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Low Cost Multi Node Data Acquisition and Control System Using Virtual Instrumentation

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Abstract : *Data acquisition and control system consists of analog to digital converter (ADC), digital to analog converter (DAC), timer, counter, pulse generator, digital input / output (DIO) depending upon requirement. All the system components must communicate with personal computer (PC) for data and control signal transmission via one of the communication protocol like Serial, Parallel, USB, GPIB. Serial communication is advantageous over other protocol due to several reasons, like long distance transmission, less number of physical connection, ease of implementation etc. The system is developed Serial Multiple based Data Acquisition and Control System, which can control different modules like temperatures pressure and vibration,, the interfacing card is designed using single serial port and A Lab VIEW based program is developed for the individual communication of each module.*

Keywords: *ADC, Digital system, communication methods, multiple data sensor, lab view, Virtual instrumentation*

I. INTRODUCTION

In the resent year numerous developments in VLSI give new era to the development of microcontroller based system call as smart system. This development is being coupled with numerous applications and continued with development changes compared with traditional philosophy of data acquisition. Traditional scheme based on simple ADC interface have been replaced in many situation where there is the need to collect information faster than a human, data loggers can possibly collect the information and in cases where accuracy is essential. A data logger is a device that can be used to store and retrieve the data [1]. Data logging also implies the control of how sensor collects analyzes and store the data. It is commonly used in scientific experiments. Data loggers automatically make a record of the readings of the instruments located at different places. The user determines the type of information recorded. The range includes simple economical single channel multi sensor and functions data loggers to more powerful programmable devices capable of handling hundreds of input [2].

The basic data acquisition and control system consists of application module like temperatures pressure and vibration etc. The module is selected depending upon the requirement. The modules are individually controlled with personal computer (PC) for data and control signal transmission using one of the communication protocol. If communication is done using different protocol for different modules in system requires knowledge of different communication protocols, communication hardware and large number of connection with the PC. We developed Serial Multiplexed based Data Acquisition and Control System. In house developed system consists of different application modules and a controller module. The application modules are controlled by controller module having serial connectivity. The control program for each application module is developed in Lab-VIEW environment.

II. RELEVANT THEORY

The task of data acquisition and logging is unique in the predefined environment is behind less complicated system but if we defined the task of remote data acquisition with the developing technology then the task is become complicated. The problem is resolve using microcontroller interfacing method with the wireless communicable environment such as RF environment. This wireless communication helps to acquire the data from the remote place and received data is show on display device or with some extra development interface with the personal computer (PC). The primary goal of this work is to design an digital system using AVR Atmega-16 Microcontroller with their communication feature (Rx, Tx) with the RF communication module (CC2205) communication protocol. The prototype work is to use data logging for temperature, pressure vibration and humidity measurements. In order to meet the above requirements, a low cost, versatile, portable data logger is designed. The temperature, pressure and Vibration acquiring is designed using microcontroller At

mega 8 and At-Mega 16. A particular value of temperature pressure and Vibration is acquired by At mega 8 slave designed unit and it send to main controller board designed using Atmega-16 work as master control, which connected with the PC at the data collection centre

III. EXPERIMENTAL WORK

A block diagram shown in Fig. 1. Consists of different application modules, which are installed on back panel of card developed using ATMega- 16 microcontroller of the system. When system is switched ON, the application module read the physical address and saves in local register of microcontroller. While transferring command for Read / Write, the logical address is sent with the interrupt status value. The microcontroller in application module compares logical address and physical address. The module program command sequence is executed in the application module whose logical address and physical address matches. All the commands are treated as either read or write considering as receive or send by PC. Data and commands are send or receive by the PC to the application module via serial interface. The application module can be installed in one to eight locations while controller is placed on ninth position. The application module has no physical positional limitation, i.e., any module can be installed in any position except the controller module.

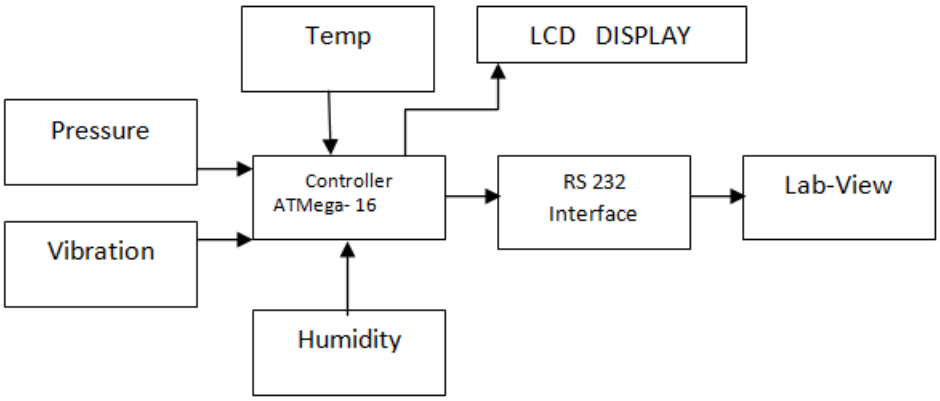

Fig. 1: Block diagram of developed system

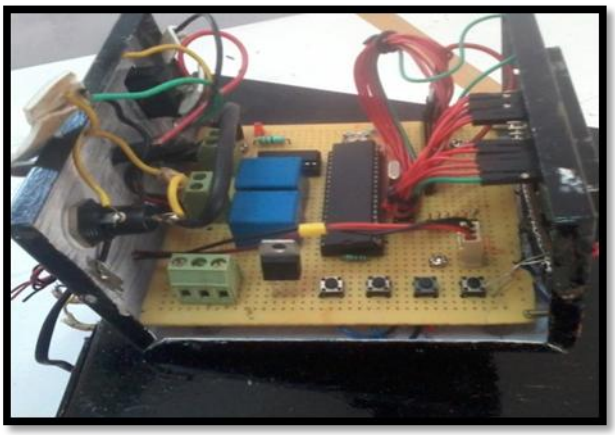

Fig. 2(a): shows the developed SMDACS assembly

The chassis as controller module, application module, back panel and in-built power supply. The right-most module is the controller module. Each application module communicates with the controller module using back panel 9 pin D-type connector for transmit, receive and power. Three pins of the 9-pin D-type connector are used for physical address of the module. The application module is used physical address for data and control information transmission.

3.1 Controller Module

Controller module is the heart of the system. It is the interface module which transmits data and control signals between PC and application module. Front panel of the module has power indicator and a data transmission receiver indicator. It has an internal trigger though the INT1 which is used as bus trigger for the entire application power status check module simultaneously. A 9 pin D-type connector is used for

communication using serial bus .A 9 pin serial connector on the back panel of this module is used to transmit and receive data or control signal.

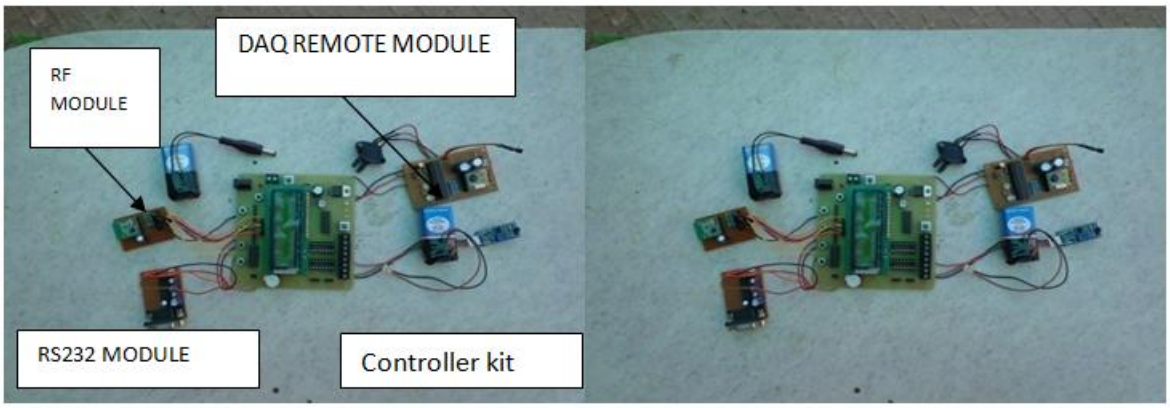

Fig. 2(b): Developed serial multiplexed based data acquisition and control system hardware.

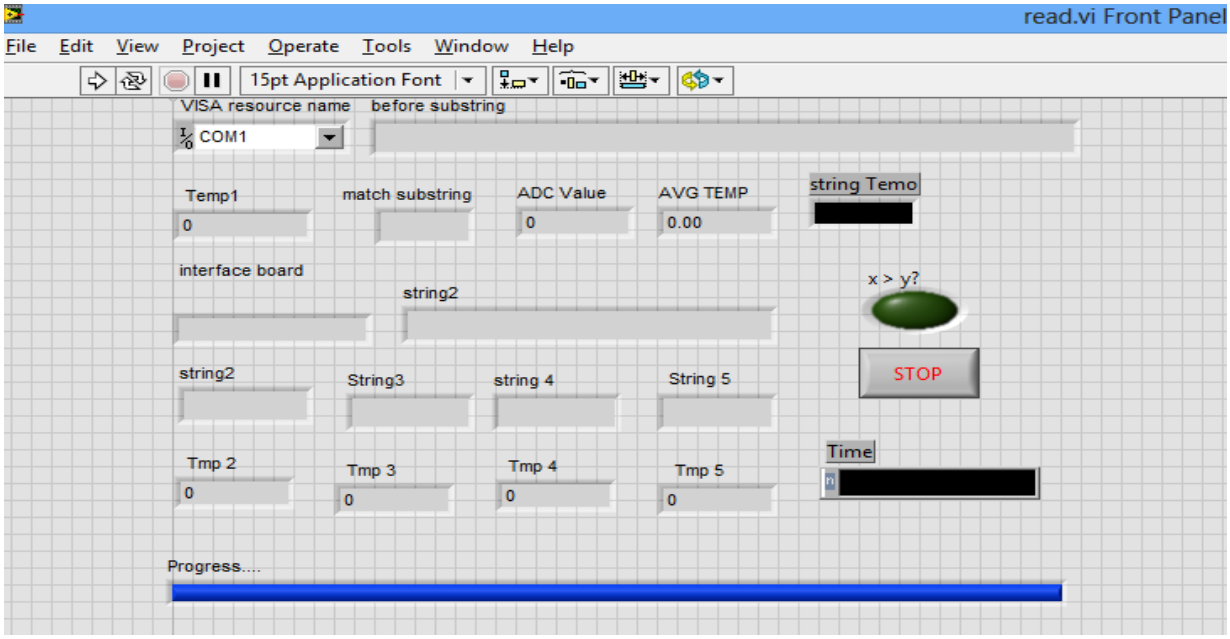

Fig. 3: Lab view based GUI program and serial application module data.

The system uses two types of programs for its operation namely system program and module program. PC System program Lab VIEW as Graphical User Interface (GUI) which is used by users while the Module program is the program written in the embedded c programming structured microcontroller of the application module. The Lab VIEW GUI program controls the operation of system as shown in the Fig 3. While executing the Lab VIEW GUI program, the following sequence is followed:

- ❖ Configure serial port by VISA resource name.
- ❖ Select Station ID (logical address) and other related parameters which are to be passed to the different application modules.
- ❖ Activate required Station ID for passing the parameters (All or specific station).
- ❖ Select appropriate command (Write or Read).
- ❖ Program can stop forcefully by Stop command.

3.2 Application Module

The Module program is written inside the microcontroller [1] of the individual application module. When power is switched ON, the microcontroller inside individual module will read physical address from the back panel and write it in the local memory micro controller. Fig. 4 shows the flow diagram of module program. The Lab VIEW program sends the logical address to application module through serial communication. The logical address send by the Lab VIEW program and physical address written in microcontroller memory is

compared. If the match in address is found, next commands end by the Lab VIEW program will be executed on that particular module. Depending upon the command send by the Lab VIEW program, data / control word will be read /write in particular application module using the serial interrupt. All the other interrupts are disabled whenever application module places data on the serial bus.

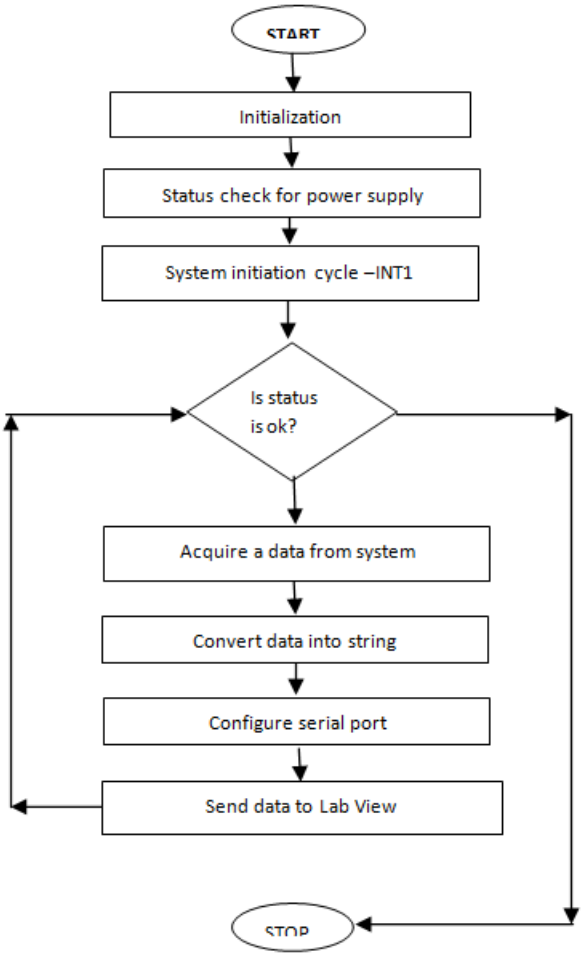

Fig. 4: Flow diagram for module program.

3.3 Digital I/O Module

The DIO module consists of eight digital inputs and eight digital outputs. This module is developed using inbuilt ADC of the microcontroller. The ATMega series microcontroller ic have 10 bit ADC, the module read the digital input and displays the status of each bit on the Lab-VIEW GUI. The different digital pattern is generated by setting the bit pattern in the GUI. The GUI transfers the digital pattern to the digital output port. Here we used the serial RS-232 port separately for communication between microcontroller and Lab View GUI.

Communication module

The communication between the lab view coding and the microcontroller is defied with the predefined baud rate of 9600baud. The RS232 module is configured using Max-232 as TTL to Digital logic convertor. The microcontroller sends the string of fixed length defined while programming and lab View (VISA) port is configure with the same data rate. Serial port activation is carryout through the VISA Read operation tool available in lab View. The received string is display in specific string constant format with the string separator.

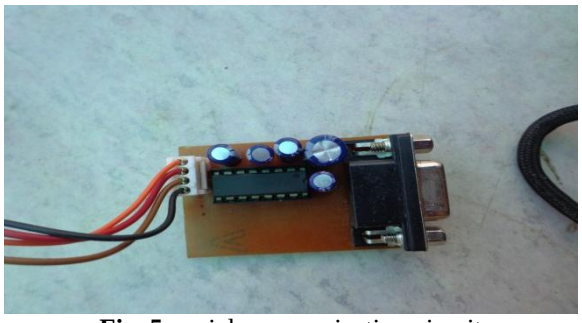

Fig. 5: serial communication circuit

3.4Result

The data capture by the microcontroller ATMega 16 is converted into string format using the standard library function and send through the serial port which is defined in the code vizard. Fig. 6 shows the snap shot of the serial port data , the independent line shows the string data printed on hyper terminal, the same data is received in the designed lab view panel. The lab view and microcontroller is configured with the tool VISA available in library. The received string is stored at location and same string is used with string splitter tool with the common separator symbol. The separate logic of string to numeric converter the string data is converted into the numeric floating point data. The data acquired by the microcontroller is shown on the LCD display attached with the microcontroller-developed board.

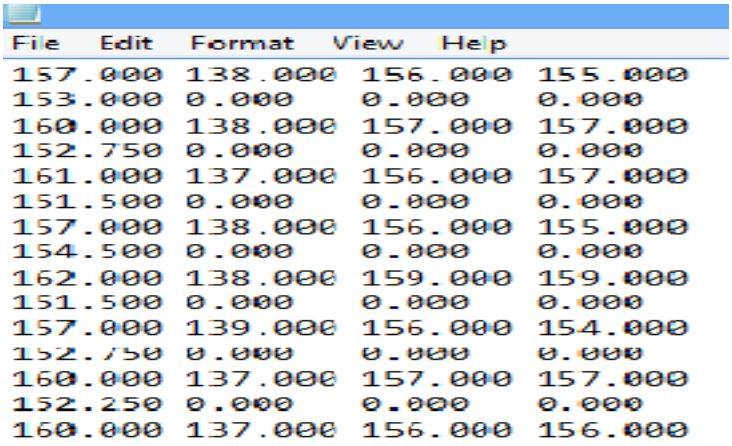

Fig. 6: Hyper terminal data output monitor send by microcontroller

IV. CONCLUSION

The developed SMDACS is stand alone and used in small experiment. The designed system is compact, stand-alone, reliable, accurate and portable with on-board display of the acquired the data from remote place or system under observation. The properly designed Data Acquisition system saves time and money by eliminating the need of service personal to visit each site for inspection, data collection logging or make adjustments.

The system can be used for acquiring slower sampling data for longer duration using digitizer module. Other than this the module generates different timing pulses using TTL delay generator to synchronize with other system. The system also generate digital pattern or to acquire system status using digital input / output module. The analog signals generated using digital to analog converter is used for analog pattern generation.

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