STAND-ALONE DATA LOGGER SYSTEM

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Special thanks to my family, project supervisor and friends

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ABSTRACT

A data logger system is widely used in various fields to log data of variable parameters such as power signal, temperature and many more. It is generally used to store and accumulate data received from a particular data source. The importance of data logger is as a recording device for creating a time-sequence history of events for a subjected parameter. In this report, the primary focus would be on the acquisition and logging of data signal. Nowadays, a data logger system is commonly directly interfaced to a PC or a server via sophisticated technology such as wireless Bluetooth which could be quite costly. Hence, the Stand-alone Data Logger System could be used as an alternative for a cheaper option. This system comprises a data acquisition circuit with an interface between data input and microcontroller and also the transfer of data from the microcontroller to the SD/MMC card via SPI mode communication. Besides, being a stand-alone system, the portability of this device allows data to be logged at any given time and location by utilizing the SD/MMC card capability to store data making it less time consuming. The expected result of the project would be a reliable and fully functional user-friendly signal data logging system with the ability to log data signal input for future references.

ABSTRAK

Sistem ‘data logger’ merupakan satu sistem pengumpulan data yang digunakan secara meluas dalam pelbagai bidang untuk mengumpul data seperti signal kuasa, suhu dan sebagainya. Secara amnya, sistem ini diaplikasikan untuk mengumpul dan menyimpan data yang dikehendaki untuk memerhatikan variasi perubahan sesuatu data yang dianalisa. Dalam projek ini, jenis data yang menjadi fokus kajian ialah isyarat data. Pada zaman ini, kebanyakan sistem ‘data logger’ diaplikasikan secara langsung kepada PC atau sesuatu ‘server’ melalui teknologi canggih seperti Bluetooth yang secara tidak langsung menaikkan kos penggunaannya. Oleh itu, adalah wajar untuk mempertimbangkan penggunaan sistem ‘Stand-alone Data Logger’ sebagai alternatif yang lebih menjimatkan kos. Sistem ini mengandungi litar pengumpul data yang yang bersambung kepada suatu mikropengawal yang seterusnya menghantar maklumat yang terkumpul untuk disimpan dalam kad SD/MMC. Satu lagi kebaikan sistem ini adalah kebolehannya sedia untuk digunakan pada setiap masa. Seterusnya, jangkaan hasil projek ini adalah satu sistem ‘data logger’ yang berkualiti lagi berkesan bagi mengumpul maklumat untuk dianalisa pada masa hadapan.

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LIST OF ABBREVIATIONS

SD	-	Secure Digital
MMC	-	MultiMediaCard
PIC	-	Peripheral Interface Controller
CPU	-	Central Processing Unit
DIP	-	Dual Inline Package
IC	-	Integrated Chip
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
PWM	-	Pulse Width Modulation
USART	-	Universal Asynchronous Receiver/Transmitter
MSSP	-	Master Synchronous Serial Port
I/O	-	Input/output
SPI	-	System Packet Interface
CLK	-	Clock
SCLK/SCK	-	Serial Clock
CMD	-	Command
CS	-	Chip Select
MOSI	-	Master Out Slave In
MISO	-	Master In Slave Out
ANSI	-	American National Standards Institute
IDE	-	Integrated Drive Electronics
ADC	-	Analog-to-Digital Converter

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CHAPTER I

INTRODUCTION

This project is mainly centered on a design of a stand-alone data logger system which is capable to acquire, record and store data / input signal from the function generator for monitoring purposes. This design utilizes both the PIC and memory card capabilities. The data stored will then be monitored using computer. The whole concept would indefinitely simplify the convenience of data logging.

1.1 OVERVIEW

A data logger is used for logging or accumulating data received from a data source. Data logging is now widely used in computer simulation to provide a record of the activity of the simulated system for subsequent processing and analysis. A data logger may generally be described as a recording device for creating a time-sequence history of events. A data logger is made up of a digital processor operationally connected to a non-volatile memory bank for storing measurements obtained from electronic sensors in communication with the data logger. An analog-to-digital converter is used to convert analog signals and discrete events into digital form for storage into the non-volatile memory bank. Typically, data loggers include a sensor which measure the required parameter (voltage signal) and are connected to the data logger. Data is derived from the signal, and the microprocessor stores the data in the SD/MMC Memory Card. Subsequently, the data is transferred from the SD/MMC

Memory Card to a computer through the computer interface. The computer then analyzes the data.

Data loggers are employed in many industries to ascertain various environmental parameters. Generally, this project is intended to provide a suitable interfacing system between the signals from the function generator to the PIC microcontroller and subsequently stores the data into a memory card for future analysis.

1.2 OBJECTIVES

The objective of this project is to develop a stand-alone data logger system for voltage signals obtained from the function generator. The objectives can be summarized as below:

a) To use PIC to acquire and record the data
b) To transmit the acquired data to a SD/MMC card via Serial Peripheral Interface (SPI mode)
c) To store the PIC data using a memory card

1.3 PROBLEM STATEMENT

The idea of this project is to eradicate the inconvenience of data logging by building a low-cost yet reliable portable data logging system with adequate memory capacities; capable of acquiring and recording data obtained from the function generator at any given time for future analysis. Logging enables the database management systems to record updates to the database to facilitate recovery in the case of a system crash or media failure.

1.4 SCOPE

a) Research study on the on the Programmable Intelligence Computer, PIC18F452 microcontroller and the control system of the circuit.
b) To acquire the function generator signal for data logging.
c) To develop a PIC to memory card interface.
d) To design an ideal circuit simulation using suitable computer language and software to enable data transmission to the memory card and test its efficiency.
e) To construct and develop the model of the circuit designed (hardware)

1.5 PROJECT METHODOLOGY

a) Project Planning
b) Literature Review
c) Data Collection
d) Software Design & Circuit Construction for the acquisition of data
e) PIC interfacing to transfer signal to memory card
f) Performance Analysis

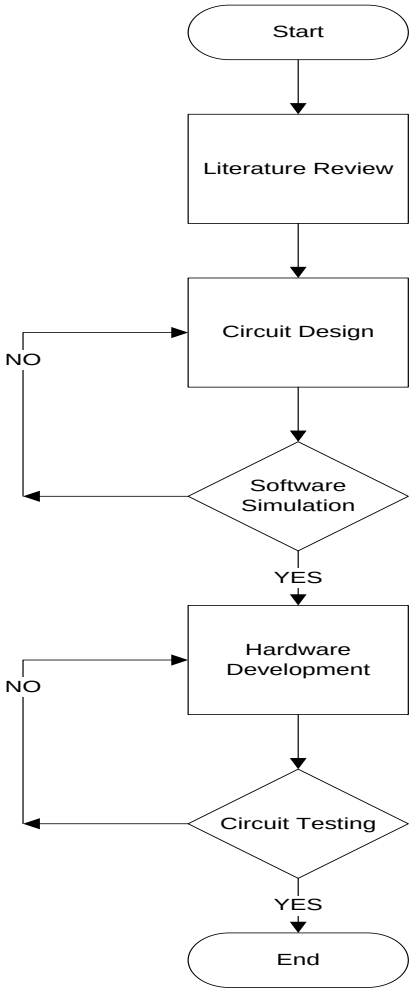

Figure 1.1: A general flowchart of the project

1.6 REPORT STRUCTURE

Chapter I briefly introduces the general overview of the Stand-alone Data Logger project. The introduction consists of overview, objective, problem statement, scope of work, methodology and report structure.

Meanwhile, Chapter II discusses about the background of study associated to the data logger system. Literature review forms the backbone of the overall structure of the data logger system as it shows the relation between project research and theoretical concept.

Chapter III explains about the project methodology. Project methodology gives comprehensive details about the method used to solve problem to complete the project. This chapter touches on the methods used for data collection, software and circuit design, PIC interfacing, SD/MMC memory card interfacing and performance analysis with the aid of block diagrams and flowcharts.

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

Lastly, Chapter V is 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

2.1 THEORY

In this chapter, the focus is on the literature review conducted on a wide range of correlated studies necessary to complete this project. This includes the Peripheral Interface Controller (PIC) microcontroller or precisely the PIC16F877A and PIC18F452 microcontrollers, RS232 Serial Port, SD/MMC Card and its interface and mikroC, the software chosen to be applied in this project.

2.1.1 PERIPHERAL INTERFACE CONTROLLER (PIC)

PIC (Peripheral Interface Controller) is a family of Harvard architecture microcontrollers. It is an IC developed to control peripheral devices, to ease the load from the main CPU. The PIC, akin to the CPU, has calculation functions and memory, and is controlled by the software. It has separate code and data spaces in accordance to Harvard architecture [1].

The characteristics of a general PIC architecture are:

f) A small number of fixed length instructions.

g) Most instructions are single cycle execution (4 clock cycles), with single delay cycles upon branches and skips.

h) A single accumulator (W), the use of which (as source operand) is implied.

i) All RAM locations function as registers as both source and/or destination of math and other functions.

j) A hardware stack for storing return addresses.

k) A fairly small amount of addressable data space (typically 256 bytes), extended through banking.

l) Data space mapped CPU, port, and peripheral registers.

m) The program counter is also mapped into the data space and writable (this is used to synthesize indirect jumps).

2.1.2 MICROCONTROLLER PIC16F877A

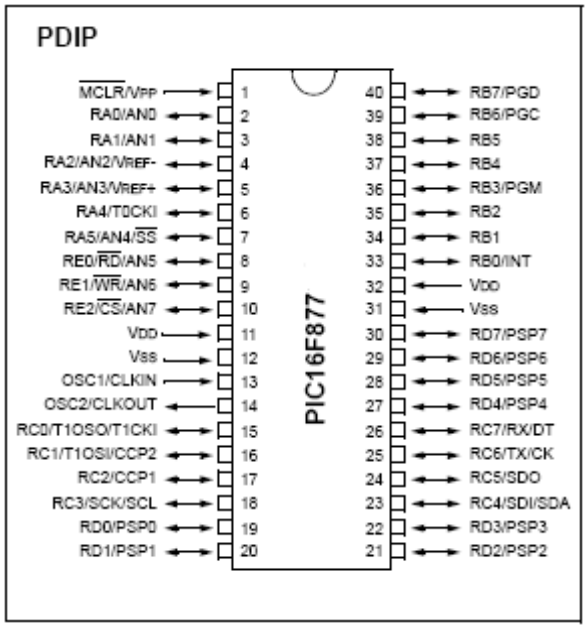

Figure 2.1: Datasheet of PIC16F877A [3]

PIC16F877A is a small piece of semiconductor integrated circuits. The package type of this integrated circuit is DIP package. DIP stand for Dual Inline Package for semiconductor IC. This IC can be reprogrammed and erased up to 10,000 times. Therefore it is very good for new product development phase.

Table 2.1: PIC16877A Key Features [3]

Key Features	PIC16F877A
Operating Frequency	DC - 20 MHz
RESET (and Delays)	POR, BOR (PWRT, OST)
FLASH Program Memory (14-bit words)	8K
Data Memory (bytes)	368
EEPROM Data Memory	256
Interrupts	14
I/O Ports	Ports A,B,C,D,E
Timers	3
Capture/Compare/PWM Modules	2
Serial Communications	MSSP, USART
Parallel Communications	PSP
10-bit Digital-to-Analog Module	8 input channels
Instruction Set	35 instructions

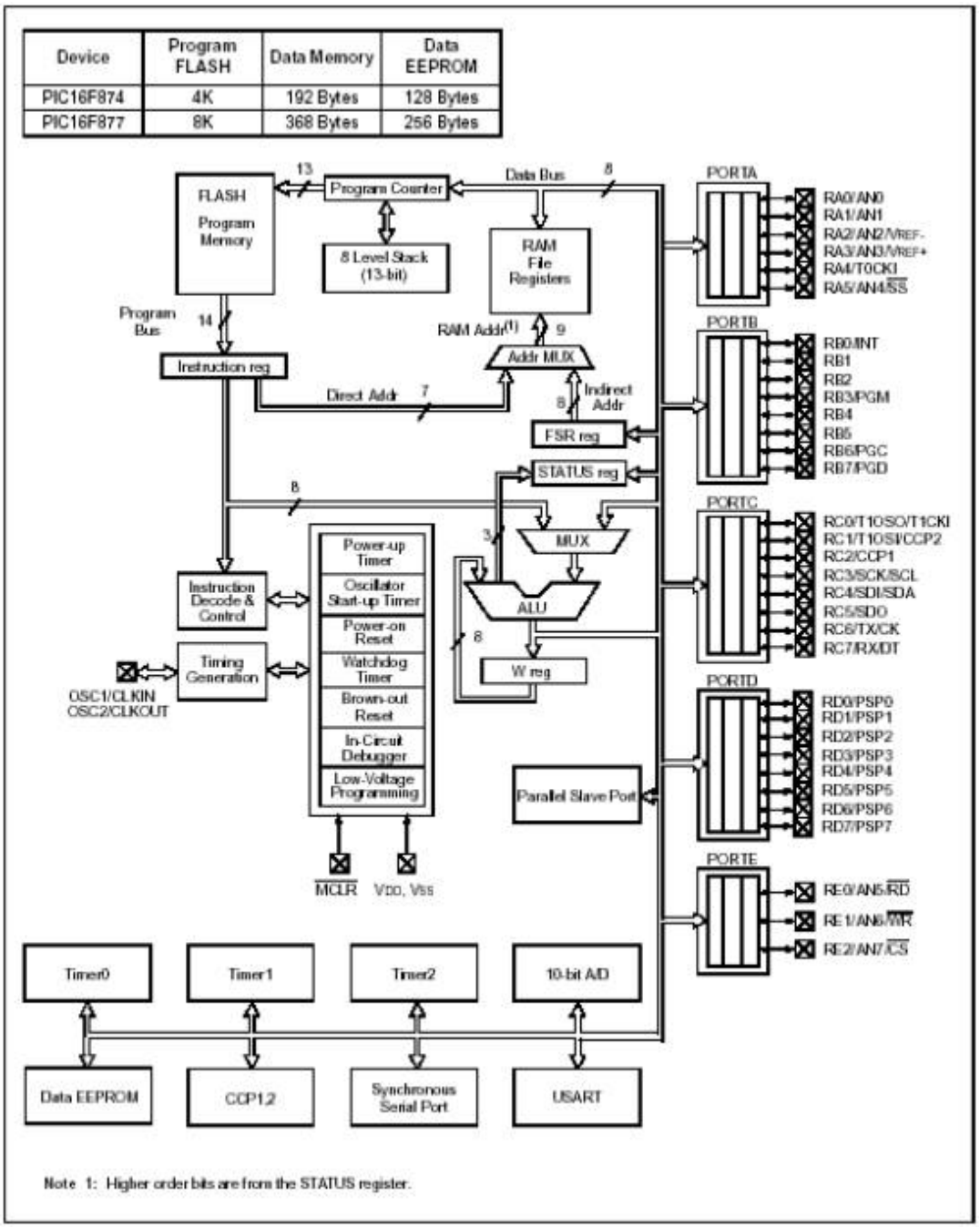

Figure 2.2: PIC16F877 Block Diagram [3]