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LAB VIEW BASED WIRELESS SOIL MOISTURE AND TEMPERATURE MONITORING SYSTEM FOR WATER IRRIGATION MANAGEMENT

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ABSTRACT

Soil moisture content has a significant role in the fields like engineering, agricultural, biological, geological and hydrological investigations. The NImyDAQ based wireless soil moisture monitoring data acquisition promotes water scheduling and management practices in water scare regions. This helps in water conservation and natural resource management for sustainable development. The present system deals with interfacing of the soil moisture and temperature sensors within an error of 0.5%. GUI developed in LabVIEW has facility to adjust the set point value of soil moisture and temperature as per the requirements of the crop, which leads to turn ON and OFF controls of water pump. GUI also provides different trends of soil moisture and temperature. The most important feature of this system is its data output which is remotely monitoring and control using Wi-Fi and web publishing tool in LabVIEW.The tool key behind is that, the wireless soil moisture and temperature monitoring sensors help in data collection, processing, displaying and storing using user friendly interface for crop irrigation schedule through internet.

KEYWORDS: NImy DAQ, Wireless Monitoring, Soil Moisture Sensor, Lab VIEW, LM35, Web Publishing Tool.

The important decision making parameters in smooth and efficient water irrigation and management are monitoring and managing soil moisture and temperature. In fact, Agricultural production is dependent on these two key aspects which are essential and unseparable part of the human health and welfare. The seamless and precise irrigation is a key for abundant yield in agriculture[1], which depends on the cost involved in monitoring and controlling the soil moisture and temperature and thereby acquisition of the data. One of the ways to curtail cost of the traditional, uneasy, bulky, less efficient and cost insensitive wired systems is to use the wireless soil moisture and temperature sensor, which allow linking between the points that are physically and or economically different to access and inturn help in conservation of water and natural resources for desirable sustainable development[2,3]. The NImyDAQ system was used in soil moisture and soil temperature data acquisition, control, monitoring and the same was uploaded on the internet to develop a visual data interpretation in the GUI form. The GUI interface analyze the data, converts it into calibrated form, displays and stores. In our system, a provision was made to set the thresholds for soil moisture and the temperature which inturn help in automation of irrigation water pumps. The developed GUI contains various trends of soil moisture and temperature nodes installed in the farms. The nodes facilitate reduction to the thermal shocks in irrigating plants and crops by incorporating temperature sensors. These sensors acquire the real-time data monitoring of the soil-moisture and temperature and augment switching ON/OFF of the motor. Aswale et.al reported the LabVIEW and arduino based soil moisture monitoring system that measure equivalent soils moisture content (humidity) at some stage in its dry and wet conditions using a moisture sensor circuit, estimate the equivalent Humidity and irrigate it based on its nature[4].Jena et.al used an arduino and LabVIEW based multiple analog input and digital I/O to make sensor data read temperature, humidity, CO2 gas, soil moisture content needed for irrigation plants and the intensity of light that applied for greenhouses[5].

A temperature monitoring system with DC motor control using a LabVIEW and Arduino has been reported by Davande et.al [6]. The system monitoring of relative humidity using NI-ELVIS LabVIEW is done by Louis et.al [7]. Whereas, monitoring of soil moisture and humidity using NI-ELVIS and LabVIEW for water pump control is reported by Arutselvi et.al [8]. All above mentioned system have lacuna of remote monitoring and controlling , which can be enabled in present system by using web publishing tool. For data acquisition an arduino with 10bit ADC resolution was used while in our case NImyDAQ system with 16 bit resolution offers a greater accuracy for measurement. The work on similar lines is done by Sridevi et.al using a NImyRIO based soil quality monitoring system that employs different sensors e.g. soil moisture, soil pH, soil conductivity and atmospheric humidity with WiFi enabled network [9]. A remote monitoring system with web application has been reported by Guofang et.al the

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system uses the temperature, humidity and soil moisture sensor to acquire the data [10]

THE DESIGN AND SYSTEM DEVELOPMENT

NImyDAQ was used to interface the soil moisture and soil temperature sensors. The soil moisture sensor was connected to +0 and -0 channel whereas the soil temperature sensor was connected to +1 and -1 channel. The water pump was connected to the analog output of the NImyDAQ and the fig.1 illustrates the schematic view of our system.

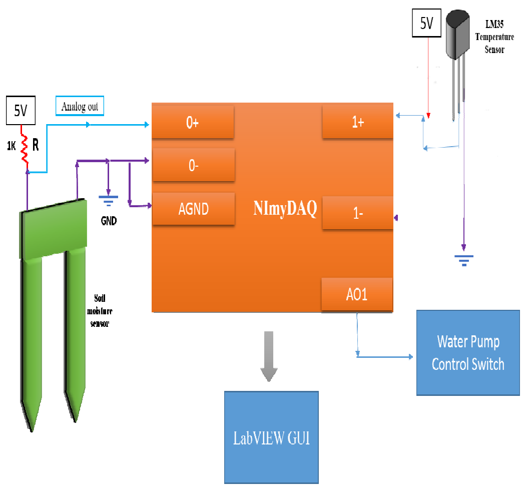

Figure 1: Soil moisture and temperature monitoring using

NIMYDAQ

NImyDAQ

There are two analog input channels on NImyDAQ which can be configured either as general-purpose high-impedance differential voltage input or audio input. The analog inputs are multiplexed (means a single analog-to-digital converter (ADC) is used to sample both channels). In general-purpose mode, you can generate the voltage signals up to ±10 V signals at upto 200 kS/s per channel. In audio mode, the two channels represent left and right stereo line level inputs. In our case NImyDAQ uses two input channel and one output channel. Both channels have a dedicated digital-to-analog converter (DAC), which can be updated simultaneously. NImyDAQ also provides eight DIO lines each line being a programmable function interface (PFI). Therefore, it can be configured as a general-purpose software-timed digital input or output, or it can act as a special function input or output for a digital counter[11]. In this work initialization of NImyDAQ was done using a measurement I/O tool kit (measurement I/O→NI-DAQmx→DAQ Assistant).

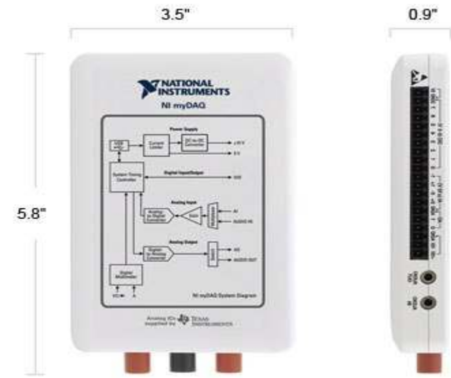

Figure 2a: NImyDAQ

Channels of NImyDAQ were configured using an Acquired Signal → Analog Input → Voltage → select channel ai0 and ai1→ Finish. Further, in acquisition mode, samples were selected continuously and read rate was kept 100 and rate (Hz) was 1K. Voltage input for ai0 was kept 0V to 5V and for channel ai1 was kept 0V to 1V.

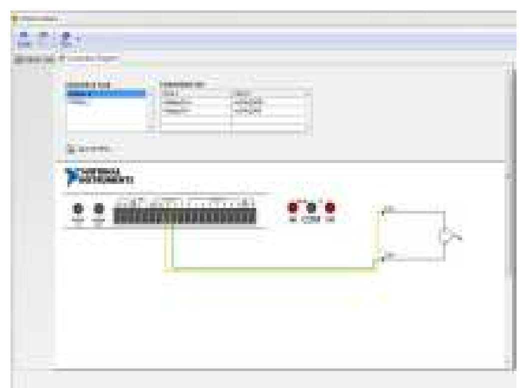

Figure 2b: Soil moisture connection to channel ai0 of NImyDAQ.

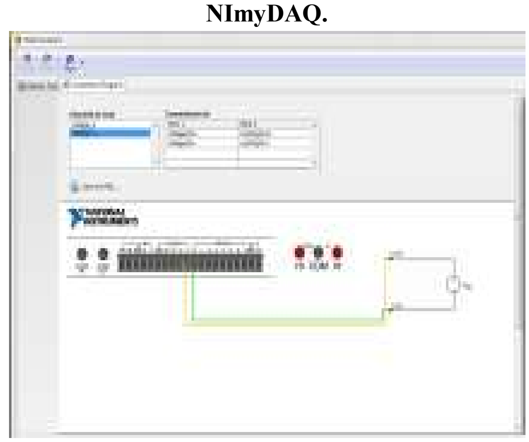

Figure 2c: LM35 connection to channel ai1 of NImyDA

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 3 shows the variation of generated voltage by sensors as a function of the soil moisture. The output voltage is fund 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,

Soil moisture in % = (Vout / 5) * 100 (1)

Where, Vout 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;

Soil moisture in % (y) = 20 * output voltage of soil moisture

sensor(x) (2)

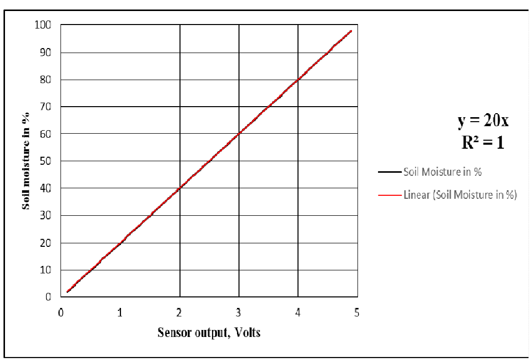

Figure 3: Soil moisture sensor responce

SOIL TEMPERATURE CALIBRATION (LM35)

To determine the soil temperature, a LM 35 precision integrated circuit temperature sensor was used, wherein output of the sensor is a linear function of the temperature. The rated temperature range of the sensor is from -55° C to 150° C.[12]. The calibration factor that converts sensor output into temperature is given by;

Soil temperature (in °C) =

(Output voltage of LM35 / 10) *1000 (3)

The alternate equation for finding the soil temperature

Soil temperature (in °C) (y) =

(Output voltage of LM35(x) *10 (4)

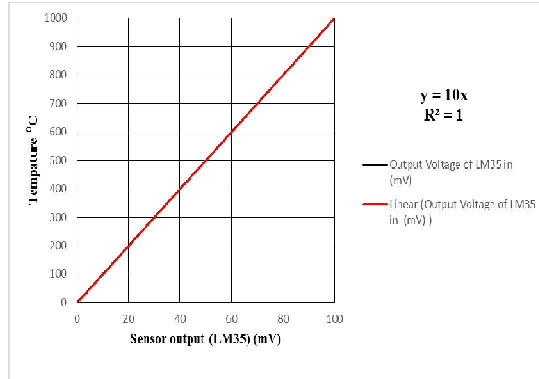

Figure 4: Calibration of LM35 temperture sensor for soil temperture measurment.

WEB PUBLISHING TOOL FOR REMOTE ACCESS

WiFi internet connectivity was achieved through the web publishing tool in LabVIEW 2014 that helps in remote access real time soil moisture and soil temperature data. The sequence of steps to access GUI is as follows,

Front Panel → Web Publishing Tool→ Browse the GUI VI → View mode → Monitor → seconds between update is 1 sec→ Next as shown in fig 5(a, b , c).

Figure 5a: Web publishing tool selecting VI and viewing mode.

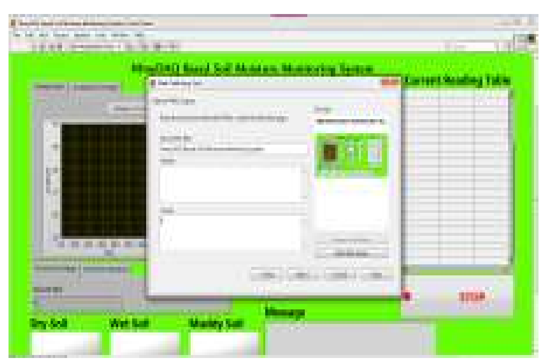

Figure 5b: Web publishing tool creating html output.

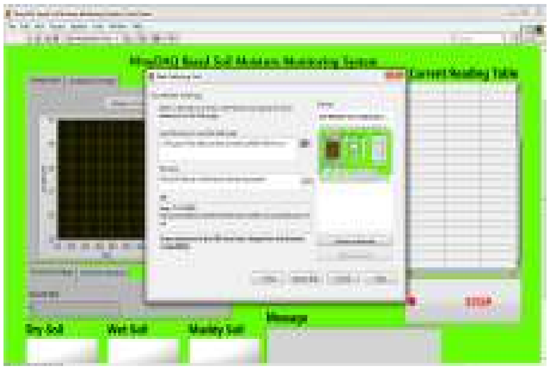

Figure 5c: Web publishing tool saving html web page for remote access.

Flow Chart of System

Flow of developed VI in LabVIEW is shown in fig 6 a)

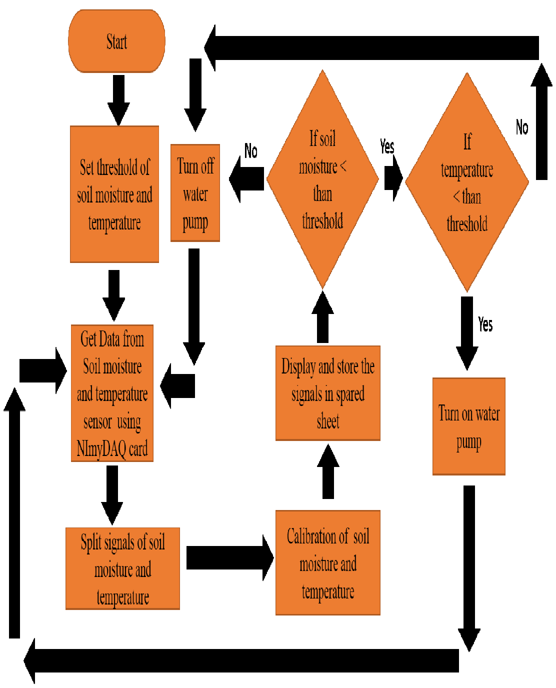

Figure 6a: Flow of VI in LabVIEW

DEVELOPED GUI

Figure 7a: GUI showing the sensenig paprameter deatails for genreal setting and soil moisture.

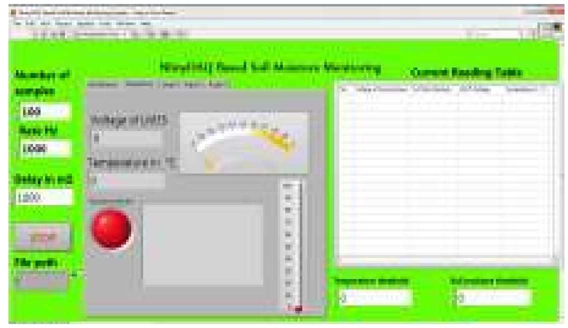

Figure 7b: GUI showing the sensenig paprameter deatails for temperture.

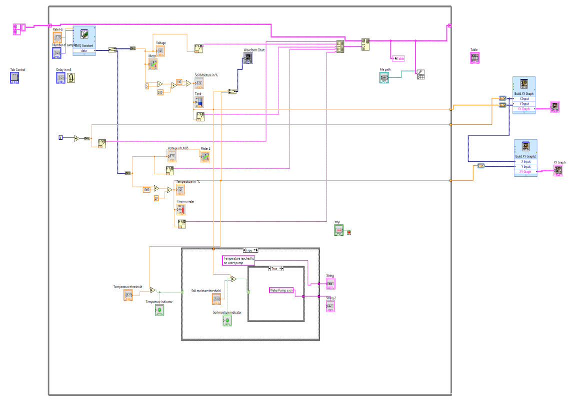

Figure 7c: G-code for GUI.

RESULT AND DISCUSSION

The system so developed helps in acquiring the seamless data of soil moisture and soil temperature using remotely controlled sensors. The accuracy of the data acquisition system is with a nominal error of 0.5% ± 0.2mV. The web publishing tool permits wireless connectivity for the end users. GUI gives flexibility in the determination of threshold values for the sensing parameters in various ambience of crop cultivation. Further the GUI gives interactive platform to evaluate the efficacy of time delay between the samples and sampling rate. The added advantage of GUI is to have the data on spread sheet and trends of the parameters. The scaling of sensing network can be augmented through NIUSB6009 DAQ or NImyRIO card. Thus the system so devised promotes sustainable usage of water resources in drought prone regions like Solapur Maharashtra, India.

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