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# PC OSCILLOSCOPE BY USING PIC 16F877A (HARDWARE)


RASEEDA BT HAMZAH

This report is submitted in partial fulfillment of requirements for the award of Bachelor of Electronic Engineering (Industrial Electronics/Telecommunication Electronics/Computer Engineering\*) with honors.

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APRIL 2007

“I hereby declare that I have read this report and in my opinion this report is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering (Industrial Electronics/Telecommunication Electronics/Computer Engineering\*) with honours.”

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Date : ..... *4 MEI 2007* .....

To my beloved father, mother, sisters, brothers, Atif, Azhad, Afif, friends and  
Miss Shima

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## **ABSTRACT**

The purpose of this report is to represent the project of PC based Oscilloscope (by using PIC) including all its methodology in detail. Generally it should display the analog value that is sampled by the PIC to computer through serial port. The critical process is to send the character through the serial port because it involves not only with the hardware but also the software. For the software part the C language is used with the MicroC compiler. C language is used as it is easy to be understood rather than assembly language. For the simulation, Proteus Professional is used. The scopes of this project are to design and construct the hardware (electronic component) required for data acquisition, including analogue circuit design for insuring input voltage falls between 0 and 5V (ADC min and max range), to design a transport medium for relaying data to the PC by using (RS232), to design and construct the hardware required MAX232, to interface the PIC microcontroller with the chosen medium and also to design a communication protocol for relaying data from the PIC to the PC in real-time and design PIC embedded software for reading the ADC at a certain sample rate and transferring the data to the PC in real-time.



## **ABSTRAK**

Tujuan laporan ini dijalankan adalah untuk menerangkan dengan lebih mendalam mengenai projek sarjana muda yang dijalankan iaitu PC based oscilloscope (by using PIC) meliputi semua metodologi secara menyeluruh lagi. Secara amnya projek ini akan mengambil isyarat analog dan menukarkan kepada isyarat digital yang dijalankan oleh proses sampling PIC. Kemudian litar DAC akan mengambil isyarat digital tersebut kepada isyarat analog untuk dipaparkan kedalam computer melalui sambungan serial. Proses yang kritikal sepanjang menjalankan projek ini adalah proses menghantar isyarat yang telah disampel ke computer melalui sambungan serial. Untuk bahagian perisian, bahasa C digunakan dengan menggabungkan penggunaan Micro C sebagai pengumpul data. Untuk bahagian simulasi, perisian Proteus 6.0 Pro telah digunakan untuk mengelakkan sebarang kesalahan penyambungan litar. Skop projek ini adalah menjurus kepada untuk merekabentuk, untuk menyambung perkakasan (komponen elektronik) yang diperlukan untuk penghantaran data termasuklah litar elektronik untuk memastikan voltan masukan 5V diperolehi, untuk merekabentuk satu medium penghantaran untuk menghantar data ke PC menggunakan RS232, untuk merekabentuk perkakasan yang diperlukan untuk MAX232 dan merekabentuk sambungan PIC ke computer dan menghasilkan kod untuk PIC menukarkan isyarat analog kepada isyarat digital.

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**ABBREVIATION**

ADC	-	Analog Digital Converter
DC	-	Direct Current
TTL	-	Transistor – Transistor Logic
UART	-	Universal Asynchronous Receiver Transmitter
USART	-	Universal Synchronous Asynchronous Receiver Transmitter
CRT	-	Cathode Ray Tube
PC	-	Personal Computer
BOR	-	Brown Out Reset
PWM	-	Pulse Width Modulation



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## **CHAPTER I**

### **INTRODUCTION**

#### **1.1 Overview**

This project attempts to achieve the same functionality as a traditional oscilloscope, using a PIC microcontroller for data acquisition (including appropriate analogue circuitry) which transfers the data to the PC (via RS232). A Microsoft Windows based software application will then display the waveform as it would appear on a traditional CRT oscilloscope. This software application will have additional features that are not presented on a traditional oscilloscope such as printing and saving waveforms with greater flexibility as additional features can be added as the development is without the need for new hardware. The digital based oscilloscope should display very low frequency waveforms in real-time.

#### **1.2 Objective**

Every project that needs to be developed must have the objectives to be achieved. The objectives of this project are to ease the used of oscilloscope, to take signal from outside to be analyzed and to replace computer as an oscilloscope also to ensure that the hardware and the software can be communicated by using interface.

### **1.3 Scope of work**

There are several scopes of work that are used as guidance in developing this project. The first scopes of works in this project are designing and constructing the hardware required for data acquisition including analogue circuit design for insuring input voltage falls between 0 and 5V (ADC min and max range). The second scope is designing a transport medium for relaying data to the PC by using (RS232). The scopes follows with designing and constructing the hardware required MAX232 to interface the PIC microcontroller with the chosen medium and designing a communication protocol for relaying data from the PIC to the PC in real-time and the last scope is designing PIC embedded software for reading the ADC at a certain sample rate and transferring the data to the PC in real-time.

### **1.4 Problem Statement**

Limitation of traditional oscilloscope not portable expensive RM50 000 connection problem limited function bulky cannot be upgrade.

### **1.5 Project Methodology**

There are several approaches taken in order to achieve the objective of this project, which are:-

#### **Literature review**

Study and research about the latest technology that has been used in developing the PC based oscilloscope.

#### **PIC 16F877 (hardware design)**

Study and implementing the features of PIC16F877 to design and construct the circuit of PC based oscilloscope. The compiler that is used to develop the source code for the project is Proton IDE Lite and the software to simulate the circuit is Proteus Professional.

### System development

The construction including the process of drawing, itching, drilling and soldering into the PCB is made after the circuit has been design.

### Performance of the system

After all the process is done, testing has to be done to ensure the circuits will properly working as expected. In this section, the combination of software and hardware part must be arranged since this to parts is the overall of the project.

### Testing on functionality

If the circuit doesn't work recheck and trouble shooting will be implemented to solve the problem until the circuit can work properly.

### Report writing

Report writing is the last stage to be finished and submit for the PSM 2 requirement.

## 1.6 Thesis Structure

This thesis is divided into 5 chapters. The chapters are stated as follows: -

### Project Introduction

Project introduction is the straightforward overview of the developed project. It is started with the importance of project also the perspective about the research that has been developed. This chapter follows with the project objective. Project objective is about the goal that will be achieved at the end of the project. The detailed of the objectives are declared in this thesis. The third part is about the problem statement. Problem statement is discussing about the related issue to find the suitable solution to improve the existence situation excluded the problem that is faced by the student while completing the Final Year Project. Then it follows with the scope of work that will state the project work scope specification and every expectation during the progress of project. It also coats the limitation and constrain for certain project and the confirmation about the material that is used in the development of the project

such as the hardware, component and the design used. The introduction of this thesis continues with the methodology where it is discussing roughly about the methods used to develop this project. The specific methodology will be discussed in detailed separately. This chapter is enclosed with the overall structure contained in this thesis.

### Literature Review

In this chapter the discussion about the background of the project is done. Largely of the literature will produce the work concept that shows the relation between the project research and the theory and the concept through diagram or the suitable model. Some of the content in this chapter are:

- I. The description about the perspective and methods that are used in the previous research and the prediction how far this project is being related to current research and theory.
- II. Show the theory and concept used in solving project problem.
- III. Explanation regarding the objectives of the project in wider range of research field also attach in this chapter.
- IV. Brief discussion about the hypothesis of the research methodology is also included in this chapter.

### Research and Project Methodology

This chapter is discussing about the project methodology. Some of the important parts of this chapter are:

- I. The technique and the approach that is used such as the orderliness to collect data, methods of processing and analysis, model, and flow chart.
- II. Considerate factors in choosing data or certain approach
- III. The advantage and approach chosen compared to the others.

### Results and Discussion

In this chapter the new invention or result is presented. Some of the content in this chapter are:

- I. The result is scheduled tidily and neatly with the support of diagram and pictures.
- II. The results must be discussed and compared with the previous result.

- III. The results are evaluated through the objectives and project problem perspective.

### Conclusion and Suggestion

The final year project thesis is enclosed with the conclusion and the summary on the research and project that was done. The contents in this chapter included:

- I. Summarization of the project finding, analysis of the result and the suggestion for the future research and improvement.
- II. Discussion about the information and contribution to the university, faculty and individual while the project is developed



## CHAPTER II

### LITERATURE REVIEW

#### 2.1 Background Study

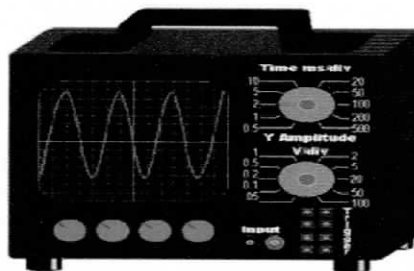


Figure 2.0: Picture of the traditional oscilloscope

The oscilloscope is an electronic display device containing a cathode ray tube (CRT), used to produce visible patterns that are the graphical representations of electrical signals. Karl Ferdinand Braun was the German physicist who shared the Nobel Prize for Physics in 1909 with Guglielmo Marconi for the development of wireless telegraphy. Braun is also known as the developer of the CRT oscilloscope.

He demonstrated the first oscilloscope in 1897, after work on high frequency alternating currents. Kosma Zworykin invented the kinescope in 1929 for television transmission. An oscilloscope (sometimes abbreviated CRO, for cathode-ray oscilloscope, or commonly just scope or O-scope) is a piece of electronic test equipment that allows signal voltages to be viewed, usually as a two-dimensional graph of one or more electrical potential differences (vertical axis) plotted as a function of time or of some other voltage (horizontal axis).

## 2.2 Oscilloscope

Nowadays, the used of oscilloscope in laboratory session seems to be very important. For the past few years, oscilloscope has been developed rapidly from analog to digital. The increasing in research and development and also the technology used day by day have improved the development of oscilloscopes. Latest PC based oscilloscope has 4 channels develop by Kollin Mc Kord from university of Ulster on 21<sup>st</sup> June 2002. That PC based oscilloscope is more advanced because it used the concept of storage oscilloscope. This oscilloscope using the technology of PIC16F877 and has the advantage in sampling process. The used of the RAM (random access memory) is to capture the highest frequency in clearly. That's means once the memory is full (or the preset number of samples has been reached) the PIC will stop sampling and transfer the data to the PC, when (acknowledgment) is received from the PC the PIC will start sampling again. This is known as a "Storage Oscilloscope", but there are some disadvantages such as it's impossible to continuously monitor a waveform in real-time for more than the amount of samples that can be stored into the buffer as there would be gaps in the data. The other characteristics of this oscilloscope are, it has 4 channels. That's mean, it can capture 2 signals as an input and 2 outputs can be display at a time [1].

The other brand of PC based oscilloscope is BitScope. Although it only has 2 channels it has the feature of Ethernet communication. It used the PIC 16F84 but disadvantage of the design of BitScope is the circuit has become more complicated because many supported chip has to be used to make it complete. This is because some features such as analog to digital converter is not provided in the PIC16F84 but