PIC Based Digital Voltmeter by using VB

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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

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"I hereby declare that this report is the result of my own work except for quotes as cited in the references."

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ABSTRACT

This project is about designing a PIC Based Digital Voltmeter by using Visual Basic Voltmeter. Microcontroller programs are developed to generate Analogue Digital Converter (A/DC). It also will need to design a GUI to display the value for the measurement by using the Visual Basic software. The voltmeter need to be connected to computer by using serial port. The advantages of this project are low power consumption, relatively low hardware requirement, low cost, overcomes the problem of actual measurement and high effective.

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ABSTRAK

Projek ini adalah berkenaan merekacipta sebuah PIC Based Digital Voltmeter dengan menggunakkan perisian visual basic. Sebuah program pengawal-mikro akan dibangunkan untuk menghasilkan Analog menukar Digital(A/DC). Ia juga perlu merekacipta 1 GUI bagi mempaparkan nilai yang diukur dengan mengunnakna perisian Visual Basic. Voltmeter mesti disambungkan ke computer dengan menggunakan serial port. Kelebihan projek ini ialah penggunaan tenaga yang redah, kurang penggunaan perkakasan, harga yang redah, menanggani masalah nilai kurang tepat dan lebih senang diguna.

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CHAPTER 1

INTRODUCTION

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1.1 Introduction

A voltmeter is an instrument used for measuring the electrical potential difference between two points in an electric circuit. Analog voltmeters move a pointer across a scale in proportion to the voltage of the circuit; digital voltmeters give a numerical display of voltage by use of an analog to digital converter.

Voltmeters are made in a wide range of styles. Instruments permanently mounted in a panel are used to monitor generators or other fixed apparatus. Small portable instruments, usually equipped to also measure current and resistance in the form of a multimeter, are standard test instruments used in electrical and electronics work. Any measurement that can be converted to a voltage can be displayed on a meter that is suitably calibrated; for example, pressure, temperature, flow or level in a chemical process plant.

First created in the early 1800s, voltmeters were originally called galvanometers. Technically, all voltmeters are ammeters, as they measure current rather than voltage. Although current is measured in amps, Ohm's Law, which establishes the relationship between voltage, current and resistance, can be used to scale the amps to volts.

Voltmeters were made possible by an 1819 discovery by Hans Oersted. When he passed a current through a wire near a compass needle, he noticed the needle would change direction. The earliest attempts to take advantage of this effect were little more than a coil of wire wrapped around a compass; the stronger the current passing through the wire, the greater the deflection of the compass needle. While functional, these early models were not very accurate.

In the late 19th century Arsene D'Arsonval discovered the instrument could be made much more responsive if the coil around the compass was made smaller, attached to the base of the needle, and surrounded by a circular magnet. This became known as the D'Arsonval movement, and is still used today in analog meters.

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In practice most voltmeters are actually multimeters capable of measuring voltage, current and resistance because all measurable electrical properties are related to each other through Ohm's Law. When measuring voltage, a large resistance is placed in line with the coil of the D'Arsonval movement to minimize interference with the circuit being measured. This is also due to Ohm's Law, which states voltage is directly proportional to resistance. By minimizing the voltage consumed by the voltmeter itself, a more accurate measurement of the circuit's voltage can be obtained. Current is inversely proportional to resistance; conversely, to minimize the amount of current flowing into an ammeter, a large resistance is placed in parallel with the coil.

General purpose analog voltmeters may have an accuracy of a few per cent of full scale, and are used with voltages from a fraction of a volt to several thousand volts. Digital meters can be made with high accuracy, typically better than 1%. Specially calibrated test instruments have higher accuracies, with laboratory instruments capable of measuring to accuracies of a few parts per million. Meters using amplifiers can measure tiny voltages of microvolt or less.

Part of the problem of making an accurate voltmeter is that of calibration to check its accuracy. In laboratories, the Weston Cell is used as a standard voltage for precision work. Precision voltage references are available based on electronic circuits.

1.2 **Problem Statement**

1. Using less pin PIC chip compare to current voltmeter.
2. Need to confirm the serial port about the pin.
3. Cannot find the PIC for the circuit.

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1.3 Objectives

The main goal of this project is to implement and design a PIC based digital voltmeter. Besides that, there are other objectives to be achieved in this project which are:

1. To create Graphical User Interface (GUI) using Visual Basic.
2. To design a smallest size of the voltmeter circuit.
3. To design a voltmeter that can save cost and reduce the weight of the voltmeter.
4. To design the voltmeter using PIC Microcontroller from Microchip.

1.4 Scope Of Project

The scope of work in this project is stated as follow:

1. Using microcontroller to design a PIC based digital voltmeter by using Visual Basis.NET (VB.NET).
2. Using VB.NET to programmer the Graphical User Interface (GUI).
3. Using Protel to design a small circuit for the voltmeter.

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CHAPTER 2

LITERATURE REVIEW

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Reference Book Review

2.1 Case Study 1

2.1.1 Introduction to Microcontroller

Microcontroller (also MCU or µC) is a functional computer system-on-a-chip. It contains a processor core, memory, and programmable input/output peripherals. Microcontrollers include an integrated CPU, memory (a small amount of RAM, program memory, or both) and peripherals capable of input and output. It emphasizes high integration, in contrast to a microprocessor which only contains a CPU (the kind used in a PC). In addition to the usual arithmetic and logic elements of a general purpose microprocessor, the microcontroller integrates additional elements such as read-write memory for data storage, read-only memory for program storage, Flash memory for permanent data storage, peripherals, and input/output interfaces. At clock speeds of as little as 32 KHz, microcontrollers often operate at very low speed compared to microprocessors, but this is adequate for typical applications. It consume relatively little power (milliwatts or even microwatts), and will generally have the ability to retain functionality while waiting for an event such as a button press or interrupt. Power consumption while sleeping (CPU clock and peripherals disabled) may be just nanowatts, making them ideal for low power and long lasting battery applications. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, remote controls, office machines, appliances, power tools, and toys. By reducing the size, cost, and power consumption compared to a design using a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to electronically control many more processes. In contrast to general-purpose CPUs, microcontrollers may not implement an external address or data bus as it integrate RAM and non-volatile memory on the same chip as the CPU. Using fewer pins, the chip can be placed in a much smaller, cheaper package.

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Integrating the memory and other peripherals on a single chip and testing them as a unit increases the cost of that chip, but often results in decreased net cost of the embedded system as a whole. Even if the cost of a CPU that has integrated peripherals is slightly more than the cost of a CPU + external peripherals, having fewer chips typically allows a smaller and cheaper circuit board, and reduces the labor required to assemble and test the circuit board.

A microcontroller is a single integrated circuit, commonly with the following features:

- central processing unit - ranging from small and simple 4-bit processors to complex 32- or 64-bit processors
- discrete input and output bits, allowing control or detection of the logic state of an individual package pin
- serial input/output such as serial ports (UARTs)
- other serial communications interfaces like I^2C, Serial Peripheral Interface and Controller Area Network for system interconnect
- peripherals such as timers, event counters, PWM generators, and watchdog
- volatile memory (RAM) for data storage
- ROM, EPROM, EEPROM or Flash memory for program and operating parameter storage
- clock generator - often an oscillator for a quartz timing crystal, resonator or RC circuit
- many include analog-to-digital converters
- in-circuit programming and debugging support

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This integration drastically reduces the number of chips and the amount of wiring and circuit board space that would be needed to produce equivalent systems using separate chips. Furthermore, and on low pin count devices in particular, each pin may interface to several internal peripherals, with the pin function selected by software. This allows a part to be used in a wider variety of applications than if pins had dedicated functions. Microcontrollers have proved to be highly popular in embedded systems since their introduction in the 1970s.

Some microcontrollers use Harvard architecture: separate memory buses for instructions and data, allowing accesses to take place concurrently. Where a Harvard architecture is used, instruction words for the processor may be a different bit size than the length of internal memory and registers; for example: 12-bit instructions used with 8-bit data registers.

The decision of which peripheral to integrate is often difficult. The microcontroller vendors often trade operating frequencies and system design flexibility against time-to-market requirements from their customers and overall lower system cost. Manufacturers have to balance the need to minimize the chip size against additional functionality.

Microcontroller architectures vary widely. Some designs include general-purpose microprocessor cores, with one or more ROM, RAM, or I/O functions integrated onto the package. Other designs are purpose built for control applications. A microcontroller instruction set usually has many instructions intended for bit-wise operations to make control programs more compact. For example, a general purpose processor might require several instructions to test a bit in a register and branch if the bit is set, where a microcontroller could have a single instruction that would provide that commonly-required function. [1]

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Table 2.1 Manufacturer of Microcontroller in the Market

Manufacturer	Description
Microchip Technology	Product: 8-bit Microcontrollers, Interface Chips. PICmicro® microcontrollers (MCUs), Analog/ interface products; Serial EEPROMs; microID® RFID tags; KEELOQ® security devices; and the dsPIC® family of Digital Signal Controllers. Very good Development Tools. Microchip had shipped their One Billionth Flash Microcontroller by June 2005.
Intel® Corporation	Product: Pentiums, High Performance Chipsets. Popular manufacturer of Pentium PC microprocessors (of course), in addition to motherboards, PC chipsets, server RAID controller, microcontrollers, PCI bridges, ethernet products, Flash memory, and a wide range of connectivity chips.
Infineon Technologies	Product: C16x, C500,TriCore.BroadRange Supplier. 8-bit microcontrollers based on the 8051. 16-bit ROM & OTP microcontrollers with outstanding development tool support. CAN and USB microcontrollers. A broad-range supplier of a wide variety of semiconductor products.
Freescale Semiconductor	Product: Microcontrollers, Broad Range Supplier. Popular manufacturer of a wide variety of analog and digital semiconductors, including a number of microcontroller families ranging from 8-bit to 32-bit.

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Atmel Corporation	Product: 8051, AT91, AVR, AVR32 Microcontrollers. Atmel manufactures three families of microcontrollers: the popular 8051, the AT91 which is an ARM Thumb and the Atmel AVR 8-bit RISC device, Flash varieties are available.
Dallas Semiconductor	Product: Fast Flash Microcontrollers Manufactures a line of high-performance Flash 8051 microcontrollers, 50 MIPS peak at 50 MHz, as well as "secure" microcontrollers, an 8051 with a watch battery to keep the SRAM alive. Extensive development tools support. Now a division of Maxim Integrated Products.

Internet Resource Review

2.2.1 Case Study 1

2.2.1 Programming a Microcontroller

Microcontrollers and humans communicate through the medium of the programming language called Assembly language. The word Assembler itself does not have any deeper meaning, it corresponds to the names of other languages such as English or French. More precisely, assembly language is only a passing solution. In order that the microcontroller can understand a program written in assembly language, it must be compiled into a language of zeros and ones. Assembly language and Assembler do not have the same meaning. The first one refers to the set of rules used for writing program for the microcontroller, while the later refers to a program on a personal computer used to translate assembly language statements into the

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language of zeros and ones. A compiled program is also called Machine Code. A "Program" is a data file stored on a computer hard disc (or in memory of the microcontroller, if loaded) and written according to the rules of assembly or some other programming language. Assembly language is understandable for humans because it consists of meaningful words and symbols of the alphabet. For example, the command "RETURN" which is, as its name indicates, used to return the microcontroller from a subroutine. In machine code, the same command is represented by a 14-bit array of zeros and ones understandable by the microcontroller. All assembly language commands are similarly compiled into the corresponding array of zeros and ones. A data file used for storing compiled program is called an "executive file", i.e. "HEX data file". The name comes from the hexadecimal presentation of a data file and has a suffix of "hex" as well, for example "probe.hex". After has been generated, the data file is loaded into the microcontroller using a programmer. Assembly language programs may be written in any program for text processing (editor) able to create ASCII data files on a hard disc or in a specialized work environment such as MPLAB.

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2.2.2 DIGITAL METER

DC voltage and current panel meters with a DC signal conditioner board combine high accuracy with high read rate and a wide range of isolated output options for computer interface and control. Accuracy is 99.99% of full scale ±1 count.

Used as a direct-reading DC voltmeter, it provides a full-scale readout of ±20,000 counts and six full-scale voltage ranges from 200.00 mV with 10 mV resolution to 600.0 V with 100 mV resolution. The 200.00 mV and 2.000 V ranges provide a high input impedance of 1 Gohm so as to minimize the load on the voltage signal. The maximum voltage which can be applied on the 20, 200 and 300 Vdc ranges is 600 Vac.

Used as a DC ammeter, it provides a full-scale readout of ±20,000 counts and four full-scale direct-reading current ranges from 2.0000 mA with 0.1 mA resolution to 5.000 A with 1 mA resolution. The 5.000 a range measures the IR drop across a built-in 10 mW current shunt.

Use with External Current Shunts

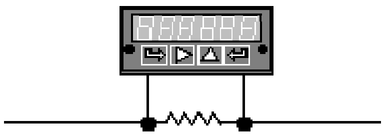

Figure: 2.2.2.1 external current shunts meter

It can be used with external current shunts, which typically produce 50 mV or 100 mV at their rated maximum current. Scaling from millivolts to amperes for a specific shunt value is easily accomplished from the front panel of the meter. The scalable readout is five full digits up to ±99,999 counts. Since the voltage signal from a current shunt can be noisy, the Laureate provides a selectable, adaptive moving-average digital filter, as explained below.

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