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Design of SCADA for Real Time System with LabVIEW and Microcontroller

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Abstract— The objective of this project is to describe the observation and construction of a microcontroller (PIC16) and LabVIEW based SCADA system for monitoring & accessing the performance by acquiring and controlling the physical parameters such as temperature Temperature, Humidity, Soil moisture and intensity of light of green house system on a real time basis. Using software like LabVIEW along with a low cost microcontroller (PIC16) based data acquisition hardware as DAQ card. The real time monitoring of physical parameters can be acquired and saved into database files like MSExcel or other format and can be communicated with other PC. The SCADA project consists of a hardware setup phase and a software development phase. The hardware setup phase consists of dedicated Sensors, Microcontroller board and Local PC. The monitoring analog input signals and a local PC are allowed the user to monitor and control system parameters by LabVIEW.

Keywords— SCADA, LabVIEW, DAQ, Microcontroller, Sensors etc.

I. INTRODUCTION

Supervisory Control and Data Acquisition (SCADA) is a process control system that enables a site operator to monitor and control processes that are distributed among various remote sites. A properly designed SCADA system saves time and money by eliminating the need for service personnel to visit each site for inspection, data collection/logging or make adjustments. Supervisory Control and Data Acquisition systems are computers, controllers, instruments; actuators, networks, and interfaces that manage the control of automated industrial processes and allow analysis of those systems through data collection .They are used in all types of industries, from electrical distribution systems, to food processing, to facility security alarms. This paper is about the work done in implementing a green house parameters control system. It monitors the physical parameters of green house system such as Temperature, Humidity, Soil moisture and intensity of light on a real time basis. This paper presents a data acquisition system by PIC16 controller with LabVIEW interface that is capable to monitor and measure few of most important parameters.

II. DESIGN METHODOLOGY

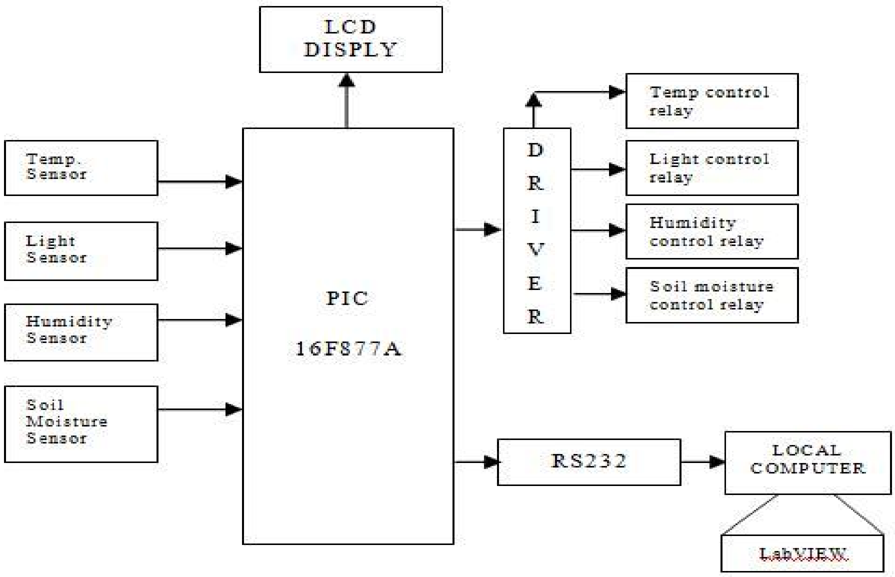

Fig. 1 Block Diagram

An embedded system is designed based on measuring of parameters like humidity, temperature, soil moisture, light intensity using PIC16F877A. Which are displayed using a LCD display and same data are to be sent to PC via RS232 for communicating with LabVIEW. The graphical user interface is made in LabVIEW. Design part consists of hardware, software and interfacing protocol.

A. *Hardware Design*

The proposed implementation of the system solves the problem of continuous monitoring of data acquisition system. The data acquisition system developed is a compact, low cost, 8-bit PIC16F877 system. Fig. 1 shows the block diagram of the basic elements of the design. The system was designed to be versatile and all operations are under software control. This will allow for future expansion or modifications without the need for major hardware changes. The system is connected to a computer through the RS232 serial link to allow user communications and to download recorded data to the computer for subsequent analysis Serial interfacing between the data acquisition system and the computer is implemented using the MAX232 line driver/receiver which is used to convert TTL (0–5V) voltage required by the data acquisition system to the -12 V and + 12 V needed by the computer for RS232 communication.

B. Software Description

The software includes the reading of various measurements from sensors, converting analog to digital values, displaying in the LCD module and sending the data to PC via serial port for monitoring the green house parameters from the LabVIEW. The data logger is made in LabVIEW which continuous update the data in data base.

C. Temperature Sensor

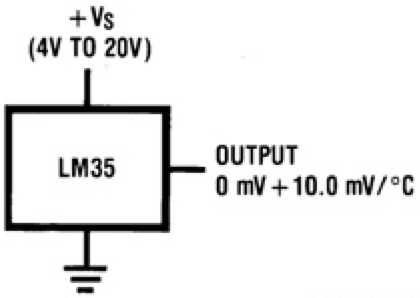

Fig. 2 Temperature sensor LM35

National Semiconductor's LM35 IC has been used for sensing the temperature. Its connections are as shown in Fig. 2. It is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C). The temperature can be measured more accurately with it than using a thermistor. The sensor circuitry is sealed and not subject to oxidation, etc. The converter provides accurately linear and directly proportional output signal in mill volts over the temperature range of 0°C to 155°C. It develops an output voltage of 10 mV per degree centigrade change in the ambient temperature. Therefore the output voltage varies from 0 mV at 0°C to 1V at 100°C and any voltage measurement circuit connected across the output pins can read the temperature directly.

D. Humidity Sensor

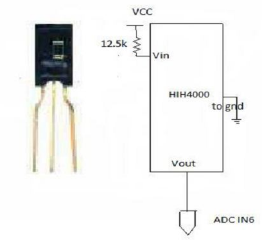

Fig. 3 Humidity sensor HIH4000

The humidity sensor HIH4000, manufactured by Honeywell is used for sensing the humidity. It delivers instrumentation quality RH (Relative Humidity) sensing performance in a low cost, solderable SIP (Single Inline Package). Relative humidity is a measure, in percentage of the vapour in the air compared to the total amount of vapour that could be held in the air at a given temperature. The connection diagram is as shown in Fig. 3. The sensor develops a linear voltage vs. RH output that is ratio metric to the supply voltage. That is, when the supply voltage varies, the sensor output voltage follows in the same proportion. It can operate over a 4-5.8 supply voltage range. At 5V supply voltage, and room temperature, the output voltage ranges from 0.8 to 3.9V as the humidity varies from 0% to 100%. The voltage is converted to the digital form by the ADC and then sent as input to the microcontroller which reads the data.

E. Soil Moisture

A simple humidity sensor (a humidity probe) can be constructed using two copper strips placed as close as possible to each other, but no touching. A simple humidity sensor (a humidity probe) can be constructed using two copper strips placed as close as possible to each other, but no touching. This sensor is based on the fact that water is not pure water which is non conductor, but it is impure which is slightly conductor.

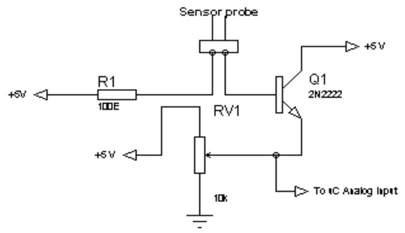

Fig. 4 Soil Moisture Sensor

Water sensor is nothing but a series of very close PCB tracks. The soil moisture sensor is shown in Fig. 4. In normal mode these tracks are not conducting, but when some water fall on these tracks these line slightly start conducting and some positive voltage is available at the base of transistor So NPN transistor is on and NPN transistor provide a negative voltage as a pulse to the microcontroller.

F. Light sensor

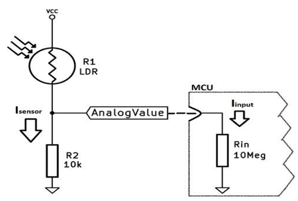

Fig. 5 Light sensor

A Light Dependant Resistor (LDR) is a resistor that changes in value according to the light falling on it. It is shown in Fig. 5. A commonly used device, the ORP-12, has a high resistance in the dark, and a low resistance in the light. Connecting the LDR to the microcontroller is very straight forward with some software calibration.

III. Implementation of SCADA

The LabVIEW VI of configuring COM port for acquiring signals form PIC16 controller to PC via LabVIEW is shown in Fig.6..

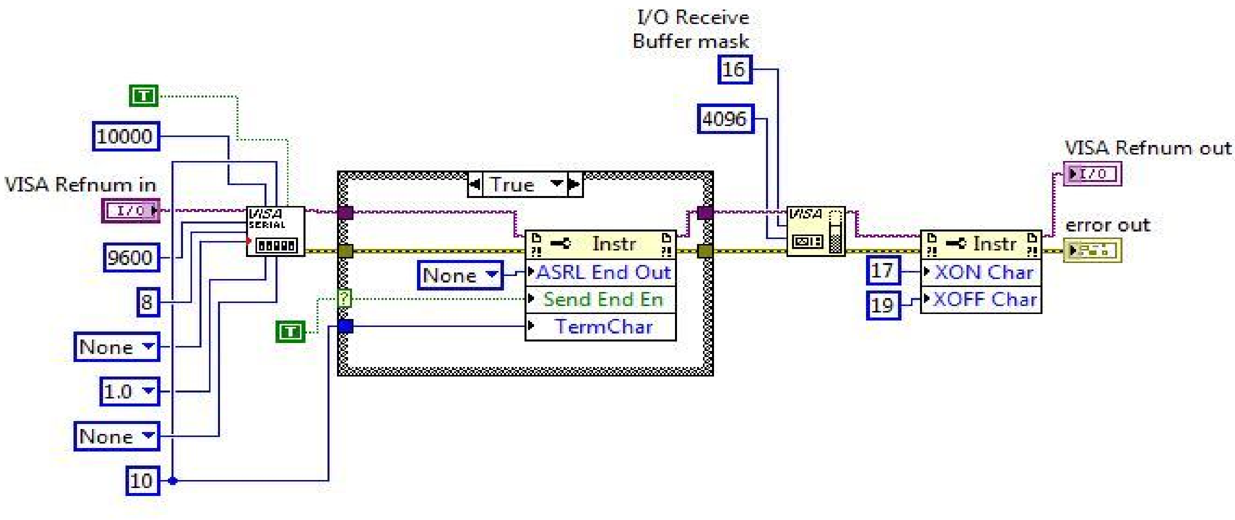

Fig. 6 COM PORT Configuration

In this VI interfacing between PC and microcontroller is shown. First initializes the serial port specified by VISA refnum name to the specified settings. Then VISA READ Reads the specified number of bytes from the device or interface specified by VISA refnum name and returns the data in read buffer. The LabVIEW VI for monitoring and measurement of the green house parameters is presented with data logger in Fig.7. Here Humidity is measured form the PIC16 to LabVIEW and displayed this real time data on chart is shown. Likewise other parameters are to be monitored.

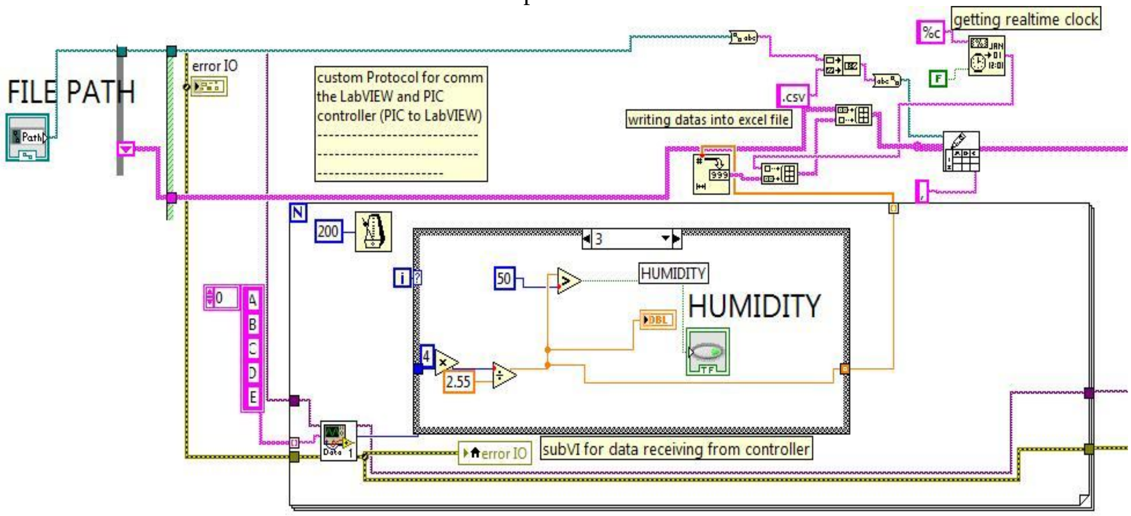

Fig. 7 LabVIEW VI for acquiring Humidity and Data logger

IV. Result and Discussion

The Front panel for monitoring and measurement of the green house parameters like temperature, humidity, soil moisture and light intensity is presented in Fig.8 below. For security purpose USERNAME and PASSWORD is to be entered to monitor real time data from sensors. The real time data from different sensors are to be monitored on the individual chart. Appropriate set points are to be set for each sensor so, when there is a data from each sensor out from the set point then appropriate LED is ON and at the same time there is a control circuit connected to the PIC16 either ON and OFF depending on requirements.

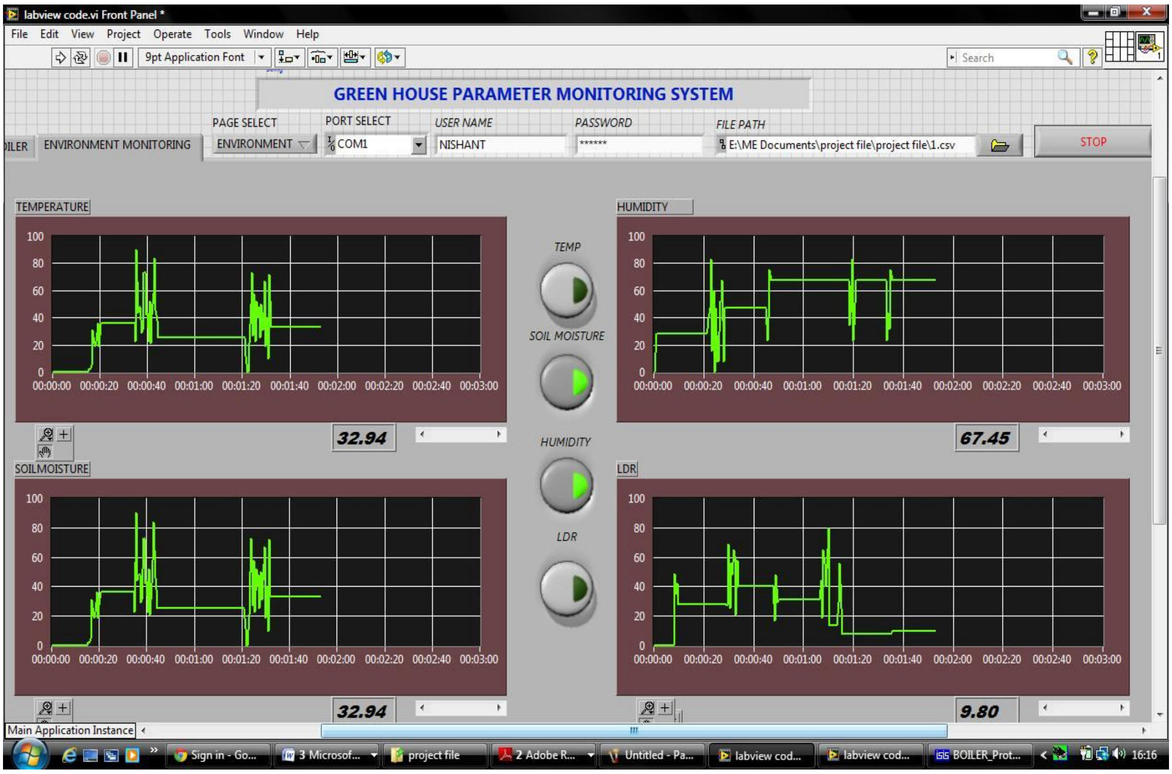

Fig. 8 Front panel of Green house parameter monitoring system

Table 1 show the database which is generated by the system. The database is generated in Microsoft excel sheet and stored in the computer. In this, the values of temperature, Humidity, Soil Moisture and light intensity are logged with appropriate date and time. The database appends all the data of the process variables as seen in Table 1. This database can be used to monitor the process data in present as well as for future reference. This data can also be used for statistical process control applications.

TABLE I

DATE AND TIME	TEMP DEG. CELS.	LIGHT INTENSITY %	SOIL MOISTURE %	HUMIDITY %
10-06-2014 11:13	46	82	90	46
10-06-2014 11:13	45	82	90	45
10-06-2014 11:13	43	82	90	43
10-06-2014 11:13	43	82	90	31
10-06-2014 11:13	42	82	90	51
10-06-2014 11:13	42	82	90	34
10-06-2014 11:13	42	82	89	43
10-06-2014 11:13	41	82	87	20
10-06-2014 11:13	41	82	74	25
10-06-2014 11:14	41	82	66	31
10-06-2014 11:14	41	82	63	54
10-06-2014 11:14	41	82	62	69
10-06-2014 11:14	41	82	58	69
10-06-2014 11:14	41	82	56	60
10-06-2014 11:14	41	82	54	46
10-06-2014 11:14	40	82	52	45
10-06-2014 11:14	40	82	51	43
10-06-2014 11:14	40	82	47	31

V. CONCLUSIONS

This paper emphasizes on the low cost data acquisition, supervisory control and data logging aspect of a green house process. The agriculture areas are of prime importance for computer control process. The green house process parameters which are under consideration here whose process data temperature, humidity, soil Moisture and light intensity should be acquired from the field, logged in a database and the data is further used for supervisory control. The GUI is made in virtual instrumentation domain LabVIEW.

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