REAL TIME CLOCK SYSTEM

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This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Computer Engineering) With Honours

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

April 2009

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : Stand-Alone Data Logger System

Sesi Pengajian : 2 / 2008/2009

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Special thanks to my family, project supervisor and friends

ACKNOWLEDGEMENT

First and foremost, I would like to extend my appreciation to all who contributed time, concern and efforts to lend a helping hand and thus allow me to gain invaluable knowledge. On top of that, I would like to reserve a special thank to my supervisor, Mrs. Sharatul Izah bt. Samsudin for her excellent mentoring and guidance. All his comments and constructive criticism played a pivotal role throughout my project development.

Next, I wish to thank the countless individuals who had contributed their constant views and evaluations in accessing my progress at all time. Finally, I would also like to express my deepest gratitude to my friends who had provided plenty of fruitful discussions with critical inputs from time to time. It would not have been possible to complete a project of this magnitude without their support.

ABSTRACT

A real-time clock (RTC) is a computer clock (most often in the form of an integrated circuit) that keeps track of the current time. Although the term often refers to the devices in personal computers, servers and embedded systems, RTCs are present in almost any electronic device which needs to keep accurate time. In many electronic devices and systems, a need for real time clock for timekeeping is required. Although the time can often be generated through processor or microcontroller itself, many processor resources will be wasted for the timekeeping. Furthermore, the timekeeping generated by processor itself is less accurate since the processor is not optimized for timekeeping. Hence, there is a need for a timekeeping to be maintained by different processor/resources which offers better accuracy and reliability. As technology grows, more demand in accuracy will expected of the timekeeping job as response time become short and shorter.

ABSTRAK

Real Time Clock (RTC) ialah jam komputer yang mengira dan menjaga masa sebenar untuk sesebuah sistem. RTC lazimnya berbentuk litar bersepadu. Walaupun perkataan RTC lazimnya merujuk kepada perkakas di dalam system komputer, RTC juga boleh didapati di dalam apa jua perkakasan elektronik yang memerlukan masa yang tepat. Walaupun masa boleh dijana oleh pemproses atau mikropengawal, penjanaan masa akan membebankan pemproses. Tambahan lagi, pemproses tidak sesuai untuk menjalankan tugas menjaga masa. Oleh itu, tugas menjaga masa yang dijalankan oleh pemproses yang memberikan masa yang lebih tepat dan konsisten diperlukan. Dengan perkembangan teknologi yang pesat, masa yang lebih tepat diperlukan disebabkan masa respons yang semakin pendek.

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LIST OF ABBREVIATIONS

PIC	-	Peripheral Interface Controller
I/O	-	Input/output
SDA	-	Serial Data Input/Output
SCL	-	Serial Clock Input
RTC	-	Real Time Clock
LCD	-	Liquid Crystal Display

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CHAPTER I

INTRODUCTION

A real-time clock (RTC) is a computer clock (most often in the form of an integrated circuit) that keeps track of the current time. Timekeeping is the act or process of determining the time. A timekeeper is an instrument or person that measures the passage of time. In many electronic devices and systems, a need for real time clock for timekeeping is required. Although the time can often be generated through processor or microcontroller itself, many processor resources will be wasted for the timekeeping. Furthermore, the timekeeping generated by processor itself is less accurate since the processor is not optimized for timekeeping. Hence, a need for a timekeeping means which is more accurate and doesn't waste processor resource is required. The aim of this project is to create a circuit for timekeeping by using a better resource for timekeeping. In this project, DS1307 clock IC was used for the timekeeping. The data will be accessed by using PIC16F877a and displayed on LCD.

1.1 Objectives

The aim for this project is to design and create a circuit for displaying the current time by using real time clock IC DS1307, PIC 16F677a and 16X2 LCD display. DS1307 is a real time clock IC which offers accurate timekeeping as well as auto-adjusting date for leap years. The DS1307 uses an I2C protocol in which it can only be operated as a slave. Microcontroller PIC16F877a will be used as a processor and master in this system to read and write data from the DS1307. The data will then be displayed on the LCD.

1.2 Problem Statement

Timekeeping task requires a certain degree of accuracy in which normal processor is not optimized for. To maintain an accurate timekeeping task, a processor may waste many of its valuable resource. To free a processor from this continuous task, a timekeeping means maintained by a different processor or resources is required. A DS1037 will maintain the timekeeping job accurately and better than the processor since it is a specially built clock IC. The data will be accessible by using PIC16F877a. By using the input from DS1037, the time and date will be displayed on the LCD. The DS1307, PIC16F877a and the LCD operate independently from the processor and hence free the main processor from timekeeping task. The PIC16F877a can also generate interrupt based on the data from the clock and control other electronic functions.

1.3 Scope

First of all the background research study on the real rime clock system was covered. From this background study ideas on the process in implementing a real time clock system was studied. After the implementation method was chosen, PIC 16F877a as a microcontroller, DS1307 as a clock IC and LCD as a display were chosen. Next the method of transferring data between the chosen clock IC DS1307 and the microcontroller PIC 16F877a which is the I2C method was implemented. The simulation circuit was done by using Proteus simulator. The source code will be implemented in CCS C language.

1.4 Methodology

The main methodology used in this project is part by part construction and verification. First of all, a basic functional circuit of PIC16F877a was simulated and verified by using the LED running light program. Next, the interface with the LCD was simulated and verified by displaying a phrase such as 'hello world'. Lastly, the I2C interface was used to obtain data from DS1307 and displayed on LCD. The data obtained was verified by using a preset data written into DS1307 by using I2C interface.

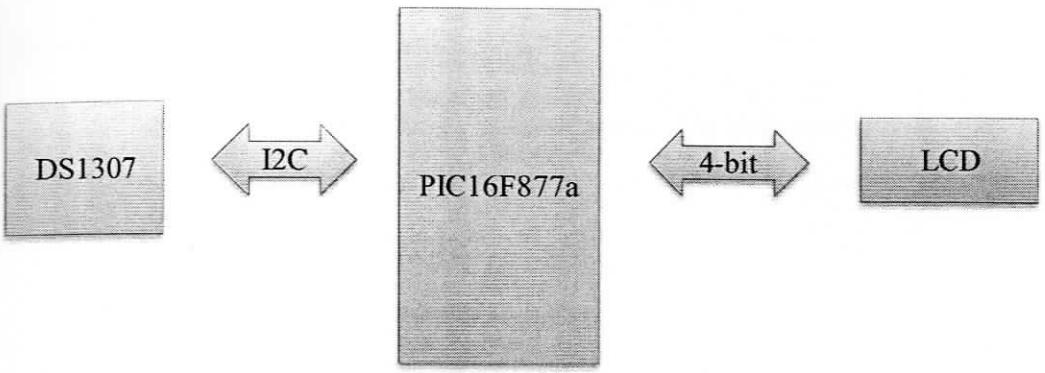

Figure 1: General block diagram of the project

1.5 Report Structure

Chapter one briefly introduces the general overview of the Real Time Clock System project. The introduction consists of overview, objective, problem statement, scope of work, methodology and report structure.

Chapter two discusses about the background of study associated to the Real Time Clock System. The literature review would show the relation between project research and theoretical concept.

Chapter three explains about the project methodology. Project methodology gives comprehensive details about the method used to solve problem to complete the project.

Chapter four consists of result and discussion to all result, finding and analysis throughout the research and project development. It inevitably shows how precise the hypothesis could be to realization.

Chapter 5 would be the project conclusion. This chapter rounds up the attained achievement of the whole project and reserves suggestions for possible future researches.

CHAPTER II

LITERATURE REVIEW

A real-time clock (RTC) is a computer clock (most often in the form of an integrated circuit) that keeps track of the current time. Although the term often refers to the devices in personal computers, servers and embedded systems, RTCs are present in almost any electronic device which needs to keep accurate time.

Although keeping time can be done without RTC, using one has benefits:

- Low power consumption
- Frees the main system for time-critical tasks
- more accurate

RTCs often have an alternate source of power, so they can continue to keep time while the primary source of power is off or unavailable. This alternate source of power

is normally a lithium battery in older systems, but some newer systems use a super capacitor, because they are rechargeable and can be soldered. The alternate power source can also supply power to battery backed RAM.

Most RTCs use a crystal oscillator, but some use the power line frequency. In many cases the oscillator's frequency is 32.768 kHz. This is the same frequency used in quartz clocks and watches, and for the same reasons, namely that the frequency is exactly 2^{15} cycles per second, which is a convenient rate to use with simple binary counter circuits.

2.2 DS1307

The DS1307 serial real-time clock (RTC) is a low power, full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV SRAM. Address and data are transferred serially through an I2C, bidirectional bus. The clock/calendar provides seconds, minutes, hours, day, date, month, and year information. The end of the month date is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12- hour format with AM/PM indicator. The DS1307 has a built-in power-sense circuit that detects power failures and automatically switches to the backup supply. Timekeeping operation continues while the part operates from the backup supply [1].

2.2.1 Key Features

- Real-Time Clock (RTC) Counts Seconds, Minutes, Hours, Date of the Month, Month, Day of the week, and Year with Leap-Year Compensation Valid Up to 2100
- 56-Byte, Battery-Backed, General-Purpose RAM with Unlimited Writes
- I2C Serial Interface
- Programmable Square-Wave Output Signal
- Automatic Power-Fail Detect and Switch Circuitry
- Consumes Less than 500nA in Battery-Backup
- Mode with Oscillator Running

2.2.2 Pin Configurations

Figure 2.1 shows the pins configurations of the DS1307 real time clock IC. There are a total of 8 pins for DS1307 real time clock IC. The pins are X1, X2, VBAT, GND, VCC, SQW/OUT, SCL, and SDA.

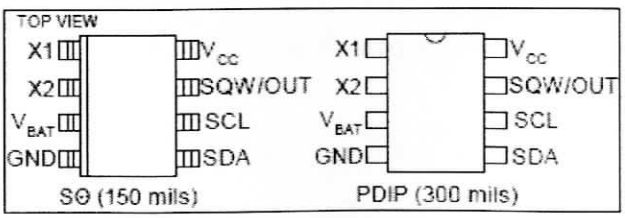

Figure 2.1: DS1307 Pin Configuration