HIGHER TECHNICAL INSTITUTE

ELECTRICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

PROCESSING OF DATA CAPTURED BY A DATA ACQUISITION SYSTEM

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Processing of Data Captured by a Data Acquisition System

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CONTENTS

SUMMARY

The main objective of this project is the design and construction of a high sampling rate data acquisition system to capture analogue signals such as sound and perform processing on this data using computer programs. The data acquisition system is interfaced to an IBM XT slot (ISA slot). Using a programming language and appropriate hardware design to implement control and data signals via the ISA slot of the PC, data is sampled and stored in the memory of the computer and later into a file on a disk, hard disk or a floppy disk. The hardware and software design of the system offers the facility to make the stored data accessible by Windows® based application software such as Microsoft Excel®, in order to draw curves and analyse and manipulate the stored digital information using Excel functions. The maximum signal frequency to be sampled is 10KHZ which is determined with the use of filters, and via the sampling program the user has the option to sample electrical signals at two frequencies, 25KHz and 50KHz. The system also offers the ability to the user to reproduce the data, and it can therefore be used as a "sound card" for the IBM PC, to store sounds in digital from, retrieve them and reproduce them at any time, or just display electrical signals onto an oscilloscope.

The project is divided into two main parts: hardware and software. The first part deals with the hardware design of the system: initially a general introduction to computers is provided and the project then proceeds with the in-depth of the electronics design and signal manipulation of the IBM PC slot, the signal conditioning (filters, amplifiers), the address decoding, the sampling (analogue to digital converter) and the reproduction of signals (digital to analogue converter). The second part deals with the software, that is the programming language and the program composed and used to sample, accumulate and retrieve the data already stored in digital form into a file, memory or disk of the PC.

INTRODUCTION

In the digital age that we live in, computers and fast speed electronics in general have become an integral part of our lives. The first ever digital computer systems, built in the 1940s, were developed to solve complex scientific problems. These systems were massive and power hungry, with relatively low speeds and small memories. Nowadays, computers have "invaded" all areas of our ways of living, in domestic, business, military and industrial applications, the methods we communicate with others, shop, pay our bills, travel. The ever-increasing computing power and expanded capabilities of these machines have made all the above a reality.

Computers, in general terms are used to store, process, manipulate and retrieve data, using appropriate programming, which is stored in digital from. The scope of this project is to take advantage of the kind of computers that are used in our households, the IBM PC and build a Data Acquisition System which is to operate using signals from the ISA slot of the computer. Data acquisition is a vast and relatively recent section under the enormous chapter of computers. Its purpose is to collect data from the outside world which is in essence analogue, such as relative position of objects, pressure, temperature and sound, convert this data into a proportional electrical signal and store the data into the computer memory or a disk in the from of a file which can be later retrieved, processed and reproduced at the will of the user.

Using hardware and software techniques, with the development of the data acquisition system described in this project, the user is granted with the ability to sample signals at a high sampling frequency (two options at 25KHz and 50KHz sampling rate are provided in the program), store them in a file and later retrieve the information at convenience. Processing and manipulation of the stored data can then be carried out using Microsoft Excel, by building graphs, finding the frequency or amplitude of the signal using Excel functions, or by reproducing the information and analysing it onto an oscilloscope. In the fulfilment of this project it was realised that the system can operate as a PC "sound card", it therefore can be used to store sound or music from a tape recorder, microphone or CD player (record) and reproduce (playback) sound via an amplifier or speaker - this is a proof of the versatility of the Data Acquisition Cell and the Data Acquisition Systems in general and the many applications they can satisfy.

Through this project general electrical terms and techniques are defined and refined such as the theory around Butterworth and active filters, the DACs, ADCs, the PC bus and amplifiers and lays all the theory into practice. It also shows the link and dependability of the hardware design and the software in order to make thinks work (mainly for address decoding and other control signals used by the software). The programming language used to write the program was Pascal, which incorporated user friendly menus, dialogue boxes, use of a mouse pointer and Assembly programming in part (used for sampling and playback which required high speed). In the last part the project provides some alternatives and improvements that can be introduced into the design to make it more efficient and accurate.