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Remote Data Acquisition of Physical Parameters Using Master-Slave Utility of Microcontroller

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Abstract— Improve the performance of remotely situated device control and data monitoring, acquisition with parameter such as temperature, pressure, vibration, humidity on real time basis give the data modularity as well as low data processing time. The infrastructure of the existing RF network is used, which is based on supervisory control, monitoring and data acquisition demands constant development and applicability in research. Versatile and highly accurate data acquisition system is investigated. In the present work, an embedded data acquisition system at operating frequency of 16 MHz is designed around the Atmega-16A microcontroller. The application of RF and microcontroller infrastructure is proposed. Wireless data acquisition deals with the creation of an inexpensive, adaptable and easy to use data acquisition within a network. The wireless data acquisition system, which is setup the temperature, pressure and vibration monetring system with the precision readout, is designed using locally available electronics component. The necessary control have been dumped or embedded as software in the microcontroller to add the intelligence to the data accusation system sufficiently recorded from remote location and store in personal computer memory using hyper terminal utility. 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.

Keywords— Remote monitoring system, RF, Sensors, Microcontroller, supervisory control, hyper terminal, etc.

1. 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. Their advantage is that they can operate independently of a computer. The range includes simple economical single channel multi sensor and function loggers to more powerful programmable devices capable of handling hundreds of inputs [2].

Data loggers are often confused with data acquisition devices; note that these two terms do not necessarily describe the same device. The former refers to a device that records data over relatively long periods of time for analysis of slow-varying trends, whereas the logger latter refers to a device that records data at a much higher sampling rate and shorter time. Temperature, pressure and vibration is the ever-changing parameter because of exposition to huge array of stimuli from their environment. All of them infer temperature by sensing some change in a physical characteristic. One must be careful when measuring temperature, pressure and vibration to ensure that the measuring instrument (thermometer, hygrometer, vibration meter, etc) is really the same temperature, vibration and humidity as the material that is being measured. Under some conditions heat from the measuring instrument can cause a temperature gradient, so the measured parameter is different from the actual temperature of the system. In such a case the measured parameter will vary not only with the temperature of the system, but also with the heat transfer properties of the system and associated parameter as vibetion, pressure and humidity [3].

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 disply 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 Family with their communication feature (Rx, T_x) 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 designed unit which work as slave 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.

2. Relevant Theory

2.1 Introduction to data loggers

The data logger is an invaluable tool to collect and analyze experimental data, having the ability to clearly present real time analysis with sensors and probes able to respond to parameters that are beyond the normal range available from the most traditional equipment [4].

Definition of Data Loggers

Data logger is an electronic device that automatically scans, records, and retrieves the data with high speed and greater efficiency during a test or measurement, at any place with time [4]. The type of information recorded is determined by the user i.e. whether temperature, relative humidity, light intensity, voltage, pressure or shock is to be recorded, therefore it can automatically measures electrical output from any type of transducer and log the value. These electronic signals are converted into binary data and become easily analyzed by software and stored on memory for post process analysis.

2.2 Characteristics of Data Loggers

Data loggers possess the following characteristic [5]

1) Modularity: Data loggers can be expanded simply and efficiently whenever required, without any interruption to the working system.

2) *Reliability and Ruggedness*: They are designed to operate continuously without interruption even in the worst industrial environments.

3) *Accuracy:* The specified accuracy is maintained throughout the period of use.

4) *Management Tool*: They provide simple data acquisition, and present the results in handy form.

5) *Easy to use*: These communicate with operators in a logical manner, are simple in concept, and therefore easy to understand, operate and expand..

3. Experimental Development

3.1 Operation of data logger

The ability to take sensor measurements and store the data for future use is definition, a characteristic of a data logger. However, a data-logging application rarely requires only data acquisition and storage. Inevitably, the ability to analyze and present the data to determine results and make decisions based on the logged data is needed. A complete data-logging application typically requires most of the elements illustrated

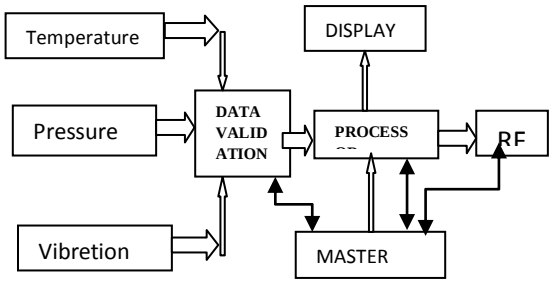

Figure 1. Block diagram of DAQ System

For the design and development of the system, the methodology and used involves the software-hardware implementation. The actual implementation of the system involves the following steps:

1) *System Definition*: Broad definition of system hardware including microcontroller and its interface with display, ADC, memory, keypad etc.

2) *Circuit Design*: Selection of Atmega-16 microcontroller and other interfacing devices, as per system definition. Design of hardware circuit and testing on laboratory with microcontroller software routines.

3) *PCB Design and Fabrication*: Generation of schematic diagrams and the production of circuit board layout data for the procurement of the circuit board.

4) *Hardware Modifications*: Making any hardware changes found necessary after the initial hardware tests, to produce a revised circuit board schematic diagram and layout.

5.) *Software Design*: Developing algorithm for the system, allocating memory blocks as per functionality, coding and testing.

6.) Integration and Final Testing: Integrating the entire hardware and software modules and its final testing for data logging operation.

3.2 Complete Design

It involves the details of the set of design specifications.

1) Hardware Implementation.

2) Software Implementation.

3.2.1Hardware Implementation

The hardware design consists of, the selection of system components as per the requirement, the details of sub- systems that are required for the complete implementation of the system and full hardware schematics for the PCB layout. Design of the circuit and its testing has been carried out. It involves the component selection, component description and hardware details of the system is

1) Component selection and description.

2) Hardware details of the system designed.

3.2.2 Selection of Suitable Transducer

For measuring the temperature, the choice of sensor is of utmost importance [7]. The sensors are used in many fields includes Thermocouples, Resistive temperature devices and bimetallic devices. The factors for the selection of sensor that we take into account includes the inherent accuracy, durability, range of operation, susceptibility to external noise influences, easy of maintenance and installation, handling during installation (delicacy), ease of calibration, and type of environment it will be used in.

3.2.3 Criteria for choosing microcontroller

1) The first and foremost criterion for choosing a microcontroller is that it must meet the task at efficiently and cost effectively [7]. In analyzing the needs of a microcontroller-based project, it is seen whether an 8-bit, 16-bit or 32-bit microcontroller can best handle the computing needs of the task most effectively. Among the other considerations in this category are:

(a) Speed – What is the highest speed that the microcontroller supports?

(b) Packaging – Does it come in 40-pin DIP (dual inline package) or a QFP (quad flat package), or some other packaging format? This is important in terms of space, assembling, and prototyping the end product.

(c) Power consumption – This is especially critical for Battery-powered products.

(d) The number of I/O pins on the chip.

(g) Cost per unit – this is important in terms of the final cost of the product in which a microcontroller is used.

2) The second criterion in choosing a microcontroller is how easy it is to develop products around it. Key considerations include the availability of an assembler, debugger, a code –efficient compiler, technical support.

3) The third criterion in choosing a microcontroller is its ready availability in needed quantities both now and in the future.

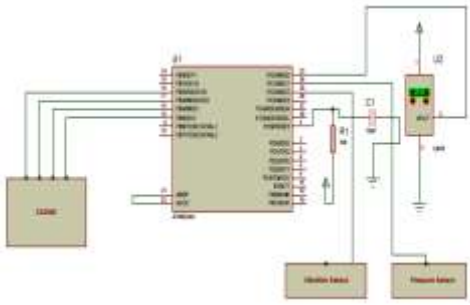

Figure 2. Schematic of designed prototype

The prototype is designed using the same schematic with the temperature, vibration, pressure sensor in the system. as LM-35, MXP10-40, LM393 and then it compares with the standard, and this analogue data is then given to the ADC which is already inbuilt in a AVR Atmega16 microcontroller. AT-Mega16 microcontroller is used to control the control action is done. The Atmega 16 microcontroller is programmed in embedded C language with Code Vision AVR IDE.

a. Pressure sensor

The MPX10 series silicon pizoresisitive pressure sensor provides accurerate and linear voltage output, diretcly proportional to the applied pressure. These satndard, low cost, uncompenseted sensor permitrs manufacturer to design and add their own external tempure compensation and signal conditioing network. In this project the companseation circuit alonge with the vibretion scanning is carryforwarded in the ASCII formate and converted the logical part in to the fixed didgital enviornment.

Figure 3. Snapshot of pressure sensor

b. Vibration sensor

The vibration is the main source of disturbing the performance of the system and same data analysis so we observed the vibration of system. Also the in prospective application the vibration data give the information of the material characterization and status of material. The more vibration is shows the poor performance of the system and durability of the system is less. Here we used the capacitive vibration, which give the smallest vibration

Figure 4. Snapshot of vibration sensor *RF module*

Here we use the CC2500 RF module for communication of the data from master to slave. This module work on the I2C protocol which make simplicity to configured the system in master salve configuration the circuit is intended to work for industrial, scientific and medical and short range device at the frequency of 2400-2483.5MHz. the RF transceiver is integrated with the highly configurable baseband modem. The modem support various modulation scheme formats and has configurable baseband module at the data rate up to 500kbps. The communication range can be increase by enabling the forward error correction integrated with the modem. The main operating parameter is 64 byte transceiver as FIFO with the controlling protocol as SPI

Figure 5. snapshot of RF Module RF module cc2500

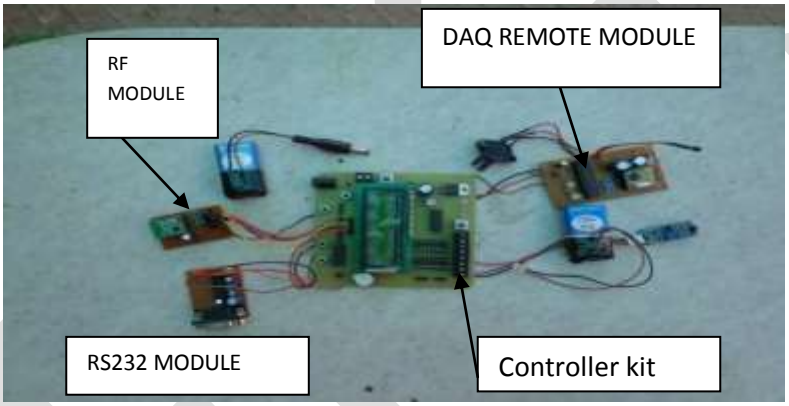

Figure 6. Complete system prototype

4. RESULT

In this system, Temperature, pressure and vibration measurements from the three sensors are taken. The performance of the three sensors is distinguished on the basis of their accuracy. All the sensors are configured with the specified accuracy in data sheet. The accuracy indicates how closely the sensor can measure the actual or real world parameter value. The more accurate a sensor is, better it will perform. As the sysytem is capebale to transmit all the data from remote place, the minimum error enviornment in terms of bit(LSB) is maintain to make the digital trnsformetion with minimum error. The resolution of the ADC is adjusted in such way the the bit remain error free, for that the complet system operate at the 4.86V in recpect of 5V supply voltage.

Figure 7. Working module of prototype

The readings are taken under different conditions for some time interval. Also the readings are taken at different temperatures in a time interval. Comparing the readings obtained from the three channels under the different conditions the most accurate channel among them is found.

Table 1. Result at Room temperature condition

Time	tandard	System	Pressure	Vibration
8:05am	33.3	33.35	04	00
8:15 am	33.3	33.39	10	50
8:25 am	33.3	33.39	08	00
8:35 am	33.5	33.50	08	230
8:45 am	33.5	33.53	03	100
9:00 am	33.5	33.53	07	37
8:15 am	33.8	33.9	03	37
8:30 am	33.9	33.9	05	37
8:45 am	34.5	33.9	3	37

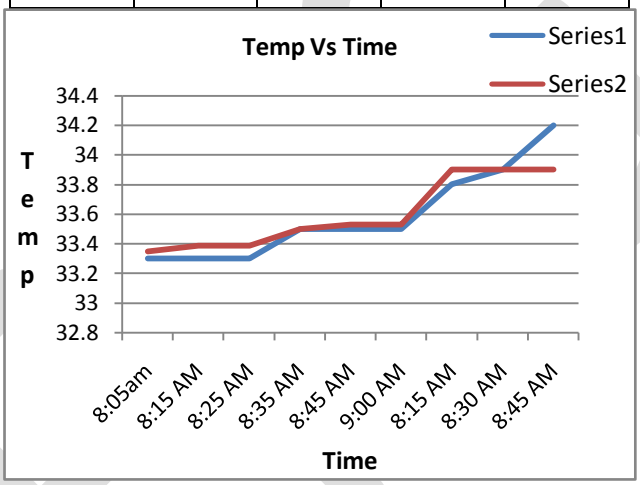

Figure 8. Grapho of temp error between manual and system acquired.

Table 2. Result at moderate temperature condition

Time	Standard	Sys. temp	Pressure	vibration
10:05 am	35	34.8	05	00
10:20 am	35.5	35.3	10	35
10:40 am	35.5	35.5	15	25
11:00 am	35.5	35.5	20	23
11:20 am	35.8	35.9	25	25
11:40 am	35.8	35.9	30	22
12:00 pm	35.8	35.9	35	22
12:20 pm	35.8	35.9	35	22
12:40 pm	36	36.3	40	22
1:00 pm	36.4	36.28	45	22
1:15 pm	36.8	37.00	45	22
1:30 pm	37	37.4	45	25

5.CONCLUSION

From the above tables of readings obtained by comparing standard temperature with the temperature of channels, the accuracy of the channels is discussed as the temperature mesurment is done using conventinal methods have some mersurment error as compaired with the new system. Accuracy is the degree of conformity of a measured analog and digital quantity to its actual (true) value that is the quality of errorless to the truth or the true value.

The application was designed and developed to prove a couple of concepts about the data acquisition in general and some notions about the possibility of adding remote controlling/monitoring. This has a teaching purpose: it is being used for a series of experiments between several laboratories, at the moment. From one point of view one can process the experimental data gathered from a real process, but one can also see the result of one remote command sent to industrial equipment in the real time.

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If acknowledgement is there wishing thanks to the people who helped in work than it must come before the conclusion and must be same as other section like introduction and other sub section