HIGHER TECHNICAL INSTITUTE
ELECTRICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

DEVELOPMENT OF A DIGITAL SIGNAL PROCESSOR

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HIGHER TECHNICAL INSTITUTE

ELECTRICAL ENGINEERING COURSE

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Dedicated to my family

DEVELOPMENT OF A
DIGITAL SIGNAL PROCESSOR

Project report submitted by
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INTRODUCTION

INTRODUCTION

I.1 Digital signal processing

Since the very beginning of the technology man tries to invent something to be able to thing and analyze things the way he does. Today the most recent of his achievements which comes close to his aim is the microprocessor. The microprocessor can do almost anything from the most boring and repetitive jobs to the most intelligent and precise ones, and most of all, it can do them fast, much faster than his creator.

So if the microprocessor can work at so great speed and accuracy it can be assigned tasks that would otherwise be almost impossible for man to complete due to the amount of time and dedication needed. One such task is digital signal processing.

By digital signal processing we mean the processing of an analog signal by digital means. But this is not as simple as it sounds. To do this normally the analog signal must be sampled first, i.e. samples of the voltage level of the signal are taken at very short intervals, while the signal occurs, and stored in memory. Once this is done, operations can be applied on each individual sample, treated separately or according to the nature of the samples acquired shortly before or after it. But just that would not be enough. The analog signal can also be output, either the original as it was sampled or the new processed image.

It is obvious ofcourse that speed and precision plays a major role in this operations since the samples acquired per second or the sampling rate as it is termed determines the quality of the copy of the signal recorded compared with the original. So if the analog signal is changing fast we have to sample it at an even faster rare to be able to reproduce it without significant distortion. Speed also affects both the time taken to reproduce the analog signal and more importantly the time of processing, since this requires examining, comparing, calculating and changing each single sample taken. All these operations are controlled by the microprocessor.

Nowadays digital signal processing is forming a new separate science. Almost all analog signal conditioning devices such as filters, amplifiers, tuners e.t.c. are now being replaced by digital signal processors. This replacement provides most of all the great advantage of reducing space. But digital signal processors can do more, they can provide logic, which brings us then to voice recognition or even image recognition. What would we then call 'impossible'?!

I.2 What is this project about

The aim of this project was to construct a device which would be able to sample and save in RAM a changing analog signal and be able to process (perform several operations on) and reproduce this signal repetitively and faster or slower than its occurrence rate of change so that it can be observed and studied later despite its absence.

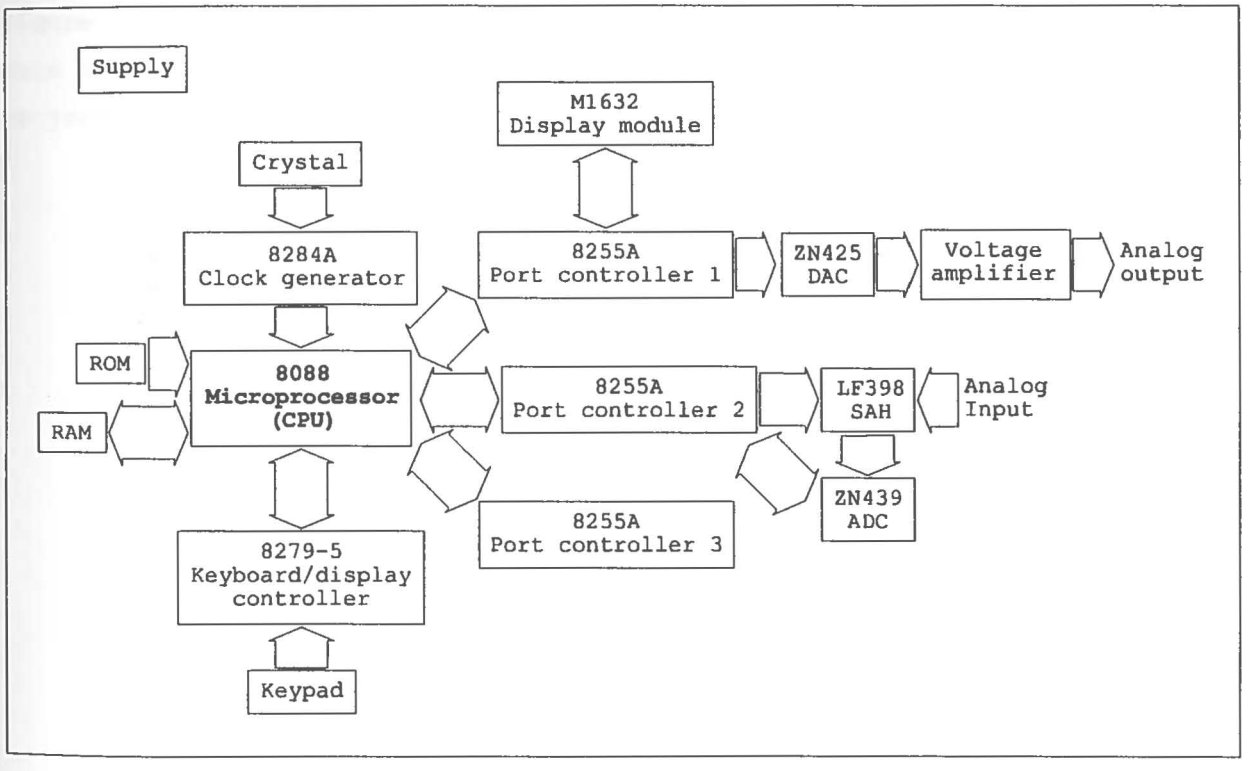

Figure I.1 The general block diagram of the design.

The device constructed to fulfill the above is a microcontroller using the Intel 8088 microprocessor as the central processing unit (CPU) of the system.

A fast high precision analog to digital converter (ADC) is used with a sample and hold (SAH) circuit to sample and convert the input analog signal to digital. The samples acquired are saved in static random access memory (SRAM). Once in memory operations can be made on all or a group of samples such as multiplication or division by a constant (change in signal amplitude), addition or subtraction of a constant (change in signal DC level or offset) e.t.c. At any time the contents of the SRAM can be sent to a digital to analog converter (DAC) which will output the analog equivalent of each sample and in effect reproduce the original or processed analog signal. The output of the DAC is buffered trough a voltage amplifier. The design uses also a keypad and an alphanumeric display to be able to communicate with the user.

The analog input can be provided to the microcontroller from any source within certain voltage and frequency limits and the analog output can drive any load with a certain current demand.

Figure I.1 shows the general block diagram of the construction indicating the main components. A complete description of each component and its use in this project shall be provided separately in the following sections.