan seluas 50 ruang , ini supaya membenarkan 10 aksara untuk dipaparkan pada suatu masa.

Aksara dalam setiap mesej yang disimpan dalam satu EEPROM dengan satu bit bertindak ke satu ruang titik. Penyimpanan aksara dengan cara ini kalau dibandingkan dengan kod-kod ASCII mempunyai kelebihannya, selain daripada mudah untuk dekod dengan elektronik, sebarang aksara atau grafik yang diperlukan boleh dibentuk dengan mudah. Litar ini berfungsi daripada 5V DC yang ditawarkan dan menggunakan lebih kurang 300mA untuk mencapai puncaknya apabila LED memancar. Jam paparan ini menjadi lebih tepat dengan meggunakan jam masa yang sebenarnya, RTC dan dikawal oleh PIC16F877.

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LIST OF ABBREVIATION

PCB	-	Printed Circuit Board
LED	-	Light Emitting Diode
MCU	-	Microcontroller Unit
PIC	-	Peripheral Interface Controller
	-	Programmable Integrated Circuit
EEPROM	-	Electrically Erasable Programmable Read Only Memory
RTC	-	Real Time Clock
IC	-	Integrated Circuit
PICC	-	Peripheral Interface Controller Card
BCD	-	Binary-Coded Decimal
DAC	-	Digital To Analog Converter
ADC	-	Analog To Digital Converter
UART	-	Universal Asynchronous Receiver-Transmitter
CPU	-	Central Processing Unit
ROM	-	Read-Only Memory
I/O	-	Input / Output
SPI	-	Serial Peripheral Interface
RISC	-	Reduced Instruction Set Code
Hz	-	Hertz
MHz	-	MegaHertz
DC	-	Direct Current
RAM	-	Random-Access Memory
PWM	-	Pulse Width Modulation
SSP	-	Synchronous Serial Port
I2C	-	Inter-Integrated Circuit

USART	-	Universal Synchronous / Asynchronous Receiver / Transmitter
SCI	-	Serial Communications Interface
PSP	-	Parallel Slave Port
RD	-	Read
WR	-	Write
CS	-	Case Series
BOR	-	Brown-out Reset
SRAM	-	Static Random Access Memory
HC	-	High Capacity
CMOS	-	Complementary Metal-Oxide Semiconductor (transistor type)
PLL	-	Phase-Locked Loop
TTL	-	Transistor-Transistor Logic
VDC	-	Volts Direct Current
DIP	-	Dual Inline Package
WWVB	-	NIST longwave (60 Kilohertz) Standard Time Signal (Radio station callsign)
ASCII	-	American Standard Code for Information Interchange
SCL	-	Serial Clock
SDA	-	Serial Data
GPIO	-	General Purpose Input/Output
LCD	-	Liquid Crystal Display (display technology)
IEEE	-	Institute of Electrical & Electronics Engineers

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CHAPTER 1

INTRODUCTION

This project is a real time clock display on ten 5x7 LED dot matrix. It has the PIC16F877 MCU interfacing with the Dallas DS1307, a time keeping chip. This project only designs circuit and troubleshooting. The character is generated with a PIC chip EEPROM. This project has adapting RTC chip into PIC circuit to generate the input for display. This real time clock is build using PIC16F877 MCU for control and display and RTC for clock. The output device is shown in LED dot matrix display that can be used efficiently to accommodate the functionality of PIC.

The DS1307 chip stores the current date and time in registers of seconds, minutes, and hours, days, months and years. The interface allows the 16F877 to read the time keeping registers, as well as writing to any of them for changing the time. The time will be displayed on a dot matrix displays.

The clock can be set to correct time using the switches and buttons. The hardware is just a collection displays and components to input and output results into and out of software to and from the real world.

In real time clock, the accuracy of the clock is dependent upon the accuracy of the crystal and the accuracy of the match between the capacitive load of the oscillator circuit and the capacitive load for which the crystal was trimmed.

In hardware project its need for real time clock or delay source. Such devices as clocks, timers, etc. are impossible to produce without knowledge of exact time. The goal of this project is to create interrupt driven real time clock for Microchip PIC16F877 microcontroller to be used in various applications.

1.1 OBJECTIVES

1) To design circuit for Real Time Clock Display.
2) To troubleshoot the hardware part.
3) To apply the programmable to IC PIC.
4) To learn the functional and application of LED dot matrix display.
5) To learn the functional and characteristic of PIC16F877 and apply to circuit RTC.

1.2 PROJECT SPECIFICATION

The Installation Assistant will consist of several parts, it includes :

1) A microcontroller
2) A real-time clock
3) Dot matrix
4) Counter
5) Crystal

1.3 REPORT ORGANIZATION

This report is divided into several chapters. They are:

1) Introduction
2) Literature Review
3) Project Methodology
4) Microcontroller & Real-time Chip
5) Design And Explanation Of Circuit
6) Real Time Clock Display
7) Conclusion

The first chapter is introduction that introduce about the project title. Beside that, the objectives of the project have been comprised.

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 LCD. Moreover, explore on different areas including the invention of real-time clock, virtue clock, and digital clock.

The third section is about the project methodology. In this chapter, the methods and the project flow chart has been explained in clearly.

The fourth chapter is about the component of microcontroller and real-time chip. In this chapter, the functional of microcontroller and real-time chip have been explained clear. Each part of these components also has been explained.

For the fifth section, the objectives of this project are comprised. By this, the circuit is designed by using microcontroller with RTC to display in dot matrix. After this, the circuit is explanation in each part of the project.

The following chapter is about the real-time clock display. In this chapter, the functional of the EEPROM and the LED 5x7 dot matrix display. Beside that, the differences of the real-time and virtue time have been explained.

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 PREVIOUS STUDIES & RESEARCH

Predictability for Real-Time Clock, many hardware and software features rely heavily on the availability of precise timing information. The application of these features in distributed systems therefore necessitates the synchronous operation of all its clocks. Even if these clocks are initialized with the same time, since physical clocks drift, due to changes in physical conditions like temperature, sooner or later, individual clocks will indicate different times.

The discrete clock is an event-driven clock advanced, whenever the scheduler starts serving a packet, by the time needed to serve this packet. The arrival time of any packet is determined by the value of the discrete clock at that instant. Let the variable *dt* denotes the discrete clock. *dt.i* is the value of the discrete clock at instant *i*. Let *C* denotes the channel capacity. At the start of serving a packet with length *L* at instant *i*, the discrete clock is advanced as

$$dt.i = dt.i + L/C$$

The discrete clock is related to the real-time clock. This relation is illustrated in the following Lemma.

The LED dot matrix display described in this paper belongs to a new generation of dot matrix displays, as the visual light emitted from the display contains audio messages. It has long been realized that visible light has the potential to be modulated and used as a communication channel with high entropy.

This application makes use of free space as a communication medium, and the receiver is required to be in LOS with the transmitter. It should be noted that the transmitter provides easy target for the line-of-sight reception by the receiver. This is because the LEDs, being on all times, are also indicators of the locations of the transmitter. This development can lead to many new applications in the industry. With diverse commercial and industrial applications, the experimental results in this paper have demonstrated that the proposed idea is totally feasible.

2.2 RECENT RELEVANT PROJECT

2.2.1 PCF8583 Real Time Clock

This project is a simple demonstration of reading date and time from PCF8583 RTC (Real-Time Clock). The code can be used with any MCU that has

MSSP module at port C. Date and time are printed at LCD. The PIC microcontroller 16F877A has driven the RTC in this project. This project displays on a 2x16 LCD. Time and date are retained up to 10 years with a small 3V lithium battery. It works with the MPLAB compiler and limited to 2K for the PIC16F877 but this is sufficient for this projects.

Beside that, this project can use the MPLAB IDE to write a program. Programming of the PIC was done with IC-Prog on a PIC-programmer built from Electronique pratique. The designer used the PCB layout then to create in board. Real-time clock (RTC) counts seconds, minutes, hours, date of the month, month, day of the week, and year. The output of PCF8583 real time clock as below

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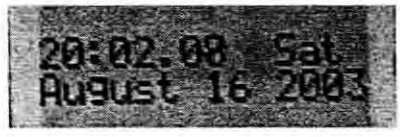

Figure 2.1 : Display Output of the PCF8583 Real Time Clock

2.2.2 ECPE-5 PIC Project Board

The PIC Project Board includes a sub-section with dot matrix displays,

switches and a potentiometer. This sub-section was designed to support a BCD clock project envisioned. The ECPE-5 PIC Project Board is a self-contained computer that includes a power supply, dot-matrix displays, discreet LED's, push-button switch input, digital to analog converter (DAC), digital thermometer, and a potentiometer for analog control.

The project board is based on the Microchip 16F877 RISC microprocessor. The processor includes on-chip I/O ports, 10 bit, ADC, timers, UART, and oscillator. The CPU section consists of the Microchip PIC16F877 PIC microprocessor, oscillator, reset circuit, and reverse voltage protection. The dot matrix display section of the project board can be configured with one large, or two small 5x7 dot matrix LED displays.

The PIC Project Board includes some simple I/O devices for testing and experimental use. These include discrete LEDs, switches, and a potentiometer. The ECPE-5 PIC Project Board includes a simple +5v power supply composed of a full wave rectifier and a fixed voltage linear regulator. The power supply components can be omitted. PIC16F877 is a dual output digital to analog converter (DAC) with 8-bit resolution. The interface to the DAC is a synchronous serial interface which can be driven by the SPI interface built into the PIC16F877.

The temperature sensor is also a serial I/O device. It uses a 1-wire interface rather than an SPI interface. The 1-Wire interface uses a single wire driven by open-collector devices as a bi-directional bus. The PIC16F877 has a very limited number of open-collector (or more correctly, open-drain) signals.

2.2.3 ZX81 Real Time Clock Project

Real Time Clock (RTC) project recently built and tested on a ZX81 but should be compatible with the Spectrum and other Z80 machines. Cost and simplicity are the main reasons for choosing the DALLAS DS1287. These RTC modules were used on some 286 AT motherboards which can often be had for free and contain other useful parts for ZX81 projects.

The DS1287 is functionally equivalent to the more common MC146818 but integrates all external components including crystal and battery in a single 24 pin DIP module. Check the date code on the unit to determine the remaining life of the internal lithium battery, which is normally good for 10 years or more. An internal flag can also be used to verify a good battery.

The DS1287 is designed to work with multiplexed address/data bus MPU's like the 6805 or the 8088. The data book shows an example of a 68000 application but there are no Z80 application examples given. This may be the reason it is seldom used in Z80 designs although the interface is straight forward. Rather than multiplexing the data and address are used two separate IO addresses: one for the address port and one for the data port.

The DS1287/Z80 interface programmer model is a block of 80 bytes, each of which can be selected by writing a byte address (0 to 79 decimal) to the address port and reading or writing data for that byte through the data port. The 74HC138 decodes IO addresses 1F, 3F ... FF any two of which (except FF) can be assigned to

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