Proceedings of the Technical Sessions, 18 (2002) 1-6
Institute of Physics – Sri Lanka

Performance of parallel port based remote data acquisition systems in real-time data processing

P.C.C.P.W. Goonetilleke and D.U.J. Sonnadara
Department of Physics, University of Colombo, Colombo 3

ABSTRACT

A parallel port based remote data acquisition and process control system was built without on board RAM and programmable timer to test the effect on the performance when processing real-time data on a network environment. The controlling software was developed using Delphi and Assembler languages to achieve high speeds. The developed software use TCP/IP protocol for network operations.

It was found that the overall performance depends primarily on the parallel port. For different types of motherboards, the speed of the data transfer varied between 460 Kbps and 890 Kbps. A minimum deviation was observed when there were no processor-bounded applications running in the system concurrently. The port speed did not depend on the processor type or the processor speeds.

For the network transfer tests, client-server architecture was used. In order to increase the throughput, data compression (Zip method) was used. A data stream of 4.5 Kb (sampled data packet of 1500 byte) could be reduced to a 427±27 bytes with this technique. The compression and de-compression time was negligible compared to the computer/network speeds. The client was able to communicate with the server at an approximate speed of 1.3 Kbps on a network with fiber optic backbone, which has a connection speed of 10 Mbps.

1. INTRODUCTION

Today, computers or micro-based system have become extremely powerful and versatile, they are heavily used in many industrial applications and research activities around the world. However, unlike most other countries the hardware capabilities of these systems are not fully utilized in Sri Lanka due to the lack of knowledge especially in the areas of data acquisition and process control.

To acquire data from experiments, researches have to use plug-in cards or especially designed instrument systems that are extremely expensive according to the local financial standards. Thus, most Universities and research organizations in Sri Lanka do not posses automated systems to control their experiments (unless it is a donation). To make the matters worse, most Universities do not provide training in handling microprocessor based systems or exposed students to such methodologies. This situation could be changed if the University teachers take the initiative to conduct research in the development of low cost data acquisition and process control systems that can be used in local industrial applications and research activities. Today this may be a matter of combining already existing technology and knowledge in the correct manner to produce the desired results.

Usually, most general-purpose I/O cards have its own multiple digital input/output ports, multi channel analog input/outputs digital gain controllers, programmable reference voltages, internal memory, ADC, DAC etc. Developing such cards with such capabilities is not difficult for lower speeds (less than 10 MHz) that are required in most local laboratories. However, the task becomes difficult for higher speeds (above 10MHz). Today, data acquisition cards that are suitable for the local environment can be developed locally at a reasonable cost for many applications.

The simplest form of all DAQ systems is the parallel-port based system, which is much easier and cheaper to handle.

Today, data acquisition systems can be made to share by several users in a computer network by designing the control software. Although it is not difficult to develop software to achieve this objective, developing software without losing the speed is a difficult task. To our knowledge, no literature is available that show the effectiveness of PC parallel port based devices when operated over a network. The aim of this work is to measure the performance of such devices when operating in a network environment.

2. DATA ACQUISITION HARDWARE

The parallel port of an IBM or compatible PC may be the easiest port available in a modern computer that can be used to build low speed data acquisition systems. Especially, for the parallel port, the software development is quite easy, the hardware requirements are very few and it never conflicts with other type of devices connected to the computer.

The new extended parallel port is the most commonly used port in PC systems. Today this port is capable of handling input/output data with speeds around 900 kbps (which vary with the PC main board type).

A block diagram of the DAQ system used in this work together with the other supporting hardware are shown in Figure 1. The system consists of a computer to acquire, store and display signals, a network to provide access to collected data to outside users and a DAQ hardware interfaced to the computer through the parallel port.

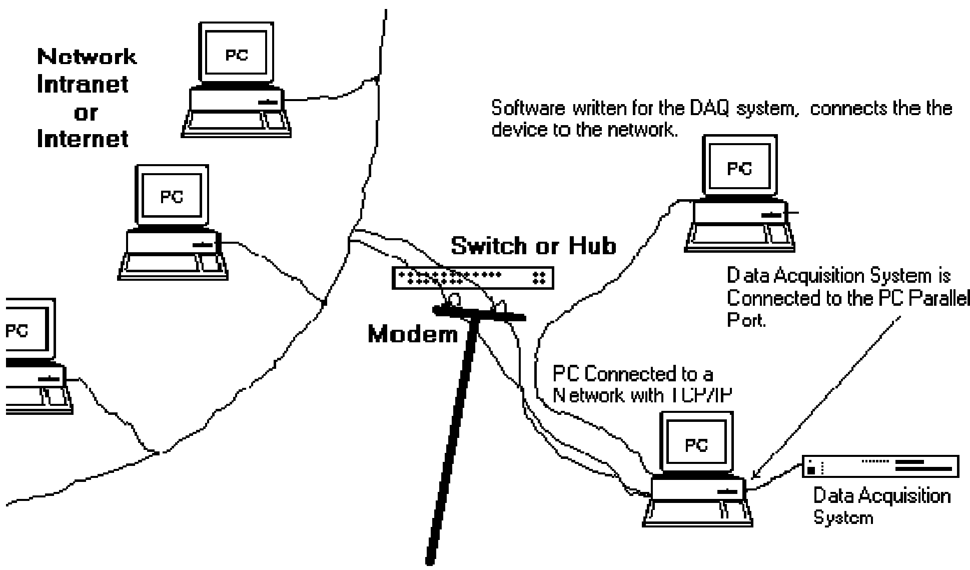

Figure 1: Device Connection block diagram.

The main data acquisition system, a parallel port based external plug unit was built without an on board RAM and a programmable timer to test the system performance when processing real-time data. The controlling software was developed using Delphi and Assembler languages to achieve high speeds which is essential in this work. The control system software uses TCP/IP protocol for the network operations.

Figure 2 shows the block diagram of the developed DAQ system. All input and output subsystems are connected to an internal data bus which connects to the external data bus through a buffer. PC port is connected to the device buffers first to minimize the current drawn from the PC parallel port. All the ports in this device (two digital output ports, one digital input port, two analog output ports and two analog input ports) can be controlled by the software. Switching between the ports is not transparent to the external connections because the hardware system which is built into the device, keeps the last written values in their buffer, until it is over written by another value at another time.

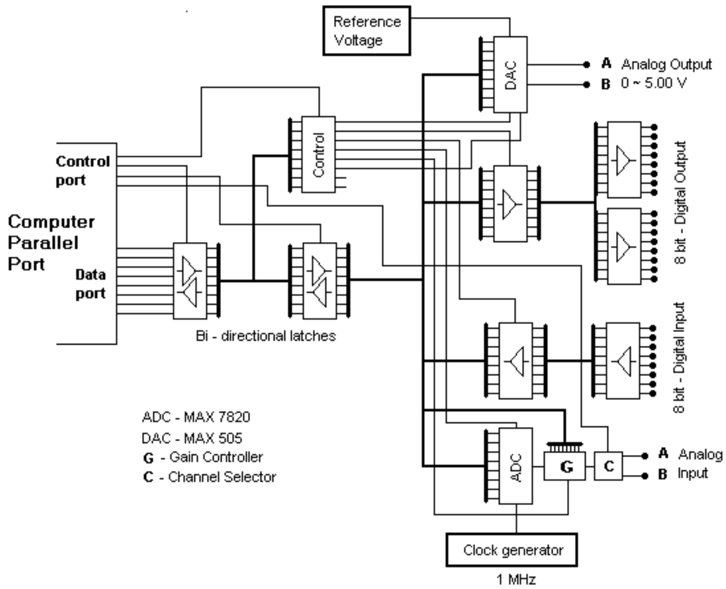

Figure 2 : Device block diagram.

3. PERFORMANCE

3.1 Parallel port

The maximum device operational speed should directly proportional to the speed of the parallel port. However the port speed may vary even in the same PC system especially when other applications are running simultaneously. Figure 3 shows the port speed variation with time for three different PC systems.

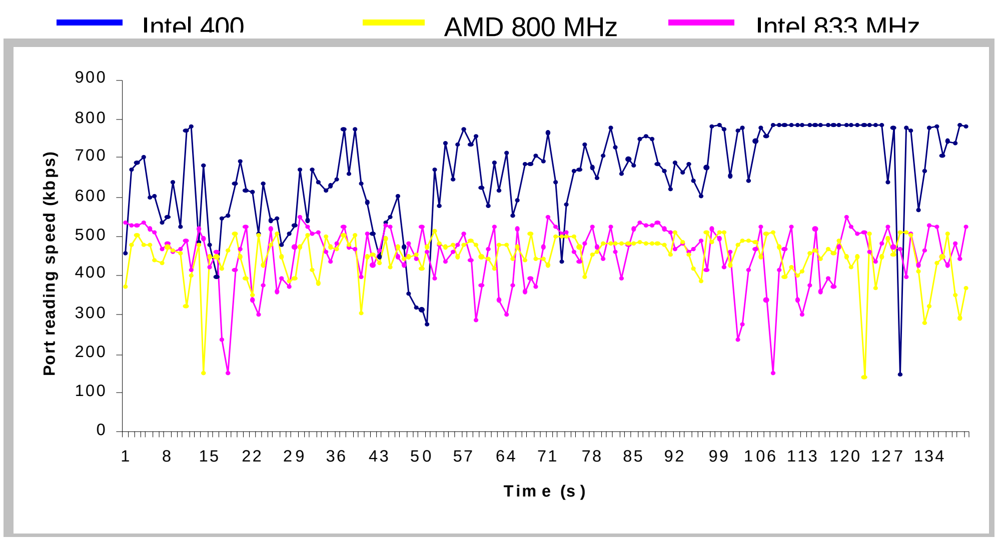

Figure 3: Variation of port speed when other applications run simultaneously

The measurements shows that the maximum port speed was not the same for all systems and it did not depend on the processor speed *(100MHz / 1000MHz or 2000MHz)* or the processor type *(AMD / Intel)*. It was found that the port speed mainly depended on the main board type *(Main board hardware)*. Table 1 shows the values of measured speeds for different main board types.

Table 1: Speed variation with motherboard types

Parameters					Port speed (kbps)		
Processor	**Speed (MHz)**	**Primary RAM (MB)**	**Mother board**	**OS**	**Data**	**Control**	**Status**
AMD Duron	799.498	130.3	MSI	Win 98 SE	510	510	511
AMD Athlon	1133.14	261.6	MSI	Win 98 SE	514	514	514
Intel	730.892	63,7	Dell	Win 98 SE	835	639	831
Intel	730.833	63,7	Dell	Win 98 SE	833	640	827
Intel	334,041	32.2	Acer	Win 97 EP	595	593	592
Intel	450.222	63.7	Dell	Win 98 SE	759	573	750
Intel	797,249	63.6	Dell	Win 98 SE	895	688	891
Intel	334.038	64.9	Acer	Win 97 EP	594	593	593
AMD Duron	700	64.9	GigaByte	Win 98 SE	830	825	847
AMD Athlon	1000.12	130.3	GigaByte	Win 98 SE	888	863	889
AMD K5	133	32.8	UMC	Win 95	840	832	861

3.2 Data transfer over the network

The computing environment of the Internet / Intranet is based on a ***client/server*** model. A client/server network has two roles for computers: clients and servers. The server is a computer that responds to requests for its services. The client is a computer that requests a service from a server. In a client/server network, the server can be considered as the host and the client can be considered as the guest.

For the DAQ device, server software and client software were developed separately and the DAQ device was directly connected to the server. The device was controlled by the server software while handling requests from many clients simultaneously.

When a DAQ device is connected to a network, its speed mainly depends on the speed of the network since network transfer speeds are always slower than the data acquisition speed. The software developed for this work supports networks with TCP/IP protocol.

To increase the data transferring speed, data compression technique was used at the server end (Zip compression). In order to do this, a digitized data with 1500 samples were taken and sent as one packet to the client on request. The initial packet size was approximately 4.5 Kbytes. When this was compressed, it reduced to approximately 420 bytes. This technique increased the data transferring speed drastically.

The device was able to transfer data at a speed of 1.3 Kbytes per second within the University of Colombo network, which is controlled by a (slow) proxy server. Although the expected values were much higher, due to the network traffic the device was not able to achieve faster speeds than 1.3 Kbytes/per second. This could be reduced further if accessed over the Internet due to the poor local telecommunication infrastructure.

4. DISCUSSION

A parallel port based remote data acquisition and process control system was built to study the effect on the performance when processing real-time data on network environment. The controlling software was developed using Delphi and Assembler languages to achieve higher speeds.

It was found that the overall performance depends mainly on the parallel port speed which is mainly depends on the main board type. The port speed did not depend on the processor type or the processor speeds. For the network transfer speed tests, client-server architecture was used. The client was able to communicate with the server at an approximate speed of 1.3 Kbps on a network with fiber optic backbone at the University of Colombo.

5. REFERENCES

1. http://www.torry.ru
2. http://www.epanorama.net
3. http://www.beyondlogic.org