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Data Logger System: A Survey

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***Abstract*- Knowledge of temperature and relative humidity course during a certain time is needed in scientific, medical and industrial applications. For retrieval of this information from various devices such as manual readings, chart recorders or data loggers can be used. A data logger is an electronic device that combines analog and digital measurements with programming methodology to sense temperature, relative humidity and other parameters such as voltage and pulse. The data loggers take input from the thermocouple temperature and humidity and other sensors. This data is then passed to the database and analysis software for storing and analyzing the monitored data. The various technical milestones achieved by the researchers in this field has been reviewed and presented in this survey paper.**

***Index Terms* — Temperature and Relative humidity, data loggers, thermocouple sensors.**

I. INTRODUCTION

Temperature and relative humidity level can affect various type of measurement recorded in many fields. Hence, temperature and humidity must be maintained within certain limits [1] to achieve repeatable results, reduce the cost of tedious corrections and meet regulatory and correctness requirements. It has been found that chart recorders cannot record temperature and humidity accurately enough to meet quality and regulatory requirements. Chart recorders are difficult to calibrate and to maintain, many are prone to sensor drift, which tends to set worse over time and it may not be fully corrected. As chart recorders use moving parts, they gradually deteriorate and require increasing amount of maintenance and calibration to keep them accurate. Data loggers use digital technologies, such as advanced microprocessors, solid state sensors and fully featured software, which maximize accuracy. As there is no moving part to wear out and with powerful software compensation, data loggers can deliver greater accuracy over larger periods of time. Due to their small size and portability, they can also be moved closer to the critical areas where calibrations take place, providing greater accuracy for each calibration.

A. Data Logger an Overview

Data Logger is an electronic device that automatically records, scans and retrieves the data with high speed and greater efficiency during a test or measurement, at any part of the plant with time [2]. The type of information recorded is determined by the user i.e. whether temperature, relative humidity, voltage, pulse is to be recorded; therefore it can automatically measure electrical output from any type transducer and log the value. A data logger works with sensors to convert physical phenomena and stimuli into electronic signals such as voltage or current.These electronic signals are then converted into binary data, which is then easily analyzed by software and stored for post process analysis.

Data Loggers are based on digital processor. It is an electronic device that record data over the time in relation to location either with a built in instrument or sensor or via external instruments and sensors.Data Logger can automatically collect data on a 24-hour basis, this is the primary and the most important benefit of using the data loggers.

B. Operation of Data Logger

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

i. Experiment: The various parameters whose values are to be recorded from a particular environment or object is given as input to the sensors in experiment part.

ii. Sensors: The inputs from various sources are given to the data logger through various sensors to measure various parameters such as temperature, humidity where electrical signals are converted to temperature and humidity values.

iii. User Interface: The interface for interaction with the software and sensors is provided and using implemented algorithm analysis is done for storage of data.

iv. Software: It displays the information stored from sensors for and also maintains data for long time storage.

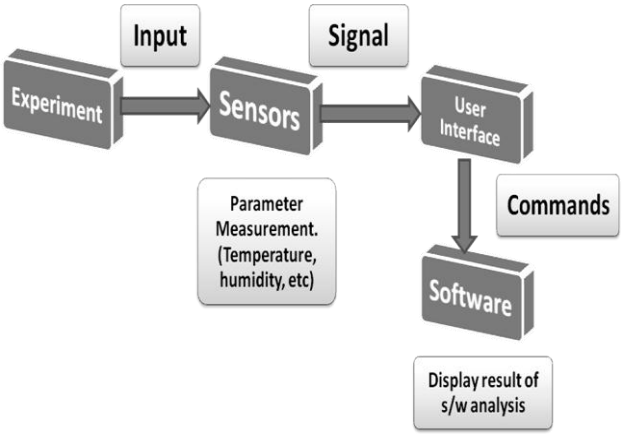

Fig. 1 A Data Logging Process

II. LITERATURE SURVEY

Dr. Saul Greenburg [3] has described the concept of logging and how logging is done is in detail. Logging is a process to record events with the use of data loggers during a test or field use of a system or a product.

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Logging is one of the usability methods that can and should be used to gather more supplementary information as an integral part of the iterative design of the usability engineering cycle. Logging has the major advantage compared with other usability methods of not interfering with the users in their performing their tasks. Users can basically ignore the log and use the system in exactly the way they would anyway.

A low cost, very low power consumption, self contained; digital data logger capable of independent operation for long periods of time has been developed by Andrew J Thompson, John L Bahr and Neil R Thomson [4]. The primary purpose was temperature measurement (0.1o resolution), but any voltage in the range 0-5V can be measured. The logger can record up to 8 channels of 10-bit data simultaneously and stores data in 512Kbyte of on-board memory.

The concept of data logger and its basic operation is described in detail by H S Kalsi [5]. A data logger is a comprehensive and highly advanced data acquisition system. It is made versatile and flexible, to render it suitable for widely varying applications, specific requirements being met simply by setting up a suitable program. It can measure electrical output from any type of transducer and log the value automatically.

The use of data loggers has been reviewed by Peter Roberson [6] as the development of the fundamental skills involved with setting up of experimental apparatus, presenting data, producing an interpreting graph, means that, at this stage, the traditional approach to performance of experiments is still an integral component. The use of the computer and data logger can be seen as an added bonus to enhance the opportunities for the new ways to explore traditional themes or to perform experiments that were previously very difficult, time consuming, or dangerous. The data logger can be of enormous benefit to allow for improvements in time efficiency, clear presentation of data to allow easier analysis and interpretation, difficult data rapidly displayed to allow clear visual interpretation of relationship between variables.

In 2004, Muhammad Ali Mazidi and Janice Gillispe Mazidi [7] overviewed the concept of 8051 microcontroller. Microcontrollers and microprocessors are widely used in embedded system products. An embedded product uses a microcontroller to do one task and one task only. In addition to the description of criteria for choosing a microcontroller, the interfacing with the real world devices such as LCDs, ADCs, sensors and keyboard is described in detail. Finally; they discussed the issue of interfacing external memories, both RAM and ROM.The 8051 family of microcontrollers is based on an architecture which is highly optimized for embedded control systems. One 8051 processor cycle consists of twelve oscillator periods. Each of the twelve oscillator periods is used for a special function by the 8051 core such as op-code fetches and samples of the interrupt daisy chain for pending interrupts. An overview of Intel 8051 microcontroller, its memory organization, addressing modes etc. are described in detail by Matthew Chapman [8].

Craig Steiner [9] discussed about the 8051 family of microcontrollers. In addition to the types of memory, special function registers, basic registers, basic registers, addressing modes discussed in this tutorial additional features including introduction to 8052 and timers are also described.

A tutorial on LCD programming was presented by Craig Steiner [10]. This tutorial has presented the underlying concepts of programming an LCD display. A detailed description of Control and data signals of LCD is provided. The 44780 LCD offers many other functions which are accessed using other commands subroutines for initializing, for giving command and data to the LCD is discussed. Thus, it provides information from initializing to displaying the data.

A tutorial on real time clock was also presented by Craig Steiner [11], which provides overview of real time clock. Real-Time-Clock (RTC) is, as the name suggests, a clock which keeps track of time in a "real mode." While there are a number of 8051-compatible microcontrollers that have built-in, accurate real-time clocks (especially from Dallas Semiconductor), some simple applications may benefit from a software RTC solution that uses the built-in capabilities of an 8051 microcontroller. The drawback of using it and its solution is also discussed in this tutorial.

A comparison of data loggers was discussed by Judy Ritchie [12]. A guide to data logging is provided. A data logger is an electronic instrument that records measurements (temperature, relative humidity, light intensity, on/off, open/closed, voltage, pressure and events) over time. Typically, data loggers are small, battery-powered devices that are equipped with a microprocessor, data storage and sensor. How does a data logger work, where are they used, who uses them, what to look in for a data logger, why to choose data logger over a data acquisition system and their applications are discussed in this article.

A microcontroller-based data logging system to record temperature and relative humidity for acoustic measurement applications, simple to use, requires no additional hardware and allows the selection of amount of data and the time intervals between them. The collected data can easily be exported to a PC computer via a serial port and analysis on that data can be one using some appropriate software installed on the PC; it was described by S.J.Perez, M.A.Calva, R.Castaneda [13].

A microcontroller-based portable GSR data logger for physiological sensing was discussed by Rajesh Luharuka, Robert X. Gao, Sundar Krishnamurty [14]. The device is configured to receive skin conductance data from a commercial GSR instrument, store them on its on-board memory, and relay them to a computer via the RS-232 serial port. The focus of the design is on portability and low power consumption for battery-driven ambulatory applications. A PIC microcontroller was used as the central control unit for the data flow coordination. The data logger prototype implemented using conventional IC is small enough for physiological sensing in the field.

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A 8-channel temperature and humidity acquisition system is realized adopting the technology of wireless communication and USB interface, and methods of multi-channel temperature and humidity acquisition as well as main characteristics and functions of the chip nRF2401 and CY7C68013A were introduced by Mei Jianhong, Sun Rongxia, Dong Limei LiuYing [15]. The interface circuit which connects nRF2401 and MCU and the USB interface circuit are designed, also the procedure of the data acquisition and transmission is shown. With the advantages of flexible design, long communication distance, high transmission speed, the temperature and humidity acquisition system has good application prospects.

In 2010, Jano Rajmond, Dan Pitica [16], designed a data acquisition system that transferred logged data by the DAQ system to personal computer, which is responsible for data storage and signal analysis. The user interface, to allow the user to configure the measurement system and select among various data analysis algorithms, was built in LabView.

In 2011, an autonomous, portable and easy to handle system for recording and analyzing intercranial pressure, which also includes software tools to aid clinical diagnosis, was designed by J. P. Oria, L. Santamaria, R. Martin, A. Vazquer and F. Viadero [17].

III. Research Challenges

There exists a scope for further improvement in its speed, number of channels, power consumption, and PC interface software for post data analysis, the software can also be developed so as to classify and predict various data patterns using Statistical Data Miner Software.

IV. Conclusion

Data Logger is a portable acquisition system of humidity and temperature data. The system can be connected with host by USB interface and process humidity, temperature and other data. The data logger is an invaluable tool to collect and analyze experimental data, having the ability to clearly present real time results, with sensors and probes able to respond to parameters that are beyond the normal range available from most traditional equipment. Data loggers used for measuring the temperature might have certain limitations in terms of speed, memory and cost. Also data loggers with increased number of channels are complex.

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