

Labview based simultaneous data acquisition system for environmental parameters monitoring

Desai R. V., Bachuwar V. D., Todkari S.M.

Department of Electronics, Sangameshwar College,
Solapur-413001, M.S. India

Abstract

The primary purpose of work is to develop low cost and portable PC interfaced data acquisition and monitoring system especially for Agro-based measurements. Data acquisition system (DAS) consists of microcontroller AT89S52, Three ADC (0804). Data acquisition system must acquire three parameters simultaneously, such as temperature, humidity and soil moisture. Data acquisition system acquires serially and sends to PC with LabVIEW. LabVIEW GUI is developed to process the data and display the value of related parameters of environment and matter under test (MUT). This design can also be utilised for simultaneous measurement of any three physical parameters in general, which is essentially most of the time in the research lab. The device can acquire three different physical parameters at the same instant and data logging with PC using USB port and processing of the signals using LabVIEW.

Keywords: *simultaneous data acquisition, AT89S52, Data converters, LabVIEW, Soil Moisture, Humidity, Temperature, Graphical user interface (GUI).*

1. Introduction

Monitoring many parameters of the agricultural environment, temperature and humidity are mostly needed to monitor in the design, we set measurement humidity and temperature as an example of data acquisition.

In general, research laboratories require smart DAS. This can be provided with the simultaneous pickup of signals from various transducers. The signals could be from any sensors measuring physical parameters. We have considered for Agro-based measurements. Monitoring soil moisture, humidity and temperature are essential. It is essential for decision making regarding the parameters involved.

LabVIEW is a program development environment, developed by National Instruments (NI). LabVIEW uses a graphical editing language G. The resulting program is the form of block

diagram [1]. Including the front panel and block diagram, the user can see the front panel, similar to the operation panel of the traditional instruments. Using the tool template to add the input controller and output indicators. We can choose the required types of controls and indicators. The block diagram is the core of support for virtual instruments to achieve its function. The design of the Block diagram involves the design of the nodes, data ports and connections. LabVIEW is graphical programming software. It has convenient programming tools based on the powerful test system.

Simultaneous acquisition of data for three physical parameters consists of the following components:

- Explicit Transducers and precise signal conditioning circuits dedicated for each parameter are required.
- Also, a USB interfaced PC with LabVIEW GUI for Data management and processing.

2. Data Acquisitions System

According to the need for measurement and monitor of environment parameters in different kind of applications, we can use another kind of sensors. The data acquisition module is used for sensing, collecting information and A/D conversion. The processor module is responsible for control the operation of the sensor nodes, storing, processing the collected data, implementation of great network protocol and switch the power work pattern.

Microcontroller AT89S51 is used to control the operation of Signal conditioning circuits and the ADC in the DAQ system. It is also used to read the converted data from the ADC and to transfer to PC. AT89S51 is an 8-bit microcontroller that operates at 11.0592 MHz clock frequency and with +5 V power supply. It has 128 bytes of internal RAM, two 16-bit Timers/ Counters, four parallel I/O ports, one programmable serial port and six interrupt sources[2,3]. Port-0, Port-1 and Port 2 of AT89S51 is used to get the converted data from the ADC and

TXD pin is used to send the serial data to the PC through USB. Port3 is used to give out control signals to INTR#, WR# and RD# inputs of ADCs[4]. To implement a simultaneous data acquisition system, three ADC0804, single channel ADC with the inbuilt clock are used. These are communicated and controlled by AT89S52 as shown in Fig. 1. ADC0804 are simultaneously communicated to AT89S52 and data regarding each parameter is stored in AT89S52. The range of voltage is 0V to 5V. Data is sent serially to PC/Laptop using serial to USB converter, which again communicated to LabVIEW GUI. In this system, PC acts as master and microcontroller as a slave.

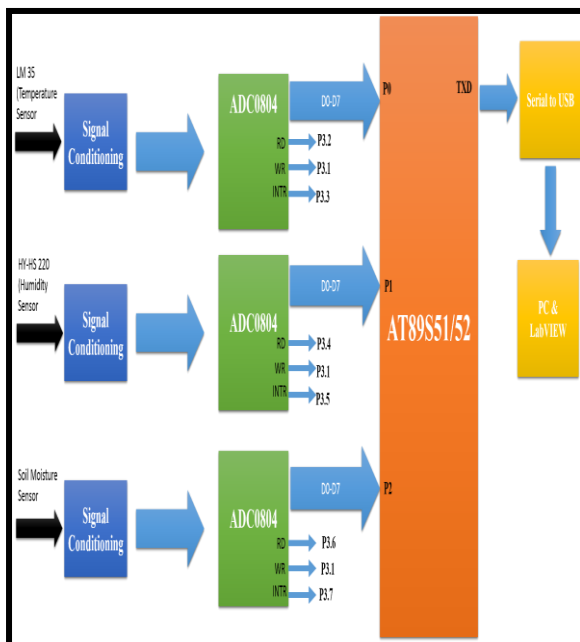


Fig. 1. Block Diagram of AT89S52 Based Data Acquisition System Signal Conditioning for Data Converters

The sensors used for various Agro-based measurements are as follows. LM 35 is used as a temperature sensor. The signal condition circuits are used as inverting/non-inverting amplifier and programmable gain amplifier with gain 2, 5 or 10. So its output will be in the range 0-5V essential for ADC.

3. Simultaneous data acquisition by ADC 0804

To executing the simultaneous ADC operation, start conversion (WR) of the all three ADC0804 are connected to commonly to AT89S52 (Pin P3.1) while end of conversation signal are connected as separate interrupts to microcontroller AT89S52 (Pin P3.3, P3.5 and P3.6 respectively), so that after receiving the interrupt microcontroller read the data from all ADC which is acquired at same time

available in latch in ADC's. The algorithm for simultaneous ADC is shown in Fig. 2.

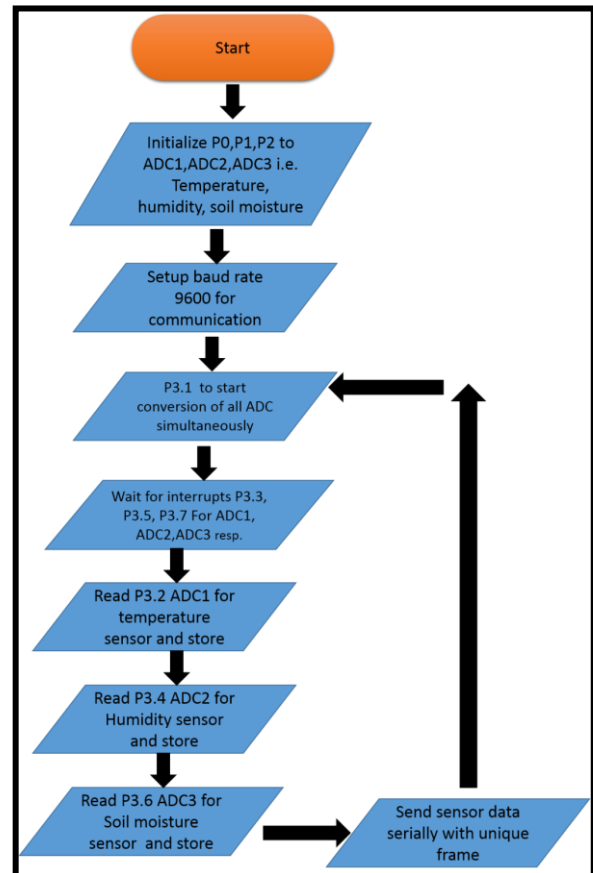


Fig. 2 Algorithm of Simultaneous ADC Sensors details

4. Soil Moisture Calibration:

The calibration of soil moisture sensor was done under two conditions: 0% soil moisture and 100% soil moisture. To get soil moisture information, the voltage type soil moisture sensors were used those were capable of generating the voltages output 5V for wet soil, i.e. 100% moisture and 0V for dry soil i.e. 0% moisture. Fig 4. a. Shows the variation of generated voltage by sensors as a function of the soil moisture. The output voltage is found to be directly proportional (linear) to the soil moisture. A calibration factor which is a measure of conversion of soil moisture in percentage is given by,

$$\text{Soil moisture in \%} = (V_{out} / 5) * 100 \quad (1)$$

Where, V_{out} is the output voltage of a soil moisture sensor, volts and 5 is the output voltage for 100% soil moisture. The alternate equation for finding the soil moisture is;

$$\text{Soil moisture in \%} (y) = 20 * \text{output voltage of soil moisture sensor}(x) \quad (2)$$

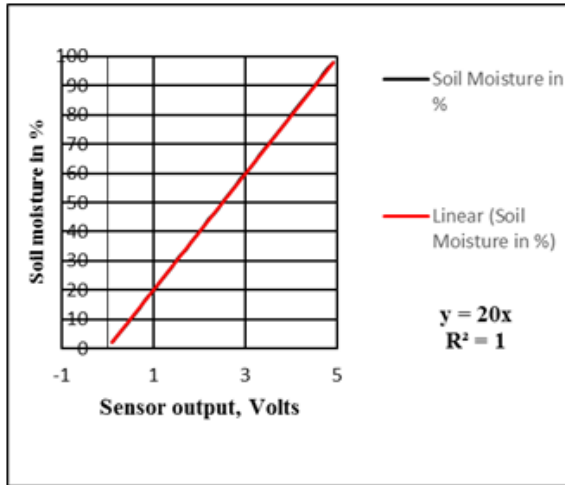


Fig. 4.a Function of the soil moisture

5. Temperature Calibration (LM 35):

To determine the soil temperature, an LM 35 precision integrated circuit temperature sensor was used, wherein the output of the sensor is a linear function of the temperature as shown in Fig. 4. b. The rated temperature range of the sensor is from -55°C to 150°C . [5]. The calibration factor that converts sensor output into temperature is given by;
 Soil temperature (in $^{\circ}\text{C}$) = (Output voltage of LM35 / 10) * 1000 (3)

The alternate equation for finding the soil temperature

Soil temperature (in $^{\circ}\text{C}$) (y) = (Output voltage of LM35(x)) * 10 (4)

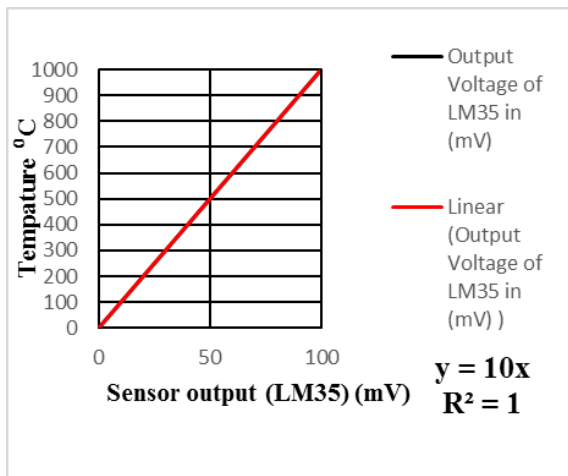


Fig. 4. b Function of the temperature sensor

6. Humidity sensor calibration (HY-HS220):

The interfacing of humidity sensor to signal conditioning circuit is shown in Fig. 4. c. Moreover, humidity sensor response is shown in Fig. 4. d. [6].

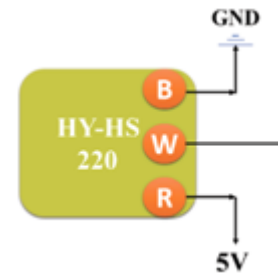


Fig. 4. c Humidity Sensor interfacing circuit

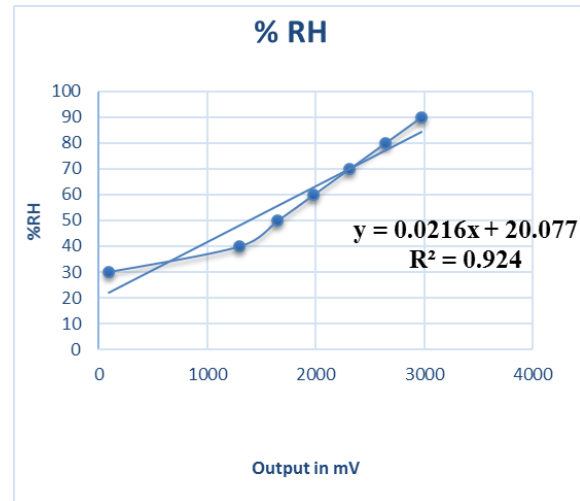


Fig. 4. d Humidity Sensor response

7. LabVIEW interface and GUI developed

Developed GUI in LabVIEW is shown in Fig. 5. a. and Fig. 5. b. for determining parameters. After setting the VISA source name, baud rate(9600) and file path it will acquire the simultaneous voltages for physical parameter measurements.

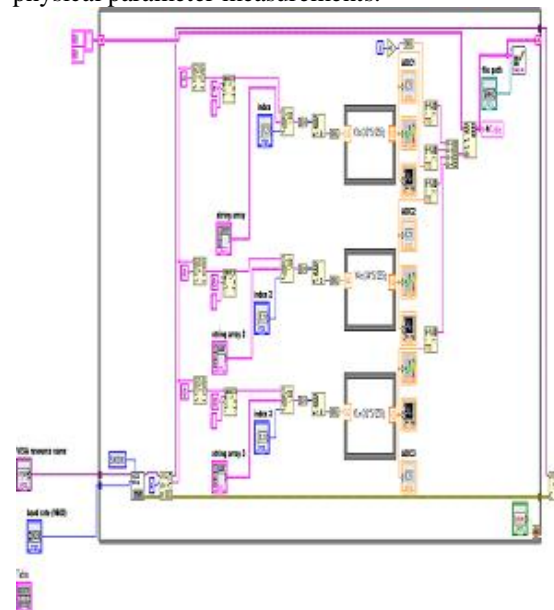


Fig. 5a G-Code GUI for determining parameters

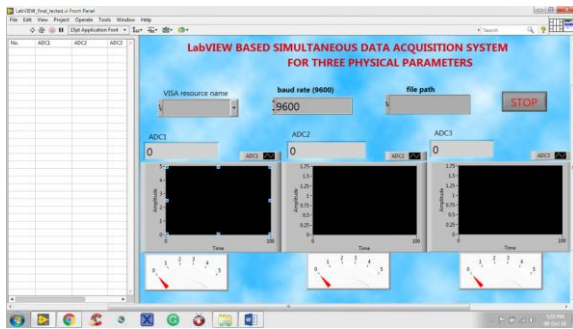


Fig. 5.b GUI in LabVIEW

References

- [1] LabVIEW Application Builder User Guide [P]. USA: National Instruments Corporation.
- [2] Datasheet of AT89S52/51
- [3] The 8051 Microcontroller and Embedded Systems: Using Assembly and C by Muhammad Ali Mazidi
- [4] Datasheet of ADC0804
- [5] Semiconductors N., 2000. LM35 Precision Centigrade Temperature Sensors, pp. 1–13. www.national.com.
- [6] Datasheet, Datasheet of HY-HS-220. Pdf, (n.d.) 1–2. <http://www.sensor-ic.com/>.