16 to 112 Channel Data Logger used for Industrial Applications: An Approach

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Abstract---With the advancement of technology, the processes are becoming more and more complex. Due to this increase in complexity, for efficient analysis of process the number of parameters required for data acquisition also increases. Data Acquisition is simply the gathering of information about a system or process. It is the process of collecting data in an automated fashion from analog and digital measurement sources such as sensors and devices. Before the computer age, most data was recorded manually or on strip chart recorders. Many new generation data acquisition products have been developed due to emergence of microcontroller that enables real time gathering, analysis, logging and controlling of data. To meet these requirements the demand of an improved, efficient and up to date data logger is increasing. A data logger is an electronic instrument that can record digital or analog measurements over a period of time. It consists of a sensor, microcontroller, a data storage device and communication for controlling system. Data loggers have an on board memory that is large enough to hold data. That is recorded over a longer period of time. Data loggers are provided with real time clocks to record the date and time of acquisition.

Keywords: Data Logger, Resistance Temperature Detectors (RTD), Thermocouple, EEPROM, Operator Terminal Unit(OTU).

I. INTRODUCTION

A data logger for specific application has been designed. The system works around the famous 8051 family and PIC32 microcontroller. The system is designed and developed to measure the temperature with the help of temperature sensors (Thermocouple, RTD etc.) and the result is stored in memory such as EEPROM for post process analysis. It will verify that there is continuous and correct acquisition of data. It will also verify that the data is within limit or not. If it is out of limit than data logger has a control on system to take system within limit. This verification is done by using serial communication (Modbus Protocol) and Ethernet. System parameter can be change using this communication. The designed system will test under different conditions: at room temperatures, at low temperatures (0 ºC), at high temperatures (55 ºC).

II. HARDWARE

The Data – Logger signal conditioner card is a 16-bit, universal input module that features programmable input ranges on all channels. This module is an extremely cost-effective solution for industrial measurement and monitoring applications. Its opto-isolated inputs provide 1,000 VDC of isolation between the analog input and the module, protecting the module and peripherals from damage due to high input line voltage. It accepts voltage inputs (1V, 5V) and current input (20 mA, requires 250 ohms resistor), thermocouple input (J, K, T, R, S, E, B).The module provides the data to the host computer.

Up to 32 Data – Logger systems may be connected to an RS-485 multi-drop network extendable up to 100 by using RS-485 repeaters, extending the maximum communication distance to 2,000 ft. The host computer is connected to the RS-485 network from one of its COM ports through the RS-232/RS-485 converter. Only two wires are needed for the RS-485 network: DATA+ and DATA-. Inexpensive shielded twisted-pair wiring is employed. There are total 5 signal cards available in data logger

1) Power Supply Card.
2) CPU Card.
3) Analog Input Card (Signal Conditioning Card).
4) Open Collector Card (16 Channel).
5) Relay Card (8 Channel).

Power supply card is used to supply different voltages to modules. CPU card is used to communicate with Analog input card and PC. Analog Input Card is used to take Analog input and then feed to the CPU Card.

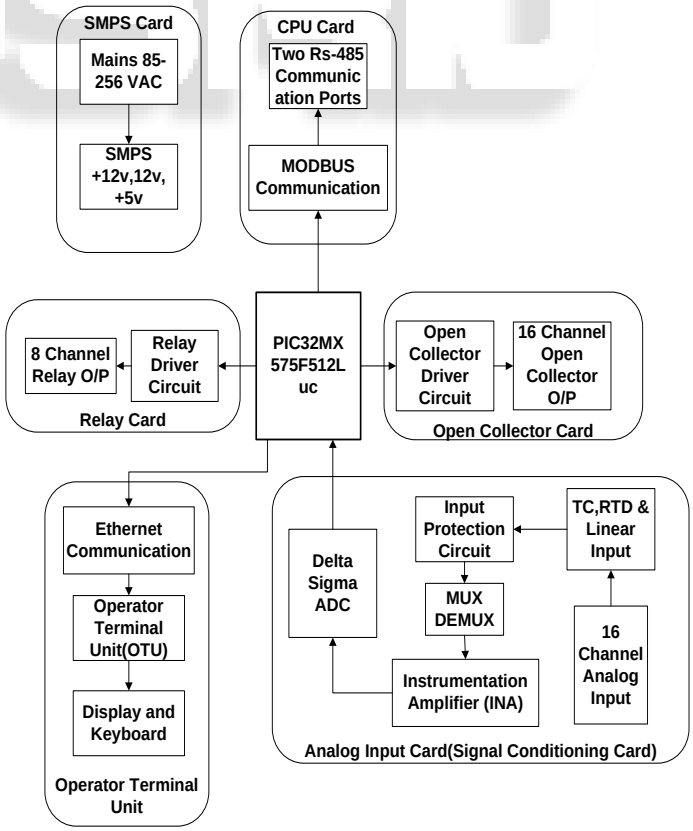

Fig. 1: Block Diagram Of Data Logger

The communication between Different Cards has been done by Modbus Protocol which is explained Above

through RS-485.The communication between CPU card and PC has been done by RS-422 protocol with Ethernet Cable.

User can configure Data logger by using Operator terminal unit (OTU) or Configuration software. OTU has Status mode, calibration mode, program mode, configuration mode, verify program mode and verify configuration mode. From OTU user can read or write the data manually from Data Logger.

Analog Input Card is used to give input and one use any channel form 16. We can give different analog inputs to this cards. It is optically Isolated and protected. By ADC the A/D conversion will be done in this card.

Relay and Open Collector Cards are used for Control Some Application. The Driver IC is used in both of the Cards.

Here the Data logger is built with the requirement of the customer of industrial environment so, it contains Relay Card and Open Collector Card For further control application. The main aim of data logger is to log the data into FLASH.

The inputs are given into the Analog input (Signal Conditioning Card) and they are RTD,TC,4-20ma,0-20ma,1-5v,0-5v.So here we can interface use any sensor with 0-20ma with data logger system. Now for selection of different inputs we are using 8-Ch/Dual 4-Ch High-Performance CMOS Analog Multiplexers.

The DG408 is an 8 channel single-ended analog multiplexer designed to connect one of eight inputs to a common output as determined by a 3-bit binary address (A0, A1, A2). The DG409 is a dual 4 channel differential analog multiplexer designed to connect one of four differential inputs to a common dual output as determined by its 2-bit binary address (A0, A1). Break-before-make switching action protects against momentary crosstalk between adjacent channels.

Then the ADC AD7705 will convert this signal into digital form.AD7705 is sigma delta 16-bit ADC. Here we are using 4 To 16 Lines DEMUX CD74HC154 for channel selection. It is High Speed CMOS Logic. A High on either enable input forces the output into the High state. The demultiplexing function is performed by using the four input lines, A0 to A3, to select the output lines Y0 to Y15, and using one enable as the data input while holding the other enable low.

We are using The INA118 is a low power, general purpose instrumentation amplifier offering excellent accuracy.

We are using SMPS card for +5v Power Supply and we have developed back plate which supply the 5v supply by the back panel to all Cards.

Then the CPU card and Analog Input card communication will occur. We developed 16 combinations for select the particular card which is connected into 1-16 slots by back panel.

Now the communication between CPU card and PC will occurs, then inter card communication is done to fetch the data from different Analog input cards. So the whole system is working like this.

The main master controller is used before was XAG 49 by PHILLIPS, but in product we are ready to change controller PIC32MX575F512L because XAG 49 has some limitations and is old product. It has only two UART port while PIC32 has Six UART port and it is very advanced now a days.

PIC32MX575F512L has 512kb flash memory, 128kb SRAM and 6 UART. It has advanced graphics interface, USB 2.0 OTG, CAN and ETHERNET features. It has operates 80 MHz at 2.3v to 3.6v for low power application. So this is all about the hardware part of our project. Now going for the software part of it.[7]

III. SOFTWARE

Now the Software part of this project is really important to Synch and operate the communication with every cards and PC. In Industry we have to do step by step simulation of different unit and for that we have to develop flow of the software.

For Software part I have used MPLAB X IDE V1.85

There are two types of communications done in this project.

A. Communication between CPU card and PC.
B. Intercard Communication

A. Communication between CPU card and PC

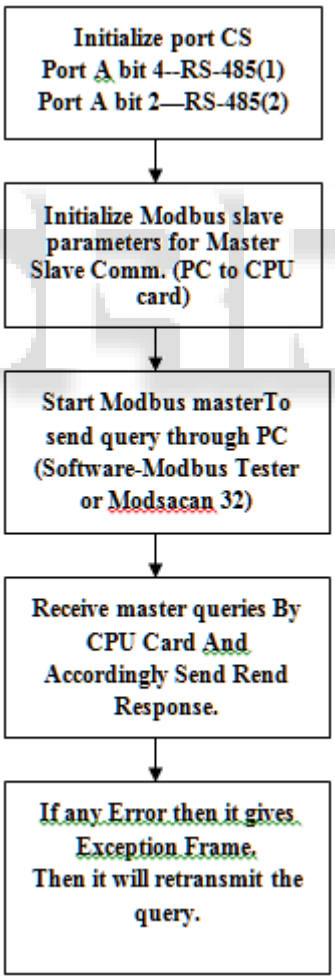

Fig. 2: Flow diagram for Communication between CPU card and PC.

B. Intercard Communication

MODBUS protocol defines a message structure that controllers will recognize and use, regardless of the type of networks over which they communicate. It describes the process a controller uses to request access to another device,

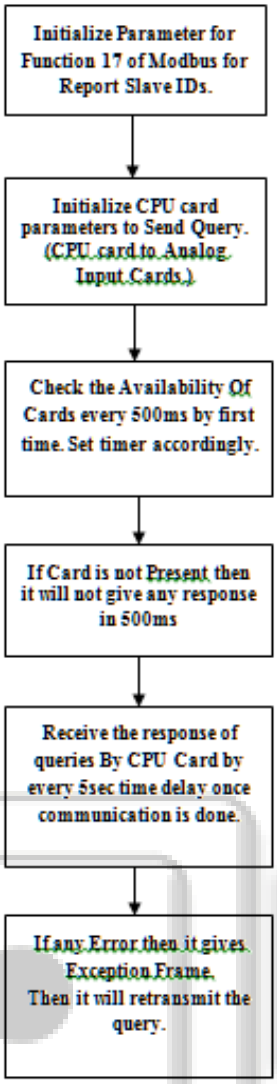

Fig. 3: Flow diagram for Communication between CPU card and Analog Input Cards (Intercards).

how it will respond to requests from the other devices, and how errors will be detected and reported. It establishes a common format for the layout and contents of message fields. During communications on a MODBUS network, the protocol determines how each controller will know its device address, recognize a message addressed to it,

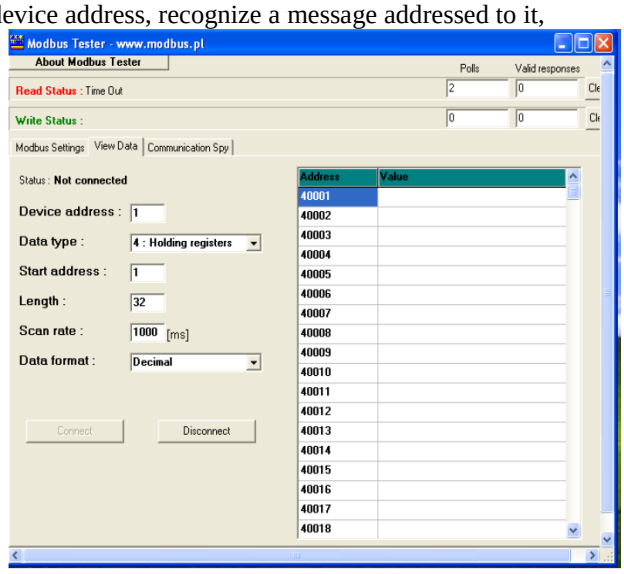

Fig. 4: Snapshot Of Modbus Tester

determine the kind of action to be taken, and extract any data or other information contained in the message. If a reply is required, the controller will construct the reply message and send it using MODBUS protocol. On other networks, messages containing MODBUS protocol are imbedded into the frame or packet structure that is used on the network. Here we check the response by MODBUS TESTER software shown below where we can easily see the response on modbus address.[6]

The communication over modbus explained above in the flow diagram. Now the main part in this project is logging parameter and how to store the data which comes from real world. There are two ways to store data, first in RAM and second is in EEPROM and FLASH.

Read-only memory (ROM) is a type of storage medium that permanently stores data on personal computers (PCs) and other electronic devices. Because ROM is read-only, it cannot be changed; it is permanent and non-volatile, meaning it will also hold its memory even when power is removed. By contrast, random access memory (RAM) is volatile; it is lost when power is removed.[5]

Now if customer wants to store data for analysis point of view that is called data logging then the data will store in the FLASH , While the main parameters of data logger should be stored in EEPROM so that if power may gone be OFF ,it will have last parameter stored in EEPROM. User can also change the parameters according to application there is no issue. For this I have used FLASH S25FL256S, EEPROM

Flash S25FL256S has 32Mbytes of memory, SPI Enabled, programming 1.5 Mbytes/sec and Erase with 0.5 to 0.65 Mbytes/sec

IV. Results and Discussion

Sensors have been interfaced with the microcontroller successfully and the EEPROM and RTC have been successfully interfaced to the microcontroller. So that FLASH is successfully storing the logged data with the time and date tag. Using OTU user can also read and write data to the system. It is user interface.[2]

V. Conclusions

In this paper we have developed a low cost data logger which has 16 bit resolution analog to digital converter. User can use any sensor which can interface with the system. Finally the communication between different analog cards and CPU card has been done perfectly .Also the Communication between CPU card and PC has been done from the software MODBUS TESTER is used. Thus whole system can work reliably.[2]

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