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Implementation of Low-Cost Data Acquisition System for Temperature Measurement

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Abstract
This research paper is used to implement a low-cost data acquisition system [DAS] to record physical and electrical quantities for environmental measurement specifically temperature. This system measured temperature using LM 35 temperature sensor and after converting it in digital form by an analog to digital converter with the help of 16- bit ADC (ADC 0808). The 16-bit ADC is designed in laboratory and it is interfaced to the PC by using parallel port C- Programming is used for this purpose.

Keywords: Temperature, DAS, low cost etc.

1. Introduction

The world is digitized now a day's i.e. in every aspect of life, use of computer is increased. Most sensors signals have been digitized at low medium resolution. A method is used to reducing these inaccuracies is to convert analog signal to digital values as early in the process as in practical and then to process the single in digital domain [1].

Taking the manual measurement direct digitalization of detector waveforms have been reported in early 1970's. These system works limited by the available technology to slow particle velocity and low count rate. In 2002 it was reported that a second-generation analog to digital hybrid data acquisition system which retain wide dynamic range and high resolution which data can be acquired to over 30.000 events per second. Now reporting third generation, higher speed data acquisition system which retain the above mutation feature of the original system [2].

The data acquisition system is basically A/D converter coupled with an interface that allows a personal computer to capture the digital output information from conversion. A data acquisition system designed for high performance will work in a very wide range of test and measurement and control application. Depending upon the DAS the analog signals are converted into the digital form. Data acquisition system is used in many different applications to monitor and collect specific type of information [3].

2. Methodology

A. Data Acquisition System

Data acquisition system can be defined as the process by which events in the real world or translated to machine- readable signal. A typical data acquisition system consists of individual sensors with necessary signal conditioning, multiple signals, data conversion, data processing, data handling and associated transmission, storages and displays system [4].

A data acquisition system uses of electronics and mechanical components to monitor and control complex processes. The methodology include following,

1) Possesses sensors that measure such parameters as temperature, pressure, voltage, current etc.
2) Transmitter that convert measurement electrical or pneumatic signals and control.
3) Software provides the computer with instructions and routine.
4) process interface devices such as analog to digital converter.

The various configuration include DAS are

1. Single Channel
2. Multichannel

3. Experimental Work

Block Diagram of Das

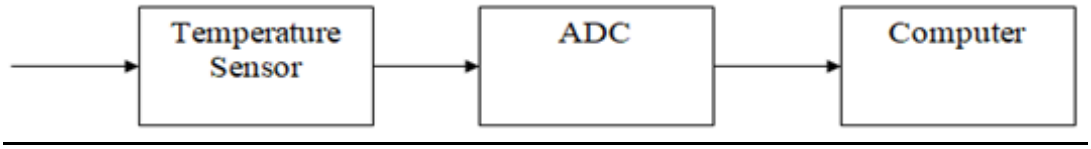

Fig 1.1: Block diagram of DAS.

A. Temperature Sensor

Sensors are the device which sense particular non electrical quantity and converting them into electrical measurable quantity. The used Sensor is LM 35 series are precision integrated circuit temperature sensors. The LM 35 does not require any external calibration and trimming to provide typical accuracies of +_ 3/4˚Cover a full -55˚C to +150˚C temperature rang. The LM 35 is a low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used single power supply; it has very low self-heating, less than 0.1c in still air [5].

B. ADC (Analog to Digital Conversion)

Analog to digital converters is among the most widely used devices for data acquisition. A digital computer use binary values but in the physical world is analog connecting digital circuitry to sensor is simple if the sensor devices is inherently digital. However, when analog devices are involved, interfacing becomes much more complex [6].

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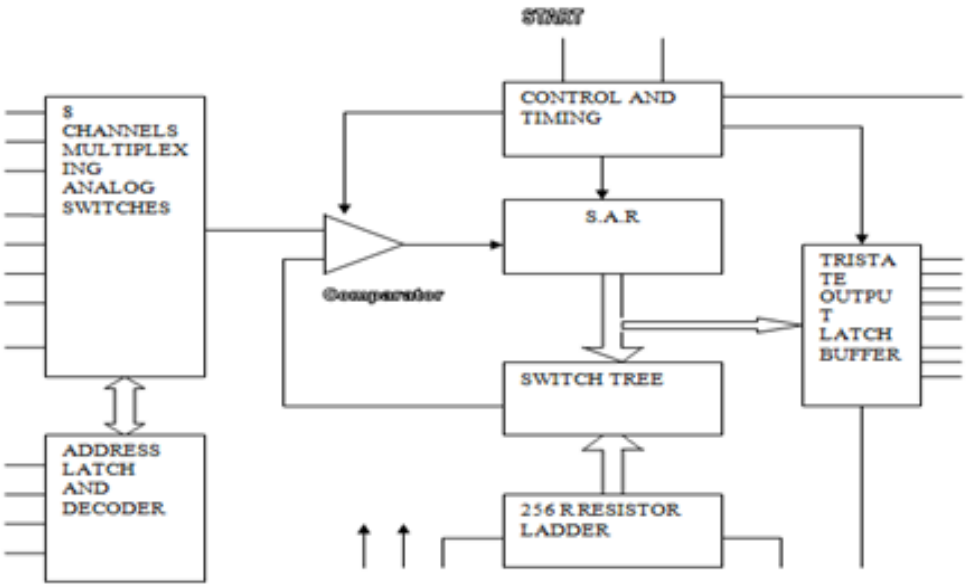

Fig 1.2: Block diagram of ADC 0808.

The ADC 0808 data acquisition component is a monolithic CMOS device with an 8-bit analog to digital converter, 8-channel Multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximations the conversion technique. The converter features a high impedance chopper stabilized comparator, a 256R voltage divider with analog switch tree and a successive approximation register. The device eliminates the need for external zero and full-scale adjustments [7]. Easy interfacing to microprocessors is provided by the latched and decoded multiplexer address inputs and latched TTL Tri-state outputs. The ADC 0808 offers high speed, high accuracy, minimal temperature dependence, excellent long-term accuracy and repeability, and consume minimal power. These features make this device ideally suited to applications from process and machine control to consumer and automotive applications [8].

The Successive approximation register by one, each output of SAR is performing 8 iterations to approximate the input voltage. One switched. SAR is reset on the positive edge of SOC pulse. Conversion starts on falling edge of SOC. If continuous conversion is required, we connect EOC to SOC. However, initially on power up, SOC will have to give externally. The last section is the comparator. It determines the accuracy of the system. A chopped stabilized comparator is used [9].

Circuit Diagram

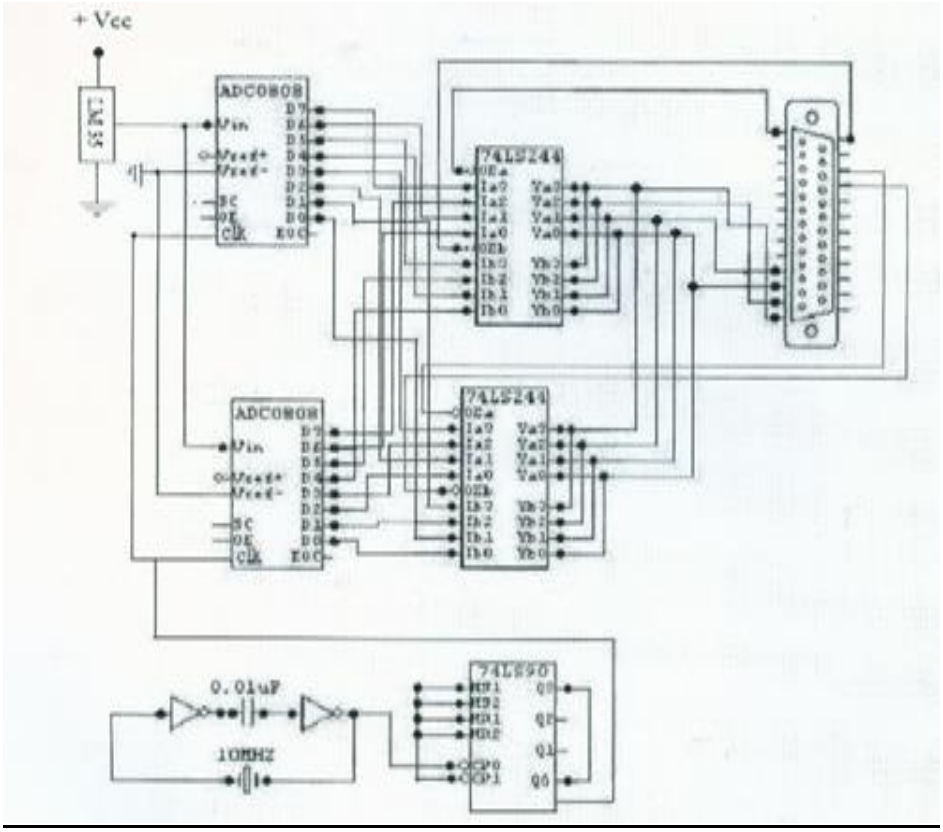

Fig 1.3: Circuit diagram of System.

Flow Chart

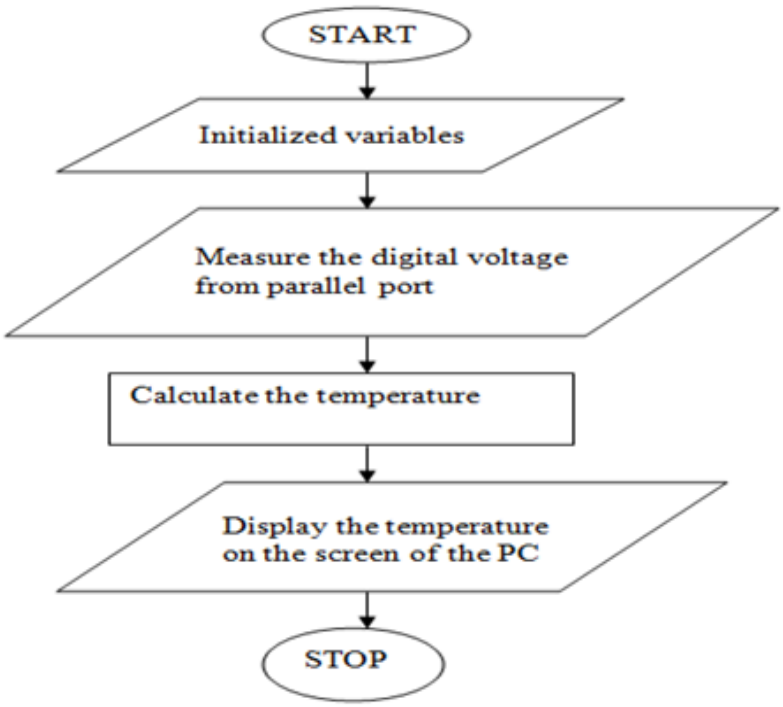

Fig 1.4: Flowchart of circuit.

4. Result and Discussion

The temperature was sensed with the help of temperature sensor LM 35. Its output is in the form of analog voltage which changes as 10 mV for 1˚C temperature range. This analog voltage from the sensor was converted to digital form for further processing with the help of 16-bit ADC. With Vref (+) =+5V and Vref(-)= Gnd, the minimum change that

16-bit ADC can detect was found to be 12mV. As the sensor change 7mV for 1˚C, so that the minimum change that the ADC can detect is 7mV.

So, the temperature sensor was give the output of 16-bit ADC and interfaced to the PC. The output of ADC with the temperature change is given in the table below.

Table 1.1: Output of ADC with temp. Change.

Temp 0°C	Digital Output																Digital Output on PC
	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	
LOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HIGH	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	65535
100	1	1	1	1	0	0	1	1	1	1	1	0	0	1	1	1	62479
95	1	1	0	1	1	1	1	1	1	1	0	1	1	0	1	1	57303
90	0	0	1	1	0	1	0	1	1	0	1	1	0	1	0	1	27385
85	0	0	1	1	0	0	1	1	0	1	1	1	0	1	1	1	13175
80	0	0	0	1	1	0	0	1	1	0	1	0	1	0	1	1	6599
75	0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	1	1425
70	0	0	0	0	0	0	1	0	1	0	1	0	0	1	1	1	679
65	0	0	0	0	0	0	0	1	1	1	1	1	0	0	1	1	499
45	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	255

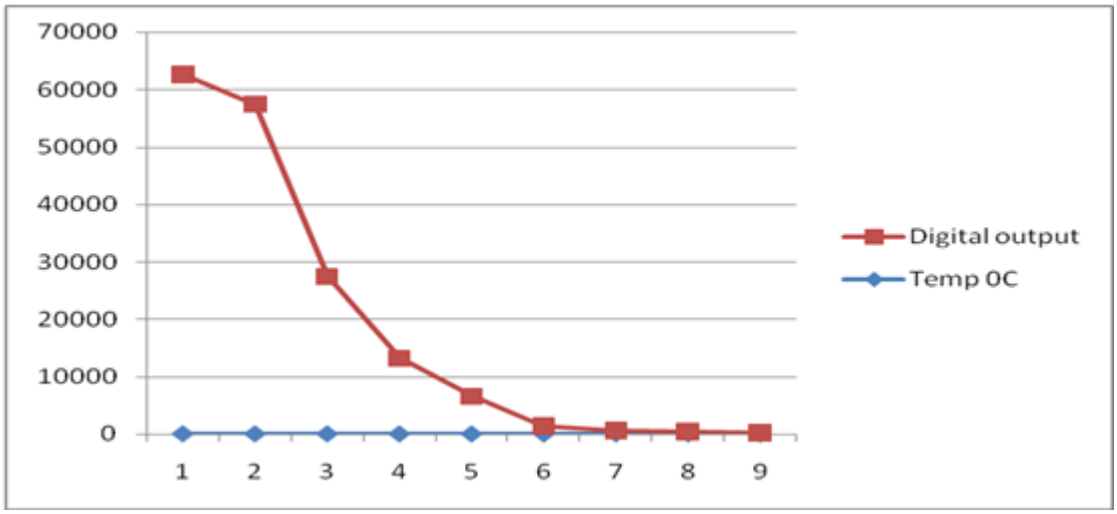

Fig 1.5: Variation of Temperature with digital output.

5. Future Scope

The 16-bit data can be interfaced to a computer by using serial port (RS 232) and it also use in microcontroller-based data acquisition system.

6. Application

1. A multichannel data acquisition can be implemented for interfacing various parameters, using different sensors.
2. High Sampling use in Videos processing and waveform analysis.
3. A ADC and Data acquisition system used in Embedded system for controlling and converting Analog to Digital Converter

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