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Monitoring of Relative Humidity of Soil Using LabVIEW

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Abstract:
This paper involves the measuring and the monitoring of the humidity and relative humidity using Virtual Instrumentation-LabVIEW. The humidity circuit is built on the NI-ELVIS and the output is indicated by the glowing of the LED at the soil's wet condition. The voltage across the output is acquired using NI DAQ-6008 which is interfaced with the PC. The humidity sensor consists of two probes from the circuit that will be in contact with the soil which senses the moisture content. A graphical block diagram is developed in LabVIEW, which includes the appropriate formula for the calculation of relative humidity (in %) and the output voltage (in volts), which is in the range of (0-2V) for dry soil and (4-7V) for wet condition. The front panel indicates the soil's moist and dry condition with the filtered output waveform graph and the readings are monitored.

Key words: *LabVIEW, Humidity, Relative humidity, NI-ELVIS, Soil Moisture*

1. Introduction

Soil is made up of a mixture of components, including mineral and organic particles, with water and air making up the spaces in between. Plants need a combination of all these components for healthy growth. By measuring soil moisture, crop water needs to be assessed and irrigation controlled, so as to maximize crop yield, quality and profitability. There are various methodologies and techniques by which the soil moisture could be measured such as

- Gravimetric Technique
- Radioactive Technique
- Capacitive Technique
- Conductivity Technique
- Soil Suction Technique

Here, we will be dealing with the monitoring of humidity in soil with the aid of LabVIEW & NI ELVIS.

Humidity can be precisely defined as the amount of water vapour in air. The necessity of humidity measurement in soil is that you can gain control of soil moisture and adjust irrigation according to the need. A properly utilized irrigation system provides a condition for optimal growing economy. Excessive irrigation is a waste of time and energy, and it risks plant's nutrient leaching. The base unit is a humidity sensor which senses the moisture content and we can visualize the output on a PC based LabVIEW system with the small circuitry on the NI ELVIS and interfacing cable PCI 6221.

Absolute humidity is the mass of water vapour to the mass of dry air in a volume of air at a given temperature. The hotter the air, the more water it can contain. Relative humidity is the ratio of the current absolute humidity to the highest possible absolute humidity (which depends on the current air temperature). A reading of 100% means that the air is totally saturated with water vapour and cannot hold anymore. The relative humidity of the soil depends on the moisture content in the soil. The drier the soil, the lesser the relative humidity and therefore there comes a requirement of treating the soil with water for irrigation purposes.

LabVIEW- Laboratory Virtual Instrument Engineering Workbench is a combination of customized software and modular measurement hardware to create user defined measurement systems which is commonly used for data acquisition, industrial automation, instrument control and on various platforms. LabVIEW is beneficial due to its feasible interfacing, code compilation, large libraries, code re-use, parallel programming, and ecosystem and user community. We've adopted this technique for humidity monitoring with the help of NI ELVIS and DAQ. Data acquisition (DAQ) is the process of measuring any electrical, physical phenomenon such as voltage, current, temperature or sound with the computer. A DAQ system consists of sensors, measurement

hardware and the computer with programmed software which makes it more powerful, flexible and cost-effective and is used in this process of monitoring humidity of the soil.
NI ELVIS-National Instruments Educational Laboratory Virtual Instrumentation Suite, uses LabVIEW based software instruments, a multifunction DAQ device and a custom-designed bench top workstation and prototyping board to provide the functionality of a suite of common laboratory instruments which is also employed in the acquisition of data in this process.

2. The Functional Scheme

This section elaborates the assessing of humidity and relative humidity process in LabVIEW. The hardware implementation and the software implementation are discussed here below.
The humidity sensor circuit primarily requires an operating voltage of about (5-12 volts) which is constructed on the NI ELVIS from which the power supply is drawn. The BC 548 transistor used in this circuit works to switch electronic signals and amplifies them. With the combination of various other resistors constructed as per the circuit diagram shown below, the moisture content is detected and hence this is indicated with the glowing of the LED. The output is acquired with the help of NI 6008 USB card and is interfaced with the LabVIEW software. Two probes will always be in contact with the soil so that it senses the wetness and the dryness of the soil.

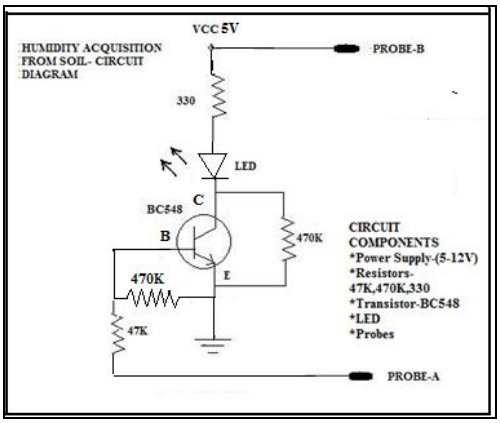

Figure 1

The real values are interfaced in the LabVIEW block diagram with the help of USB port connected to the NI ELVIS and are acquired. The block diagram clearly depicts the acquisition of the signal from DAQ, the output in volts, the relative humidity calculation according to the nature of the soil, and the filtered waveform graph. The front panel indicates the soil condition by the glowing of LED, and the filtered waveform.
The output voltage obtained is high in the range of (5-7V) for dry soil and (1-3V) for wet condition. The relative humidity is of about 40-50% for wet condition and 20-30 % for dry condition. This method of monitoring of relative humidity of soil thus becomes very feasible, accurate, fast response at high and low humidity and reduces complexity. The readings could also be saved for backup in LabVIEW.

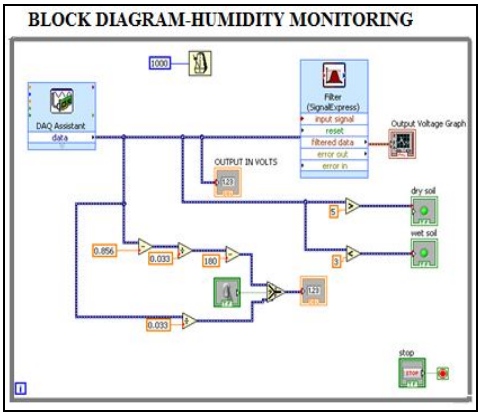

Figure 2

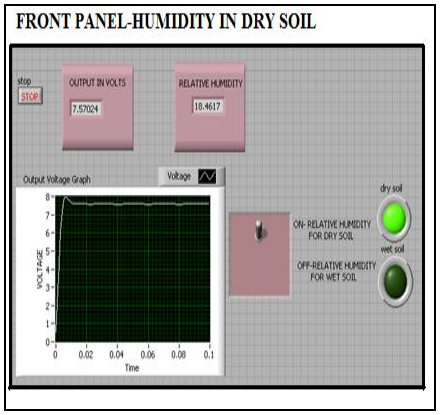

Figure 3

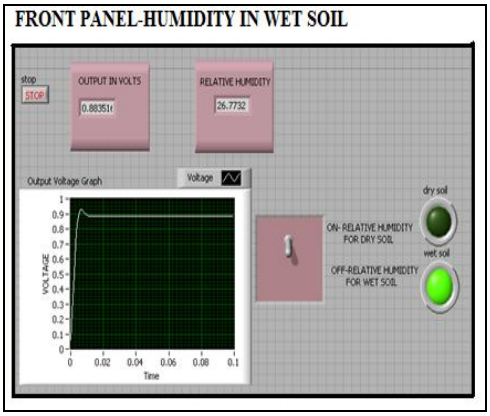

Figure 4

3. Conclusion

The output obtained from the hardware circuitry is directly interfaced with LabVIEW using NI ELVIS and is acquired as voltage from which the relative humidity is calculated for different soil conditions. This monitoring thus enables agriculturalists about the acknowledgement of the soil's humidity conditions in a very accurate, precise and simple manner. The front panel and the block diagram presented in the screenshots above are for a detailed sketch.

4. References

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