WEATHER MONITORING USING LIFA

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Abstract

The current state of the atmosphere plays a major role in the field of agriculture, forestry, marine, utility companies etc. Due to the recent advancements in technology functionality of many home appliances is being controlled based on the conditions of weather. The program is designed using LabVIEW. In this we use an Arduino board with LabVIEW interfacing different sensors placed in local environment. This paper involves the measuring and the monitoring of the temperature, humidity, pressure, wind speed and radiation using Virtual Instrumentation-LabVIEW.

Keywords: temperature, humidity, pressure, wind speed, radiation, Arduino, LabVIEW.

1. Introduction

Humidity is one of the important parameters in the atmospheric gases. The natural air can contain humidity and varies from season to season. Humidity indicates the likelihood of precipitation, dew, or fog. There are three main measurements of humidity: absolute, relative and specific. Absolute humidity is the water content of air. Relative humidity, expressed as a percent, measures the current absolute humidity relative to the maximum for that temperature. Specific humidity is a ratio of the water vapor content of the mixture to the total air content on a mass basis.

The temperature is a numerical measure of hot and cold in a body that is in its own state of internal thermal equilibrium. Its measurement is by detection of heat radiation or particle velocity or kinetic energy, or by the bulk behavior of a thermometric material. Temperature is important in all fields of natural science, including physics, geology, chemistry, atmospheric sciences and biology[1].

An anemometer is a device used for measuring wind speed, and is a common weather station instrument. The first known description of an anemometer was given by Leon Battista Alberti around 1450. Anemometers can be divided into two categories. By measuring the speed of wind and pressure of wind. Velocity anemometer and pressure anemometer. Cup anemometer, vane anemometer, hot – wire anemometer, laser dopler anemometer, sonic anemometer and ping – pong ball anemometers based upon the velocity. Plate anemometer and tube anemometer works on the basis of pressure [2].

Devices measuring various physical parameters are being used extensively throughout the world. The parameters may be force, pressure, temperature, displacement and other such quantities. Pressure is the amount of force acting per unit area. The SI unit for pressure is the Pascal (Pa), equal to one Newton per square meter (N/m^2or $kg \cdot m^{-1} \cdot s^{-2}$). This special name for the unit was added in 1971.Before that, pressure in SI was expressed simply as N/m^2. Atmospheric pressure is the force per unit area exerted on a surface by the weight of air above that surface in the atmosphere of Earth [1].

There are three methods for measuring pressure: absolute, gauge, and differential. Absolute pressure is referenced to the pressure in a vacuum, whereas gauge and differential pressures are referenced to another pressure such as the ambient atmospheric pressure or pressure in an adjacent vessel [1].

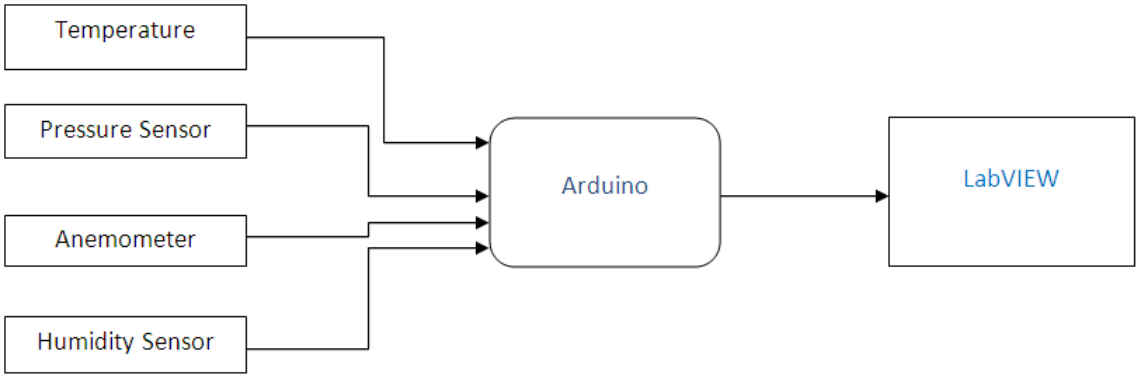

Fig 1.Block diagram of the system

All common light sources, such as the sun, light bulbs and fluorescent tubes, also give out other forms of radiation, to varying degrees. The most significant of these are UV and infrared radiation. Radiation is energy that travels in waves. It includes visible light, ultraviolet light, radio waves and other forms, including particles. Each type of radiation has different properties. Non-ionizing radiation can shake or move molecules. Ionizing radiation can break molecular bonds, causing unpredictable chemical reactions [3-6].

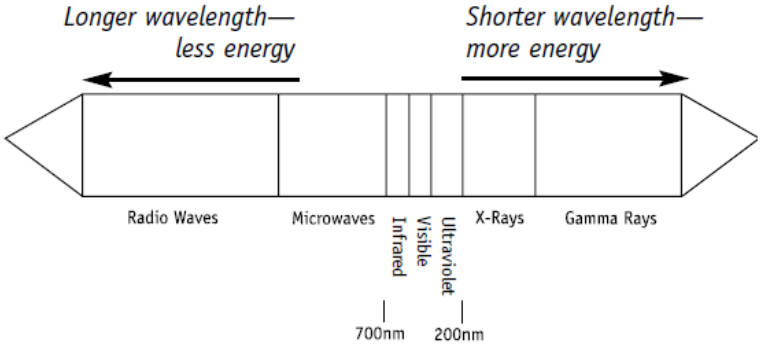

Fig 2.Wavelength of Light

Arduino is a single-board microcontroller, intended to make the application of interactive objects or environments more accessible. It's an open-source physical computing platform and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino has some advantages for educational and interested recreational over other systems like Inexpensive, Open source and extensible software, extensible hardware [7].

LabVIEW (short for Laboratory Virtual Instrument Engineering Workbench) is a system-design platform and development environment for a visual programming language from National Instruments. The software is perhaps the most important component of the system. The main routine, or VI, provides a front panel interface that allows the operator to control and monitor the system. It calls to perform functions that gather analog input, send analog output.

The front panel is what allows the operator to control and monitor the process. It includes software controls and indicators that mimic physical controls such as buttons, sliders, LEDs, and charts. The block diagram is a graphical representation of the underlying software program. It consists of icons that represent typical programming elements such as constants, variables, subroutines, and loops.

The LabVIEW Interface for Arduino (LIFA) allows users to control sensors and acquire data through an Arduino microcontroller using the graphical programming environment LabVIEW. Arduino microcontroller acts as an I/O engine that interfaces with LabVIEW VIs through a serial connection. This helps to move information from Arduino pins to LabVIEW without adjusting the communication, synchronization. Using the common Open, Read/Write, Close convention in LabVIEW, we can access the digital, analog, pulse-width-modulated, I2C, and SPI signals of the Arduino microcontroller. The LabVIEW software package from National Instruments is used to develop the custom data acquisition [8-9]. The program measures the temperature, humidity, pressure, wind speed and radiation from the process.

2. INTERFACING OF LM35, SY-HS-220, ANEMOMETER, PRESSURE & UV SENSORS TO ARDUINO

Temperature measurement is performed by an integrated circuit temperature sensor LM35. The output voltage of sensor is linearly proportional to temperature with a gradient of 10mV/ºC and able to operate in the range -55ºC to+150ºC with an accuracy of ± 0.5ºC. These make LM35 good choice for patient temperature monitoring. The LM 35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supply, or with plus and minus supplies. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.10C in air. The LM 35 sensor has three terminals, the first terminal is connected to 5 Volts Vcc supply and the third terminal is grounded. The centre terminal is terminal two and this is the output terminal Vout that gives the output voltage corresponding to the sensed temperature The centigrade temperature is converted to Fahrenheit temperature and displayed [10].

LM35 is a transducer or temperature sensor that converts heat energy into electrical energy i.e. it senses the temperature and gives an output voltage corresponding to the sensed temperature.

Humidity measurement is performed by the humidity sensor SY-HS-220. This sensor module converts relative humidity (30-90%RH) to voltage and can be used in weather monitoring application. The SY-HS-220series are linear voltage output vs % RH. Operating humidity range of 30-90% RH with an accuracy of ±5%RH (at 25℃ 60%RH). SY-HS-220 has three terminals. The red terminal is connected to 5 Volts Vcc supply and the blue terminal is grounded. The centre terminal white terminal two and this is the output terminal Vout that gives the output voltage corresponding to the sensed humidity [11-14].

For the measurement of pressure, a MPX5999D pressure sensor is being used. It is a 6-pin device. The last 3 pins are not used in the first three pins are Output voltage, Ground and input voltage

respectively. It operates for a biasing voltage of +4.75 volts to 5.25 volts. The output voltage is in the range of 0.2 volts to 4.7 volts. The sensitivity of the sensor is 2mV/kpa. The Output deviates from a straight line relationship with pressure over the specified pressure range. able to operate in the range 0° to 85°C with an accuracy of ± 0.5ºC.The MPX5999D sensor has six terminals, the first terminal, output terminal Vout that gives the output voltage corresponding to the sensed pressure. The second terminal is grounded. The third terminal is connected to 5 Volts Vcc supply. The output voltage is converted to kPa, psi and displayed [15].

The Grove – UV Sensor is used for detecting the intensity of incident ultraviolet (UV) radiation. This form of electromagnetic radiation has shorter wavelengths than visible radiation. The Grove - UV Sensor is based on the sensor GUVA-S12D which has a wide spectral range of 200nm-400nm. The module outputs electrical signal which varies with the UV intensity. It is having High stability with an operating range of -30ºC to +85ºC.

The Grove – UV Sensor having four terminals. First terminal is output terminal Vout that gives the output voltage corresponding to the sensed radiation. Second terminal no need to connect. The third terminal is connected to 5 Volts Vcc supply. And the last terminal is grounded. In sunlight, the UV index and Photocurrent are a linear relationship. The main features of GUVA-S12D are UV index monitoring, and UV –A lamp monitoring [3].

Anemometer is used for measuring wind speed. The adafruit anemometer gives the output in terms of voltage. The voltage range is from 0.4V up to 2.0V. The sensor is rugged, and easy to mount. The limitations in terms of wind speed will be 32.4m/s with an accuracy of 1 m/s. The maximum wind speed 70 m/s can be measured by this instrument [16].

The Fig (3) shows the hardware interfacing of LM35,SY-HS-220,Grove UV sensor,MPX5999D,and Wind Sensor to the Arduino board.

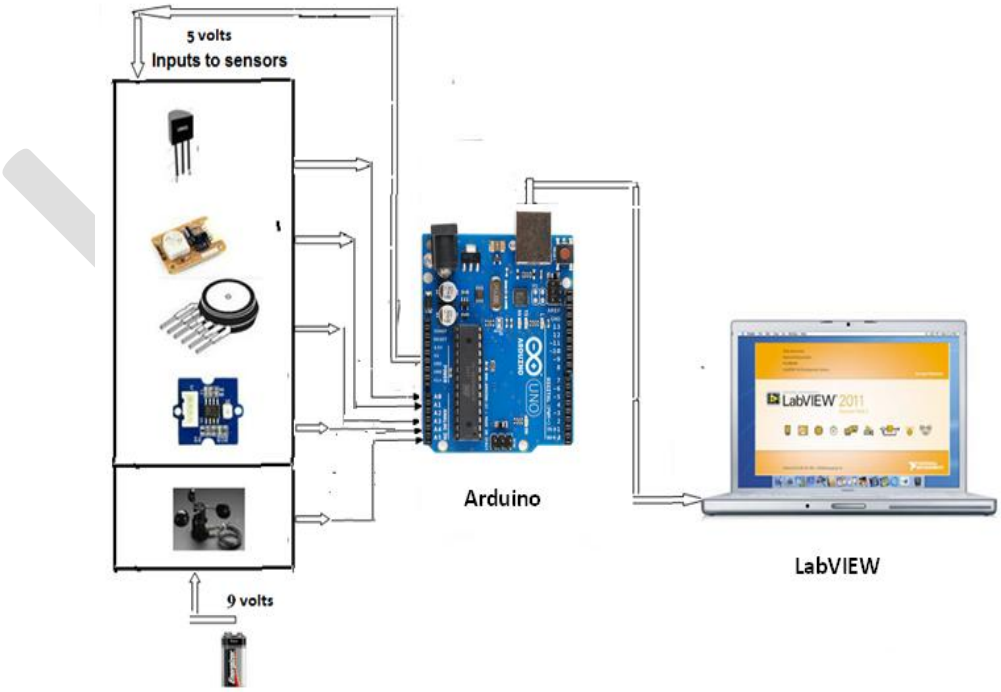

Fig 3. Schematic of the System

3. MODELING AND SIMULATION OF THE SYSTEM

The program has been developed for sensing the voltage from sensor, process data and display the room temperature and humidity. The software language LabVIEW is used to develop the program. LabVIEW (Laboratory Virtual Instrument Engineering Workbench) uses dataflow programming, where the flow of data through the nodes on the block diagram determines the execution order of the VIs and functions. The block diagram contains this graphical source code, also known as G code or block diagram code. Front panel objects appear as terminals on the block diagram.

The output of the LM35 sensor is connected to the pin A0 of the Arduino. Using LIFA(LabVIEW Interface For Arduino) the Arduino Uno board is interfaced to LabVIEW. And The output of SY-HS-220 is connected to the pin A1 of the Arduino. In the very first step Arduino was initialized. The temperature sensor reads the temperature of the particular environment, which we want to measure and converts the temperature into corresponding electrical signal. Then the analog value is converted into digital by means of analog to digital converter in order to read microcontroller. From the Arduino resource by using analog read.vi we can read the values of temperature and humidity in terms of the voltage. The temperature is measure in Degree Celsius (°C) and Humidity is measured with respect to perfect vacuum (%RH)

The output of the MPX599D sensor is connected to the pin A2 of the Arduino. Using LIFA (LabVIEW Interface For Arduino) the Arduino Uno board is interfaced to LabVIEW. And the output of Grove – UV is connected to the pin A3 of the Arduino. In the very first step Arduino was initialized. The pressure sensor reads the pressure of the particular environment, and converts the voltage into corresponding units. i.e. in terms of kPa, and psi.

Anemometer is connected to a 9VDC.The black wire is connected to ground. The output blue wire is connected to the pin A4 of Arduino Uno.

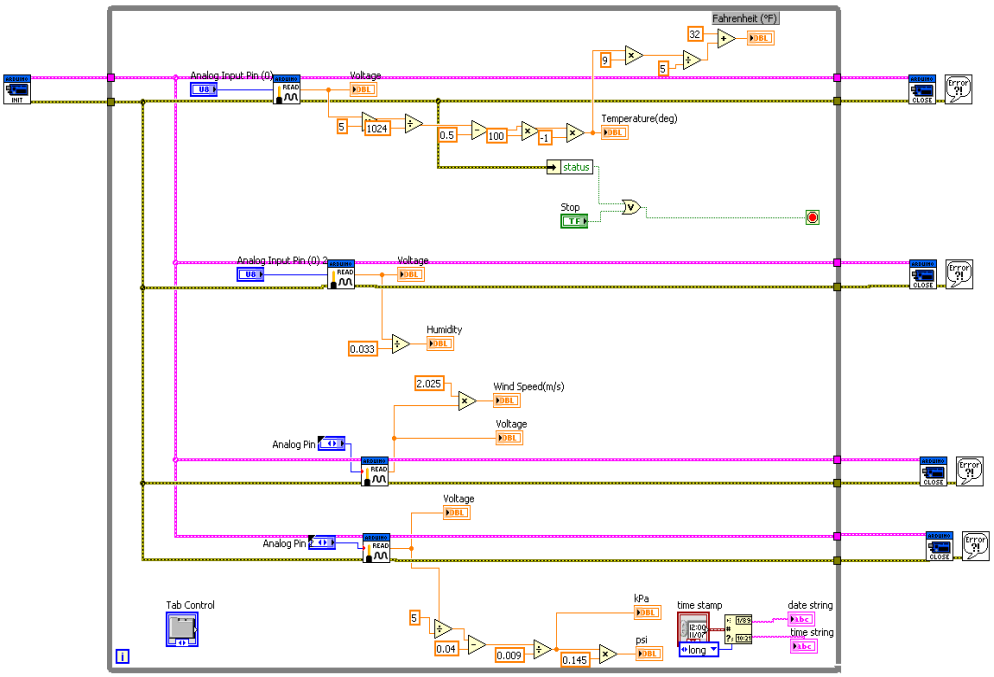

Fig 4. Block diagram of Weather Station

From the Arduino resource by using analog read.vi we can read the values of temperature, humidity, pressure, wind speed, UV radiation. To end the process we had to place the Arduino close for the process.

4. RESULTS AND DISCUSSION

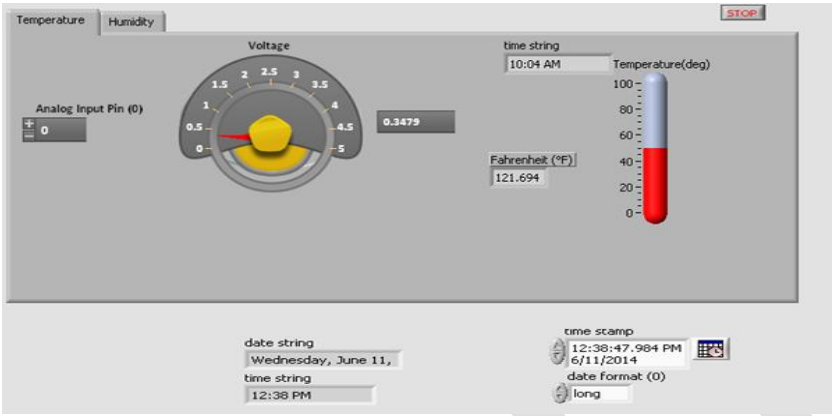

Fig 5. Front panel of the Temperature measurement

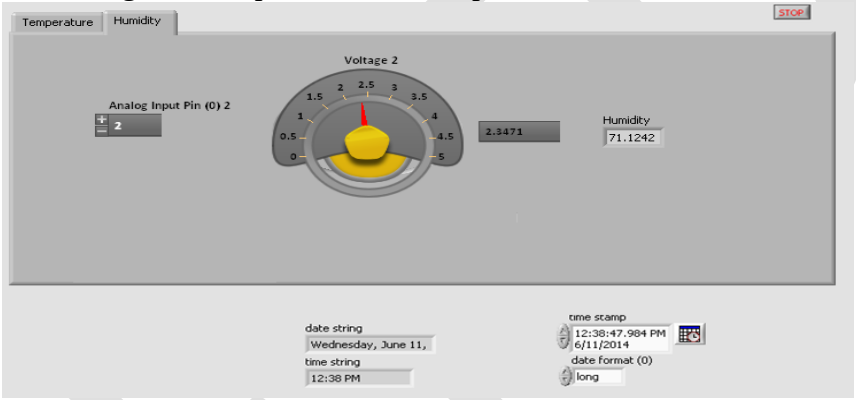

Fig 6. Front panel of the Humidity measurement

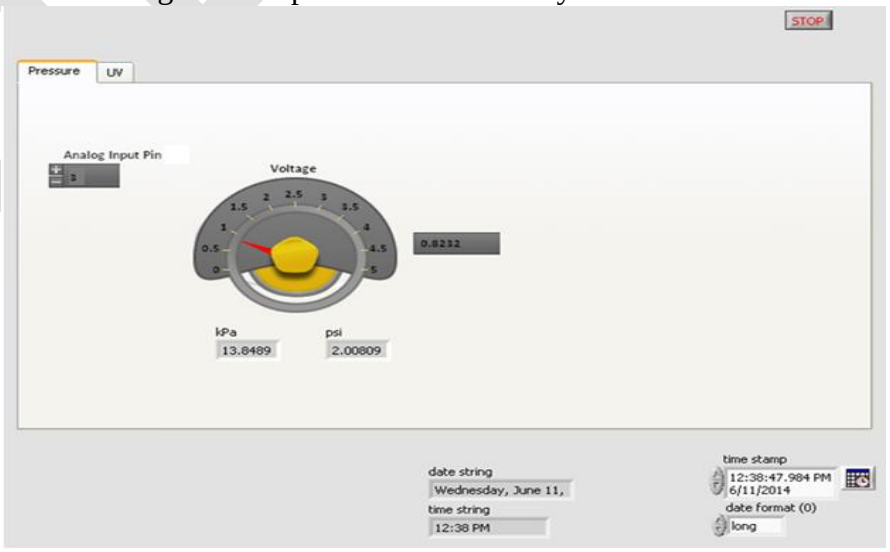

Fig 7. Front panel of the Pressure measurement

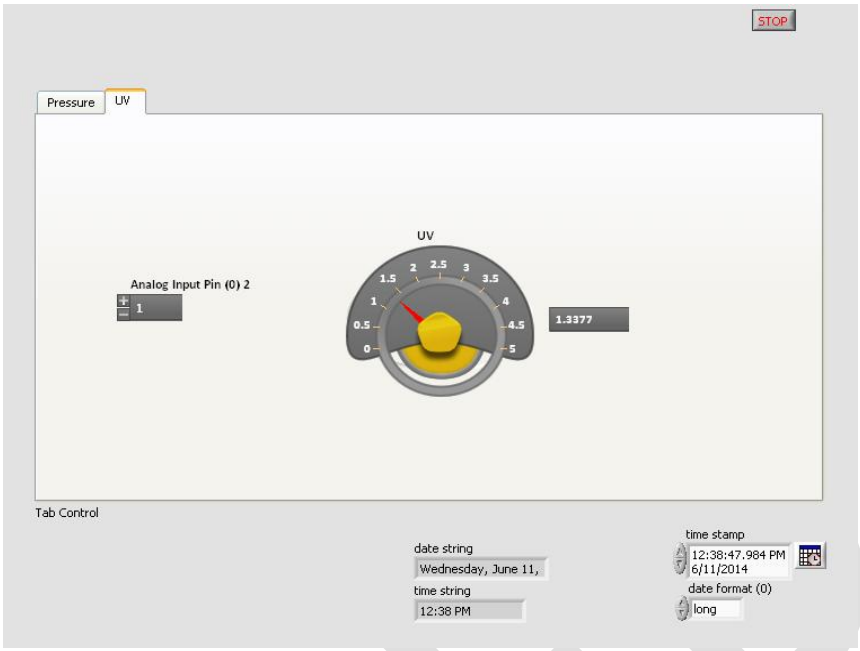

Fig 8. Front panel of the Radiation measurement

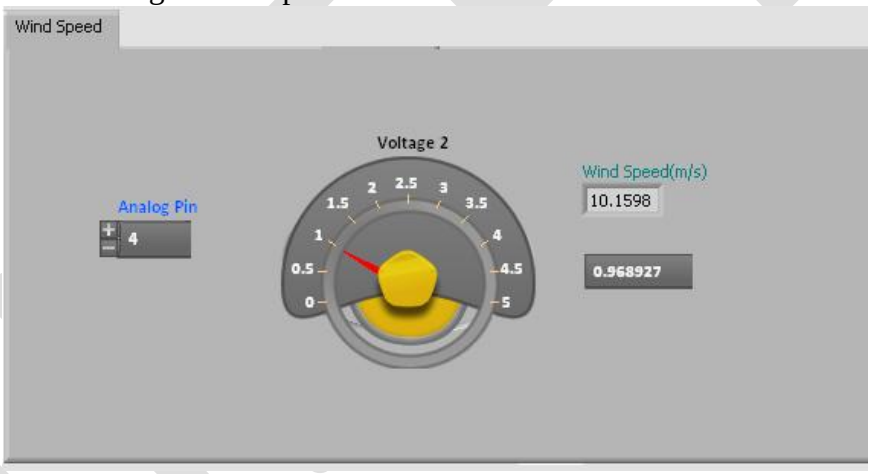

Fig 9. Front panel of the Wind speed measurement

We have obtained observations of temperature, humidity, pressure, wind speed and UV radiation from the Arduino blocks in LabVIEW. This inexpensive system is designed for Industries, having analog I/Os to measure and record the processes in industries. This work has considered important parameters to measure and display in industries. The presented system can be useful for studying behaviour of weather stations at remote location.

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