WIMALASURENDRA POWER STATION REMOTE SUPERVISORY CONTROL PROJECT

by

Ravindra Prematthilaka

Introduction

Background:

Wimalasurendra Power Station is one of the oldest power stations in Sri Lanka. It had been commissioned in 1965 under Stage II B of Ceylon Hydro Electric Scheme. Originally it was equipped with supervisory control from Laxapana Power Station. The control technique was based on 48 V dc impulse transmission. The control signaling and data transferring were done via a multi core under ground cable. This system had been working till late seventies. Thereafter some failures and deficiencies had been reported and attempts to restore were also reported, not successful mainly due to unavailability of spares. Also, it was found that the above system had very limited capacity and was based on obsolete technology.

On above grounds, it was felt that introduction of a new remote supervisory control system would be more appropriate. Since then information was collected with a view to identify a modern and most cost effective method of supervisory control.

Scope of work:

After a detailed investigation following scope of work was formulated.

a. Install a centralized Personal Computer (PC) based Man Machine Interface (MMI) at Laxapana control room as control desk.

b. Equip Wimalasurendra power station with a processor based Remote Terminal Unit (RTU) and necessary interfacing circuitry to be compatible with existing instrumentation and control.

c. Establish a dedicated transmitting channel, which may be via either existing Pilot Cable, Microwave or Power Line Carrier (PLC) system.

Cost benefit:

Several inquiries were made from reputed suppliers to supply remote supervisory equipment for the above scope of work. The inquires revealed that a fully configured system will cost around 5- 10 million SLRs. Meanwhile, a very low cost proposal also was formulated based on local technology to assemble a system using a micro controller. The only foreign component in this proposal was the micro controller which was US$1190 (approx. Rs.80, 000/=).

As this low cost proposal fulfilled the requirement at a very reasonable cost, it was decided to implement as a pilot project.

Assembling the Remote Terminal Unit:

The Micro controller as purchased was originally capable of reading 8 analog inputs, 4 Digital inputs and to drive 4 Digital outputs. Locally designed and fabricated interface circuitry was introduced in order to expand the capability of Digital inputs & outputs. Ultimately, controller capacity was increased to read 20 Digital inputs and to Drive 14 mono-stable & 2 bi-stable Digital outputs. The necessary transducers were also designed & fabricated locally. Power station staff did the installation of interposing relays to interface with existing instrumentation & control.

Man Machine Interface software:

Meanwhile the most attractive presentation of Man Machine Interface (MMI) software part was comprehensively developed by Mr. M.H.C.Janakantha, an Electrical Engineer attached to the Transmission projects branch. The software was written in Visual Basic to operate on Windows 95 environment. Thanks to my colleague, Mr.Janakantha for this valuable con-

Eng. Ravindra Prematthilaka, BSc Eng, CEng, MIE (SL), MIE(Aust.) Electrical Engineer, Ceylon Electricity Board, Wimalasurendra Power Station , Norton Bridge.

tribution which fine tuned the project and kept the MMI computer user friendly and enabled the operator to have a very clear understanding of the remote on line process.

Project was completed successfully on 21st July 1997.

Technical Discussion

The Remote Supervisory Control system consists of two basic components

1. **Remote Terminal Unit (RTU) operating as Supervisory and Control processor.**

   This is an assembled system using several sub systems. The nucleus is an Intel 8052 CPU incorporated with several sub systems such as RAM, EPROM, and some I/O interface circuitry etc.

2. **Operator station at Laxapana mother station as Man Machine Interface (MMI)**

   This is a standard personal computer connected to the Remote Processor through a Modem. This runs the MMI software on Windows 95 flatform. The main function of this computer is to receive data from remote processor and to send data to the remote processor on interactions of the operator.

Remote Terminal Unit (RTU)

This unit is a low cost RTU designed for industrial applications aimed primarily for Data acquisition and supervisory Control of any remote process. The RTU is based on Intel 8052AH Micro controller. It is supported by 32KB RAM &16 KB EPROM. The CPU has an internal 8KB high speed Floating point BASIC interpreter. The 8052AH CPU has 16 bit address bus and 8 bit Data bus. The lower 8 bits of the Address bus are shared with Data bus. The RTU can be accessed for programming via the on chip 1200 baud serial port. The RS232comport of a PC can be directly connected with any serial port communication software.

The 8255 Programmable Peripheral Interface (PPI) is used to interface the I/O devices to CPU. This 8255 has 24 I/O lines, which may be programmed as either inputs or outputs in many combinations.

Programming Language

The CPU manufacturer Intel named the programming language of this CPU as MCS BASIC 52. This MCS BASIC 52 provides most of the features of standard BASIC plus many additional features that apply to the architecture of the CPU 8052. This is a powerful software tool that can reduce the design time of many projects and that would make it easy for a hardware designer to interact with the 8052 CPU without much complications of an advanced programming language.

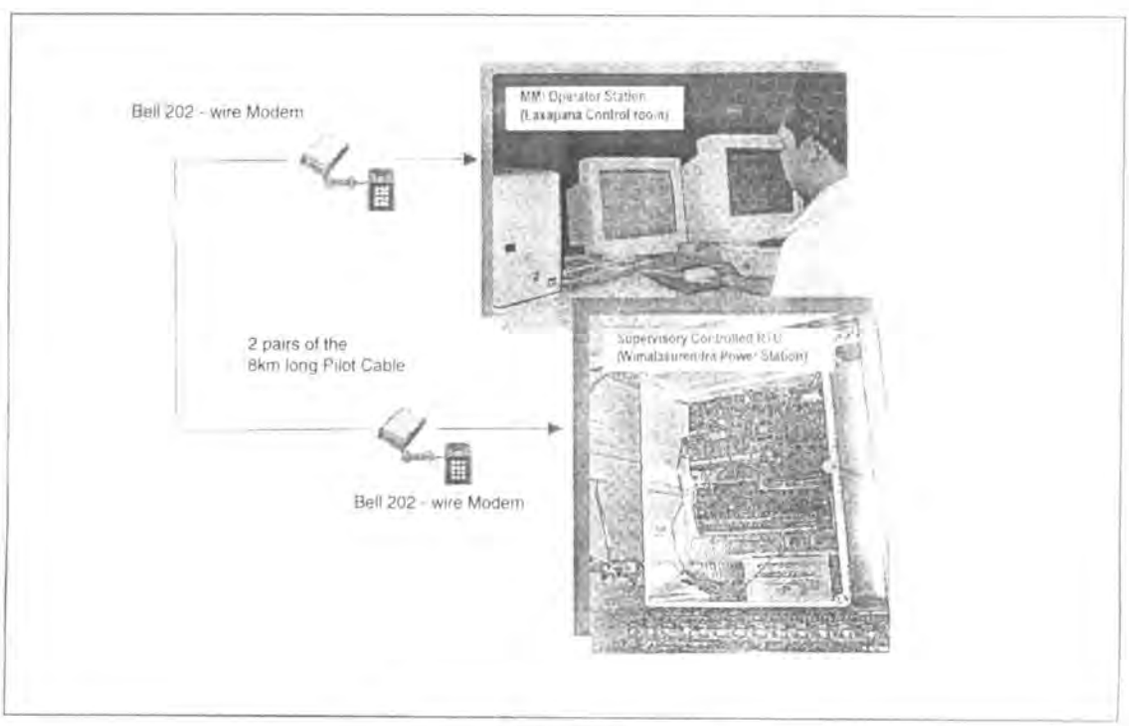

Figure 1: Basic configuration

Built-in EPROM Programmer

One of the unique and powerful features of the 8052AH CPU is its ability to execute and save programs in an EPROM (27C128). This eliminates the necessity of having a separate EPROM programmer and also enables to make minor program changes on site saving several days in waiting for EPROM s from system programmer. This feature permits a technician to change the system operation on site without waiting for program modifications from the system programmer.

Communication

The RTU supports the following three communication methods

1. The industry standard Hays automatic dial & answer modem to connect via PSTN.
2. A bell 202 compatible modem via a lease line or Radio.
3. Direct serial RS232 COM port communication.

Programming point of view

The programming part can be basically divided into two sections

1. RTU Programming 2. MMI Programming

1. RTU Programming :

- Reading Analog input data
- Reading Digital Status data
- Coding & Sending analog and status data to MMI station via Modem
- Receiving & manipulation of data from remote MMI station
- Controlling of relay drivers according to the Data received from MMI station

2. MMI programming :

- Receiving and manipulation of Data from RTU
- Update & presentation of the MMI data
- Coding & Sending the operators data to RTU
- logging the status changes and historical data

Conclusion

Electronics perhaps more than any other field of technology has enjoyed an explosive development in the last decades. As a result Microprocessors have defined a new era for industry standards every where. But in Sri Lanka, the application of Microprocessors are almost limited to Personal Computers (PCs) used in most of the offices for accounting and word processing. But microprocessors are too smart to be used only as such personal computers. Very few Sri Lankans are enjoying the power of Microprocessors & Micro controllers for the industry related applications. As the cost of Microprocessors and electronic components are coming down it is absolutely advantageous to use them in industry than continuing with traditional, expensive & obsolete technology. Therefore an ever-increasing demand and many demanding applications will be anticipated in Sri Lankan industry within the next decades.

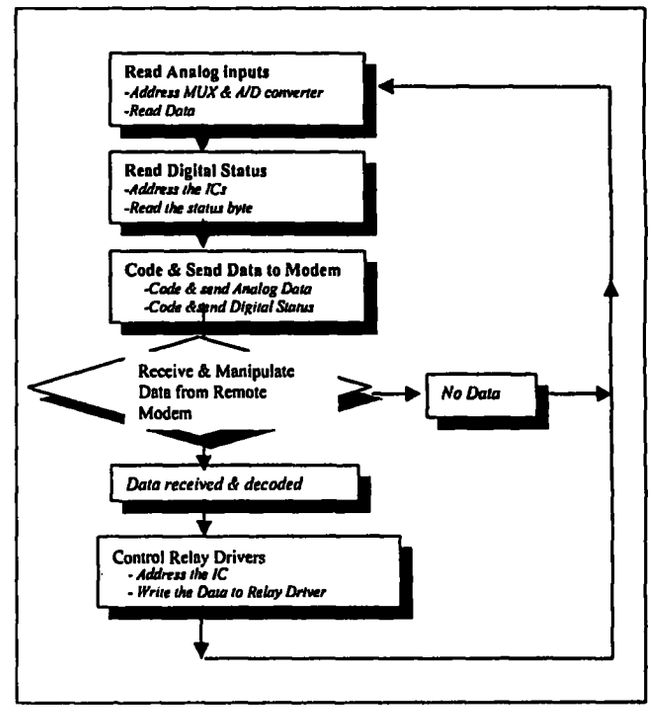

Figure 2: Flow chart of the RTU program

On above grounds it is worthwhile to study & research to assemble such systems using inexpensive components available in the market, than importing the whole system as a unit which is expensive, probably ten times or more. The disadvantage of assembling such a system is lack of documentation & after sales service. But both of above deficiencies can be overcome by using common components available in the market and having enough spares. Also an effort must be made to complete the documentation in order to facilitate future maintenance. All circuit diagrams and technical literature must be made available at the site as well as with the staff for future repairs and maintenance.

Finally I would like to deliver my further study and research on above and to introduce a well-developed Microprocessor based control systems for various applications prevailing in the Ceylon Electricity Board. I hope that introducing such local assembled systems instead of imported systems can save an enormous amount of money & foreign exchange for the country.