

DEVELOPMENT OF A PC SOFTWARE BASED WIRELESS WEATHER MONITORING SYSTEM FOR DATA ACQUISITION

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Abstract- Accurate monitoring and measurement of weather conditions with the parameters are important for weather analysis in evaluating the performance and prediction of the future of the raining and sunny days. However, these systems requires intensive human efforts and are sometimes inaccurate in its prediction which is aimed at the development of a cost-effective parameter-measuring and logging system for weather conditions. Wireless weather monitoring stations are created to monitor weather virtually or remotely without the requirement of direct human efforts. Therefore, the system is designed to implement sensors which accurately acquire digital data passed to a microcontroller for the storage and processing of these data. This journal focused on the developed and implementation of a software wireless weather monitoring system to be able to sense temperature, humidity and light intensity for normal use by regular users, application in agriculture, science laboratories, industries and creation of weather reports.

Key words: wireless fidelity, Software, PIC Microcontroller, Liquid Crystal Display, Real-time Clock.

1.0 INTRODUCTION

Modern world of information and technology, monitoring and predicting weather conditions is essential in planning out human activities; In Agriculture to determine where and when to plant and wait for harvest, in our social lives to determine where and when to hold events, in transportation to determine how safe it is to travel by road, by air, or by water because, all of these have weather as a major factor, whether it's a hindrance or a benefit [1, 2].

Telecommunication allows for weather conditions to be monitored and analysed wirelessly without much effort or human interaction from the user with the aid of sensors and the transmission of information accessed through IP address connected to the software installed on the PC [13]. Weather monitoring systems allow for certain weather conditions to be detected or predicted before they come in phase.

Wireless weather monitoring systems however, allow users to gain access to these systems virtually or remotely without the necessity of physically being present [4]. The system senses the climatic conditions with weather sensors by studying its patterns and giving a more accurate prediction unlike weather forecasting [11]. It senses data wirelessly over a given distance where the outcome is shown on an LCD screen, and transmits the results through the IP address to a software installed.[12]. It is able to detect various weather conditions like temperature, rain, humidity, wind, sunlight intensity and other weather parameters.

The different sensors are able to work together by interfacing them on the microcontroller, thereby, allowing a single weather monitoring station to be able to sense various weather conditions and reducing the cost of constructing a weather monitoring station that is able to analyse only a particular type of weather condition [7].

The objective of this development is to implement a weather monitoring system that is able to:

- Acquire data about multiple weather conditions using sensors interfaced on a microcontroller.
- Convert analog data to digital data with an ADC (Analog-to-Digital Converter) before being fed to the microcontroller.
- Display data on an LCD screen after processing at the microcontroller.
- Assess the results through the IP address developed with the software.

2 LITERATURE REVIEW

There are many methods which are helpful to calculate the weather parameters. Manual methods need to take the readings at the place of the station by human being. This method of traditional approach is accurate and depend on the person who takes the values. Before going for any method we must know the definitions and standard unit of the weather parameters. A manual inventory system is relies heavily on the action of the people which increases the possibilities of human error.

2.1 Human Error

People might forget to record the weather parameters or simply made mistake in writing any value. This can affect the systems integrity. The time taken for sensing using this types of analogue instruments is very much hence it also cause the error. As far as the accuracy is concern this system is less accurate than nowadays digital system

2.2 Modern Approach

Nowadays wireless technology is rapidly increasing and also used in monitoring weather parameters remotely. In addition all features of sensing time is very advantageous. The system design consist of transmitter as well as receiver. Transmitter section

consist of different types of sensing units such as temperature measurement, Humidity measurement, Atmospheric pressure measurement, Air quality measurement, Rainfall measurement, Wind speed and wind direction measurement. The output can be shown on the either LCD or Computer Monitor. In case of the wired system output is usually displayed on the Liquid crystal display, while using wireless protocol output shown on the computer monitor at remote place.

2.3 REVIEW OF LITERATURE

In [14], the author describes an IoT-based weather monitoring system. The environmental parameter can be collected by sensors in this study. The author employs a variety of sensors to scale various parameters such as humidity, temperature, pressure, and rain value, including the LDR sensor. The temperature prototype is also used to compute the dew point value. The temperature sensor can be used to determine the temperature of a certain region, room, or location. The light intensity can be employed as described by the author with the help of the LDR sensor. The author employed an additional functionality of weather monitoring in this as an SMS alert system depending on the value of sensing parameters such as temperature, humidity, pressure, light intensity, and rain exceeding the value of the sensing parameters.

Weather Forecasting using Arduino Based Cube-Sat, by M. Rahaman Laskar, R. Bhattacharjee, M. SauGiri and P. Bhattacharya [15]. They have designed an autonomous small cube satellite which provides the weather information without using any internet network. The limitations of this system are that it may not communicate to a long distance without powerful transceivers section, there may be problem in recording data at higher with the help of gas balloon. The components have no protection from rain so they may get damaged even due to long time use.

3 METHODOLOGY

The components used in the construction of the system and the integration of the hardware components and software module is discussed. It describes the interfacing of the sensors on the microcontroller on the Arduino board, the connection of the LCD and wireless module. The block diagram of the proposed system design and a flowchart is also depicted to show the construction process of the weather monitoring station.

3.1 HARDWARE COMPONENTS

The hardware components required to implement this project are:

- Arduino nano Microcontroller
- Temperature sensor; DS18B20
- Humidity Sensor; DHT11
- Light Intensity Sensor; Light Dependent Resistor
- Liquid Crystal Display; 16 * 2
- WIFI Module; SIM800

3.1.1 ARDUINO NANO MICROCONTROLLER

The Arduino nano microcontroller board is in-built with ATmega328p microcontroller in a plastic quad pack with consisting of 32 pins with 2 of them being used for the ADC. It comes with 8 ADC ports and a mini USB port used for programming and serial monitoring. It selects the strongest power source using the potential difference. It has 14 digital I/O pins working with a maximum of 5V and a low of 0V, produces and receives current values of up to 20 mA with a pull-up resistance of 20-50 k Ω .

3.1.2 TEMPERATURE SENSOR

The temperature sensor is a digital thermometer that outputs 9 – 12 bits measurement values in Celsius. It connects with the microcontroller with single wire bus and possesses the ability to source power from this line without the need for external power supply. It has an alarm function which is user programmable. A number of DS18B20 sensors can be multiplexed on a single wire bus due to its unique 64-bit serial code, giving the microcontroller the ability to control all the DS18B20 sensors connected to the single wire bus.

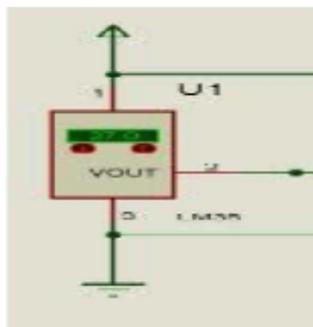


Figure 1: Temperature sensor

3.1.3 HUMIDITY SENSOR

The humidity and temperature sensor is used only for the monitoring of humidity in this project. It is a reliable, inexpensive and low power consuming device. It acquires digital signal values making it highly reliable and giving it long term stability. The sensor has 4 pins and makes use of resistive type humidity component with an 8-bit microcontroller to output values of humidity data serially. It is able to measure humidity in the range of 20-90% precisely with $\pm 1\%$ accuracy.

3.1.4 LIGHT DEPENDENT RESISTOR SENSOR

The light sensor has a variable resistance that changes with the level of light it receives. The resistance is decreased when light falls on it and increased in the dark. They operate based on the principle of photo conductivity where the conductivity increases with the fall of light on the material and decreases in the absence of light. They are generally inexpensive and easy to use. It is applied in weather monitoring stations to measure the intensity of sunlight, and can be applied in other technologies such as alarm locks and street lights. The figure below shows the image of a light dependent resistor.

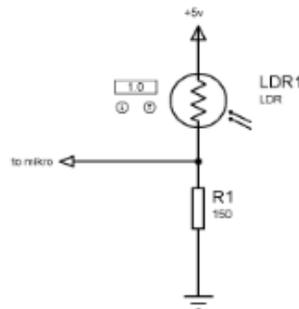


Figure 2: Light Dependent resistor

3.2 SOFTWARE IMPLEMENTED

3.2.1 ARDUINO SOFTWARE

The software used in this project is the ARDUINO software. Arduino IDE software is written in Java programming language and operates on Windows, macOS and Linux. It supports C and C++ languages and is the platform for writing and editing program codes which are interpreted to HEX files which the Arduino hardware supports. Sketch is the program code written on the Arduino IDE and are stored as text files on the computer memory with extension. The two required functions of the programs are: **setup ()** and **loop ()**.

Setup (): This function is called once at the startup of the device and runs throughout the program. It initializes the variables and I/O pin modes.

Loop (): This function allows the program to change, respond and control the Arduino hardware and is executed continuously throughout the program.

3.2.2 PROTEUS PCB DESIGN AND SIMULATION SOFTWARE

Proteus is a design and simulation software used in the circuit design of the system. It was developed by Lab center Electronics for the design of electrical circuits. It provides real time simulation of circuits by allowing human access during run time.

Its features are:

- It has a wide range of components in its library
- It has sources, signal generators and analysis tools.
- It probes for real time monitoring of the parameters of the circuit.

3.3 FLOW CHART

Designed software for the weather station is made with a bunch of software programming using C language support. These programs are designed to be incorporated into the microcontroller memory controller located on separate chain. To control circuits based microcontroller would require software that is integrated in the microcontroller chip. After passing the test and the program as expected, then downloaded to the microcontroller program.

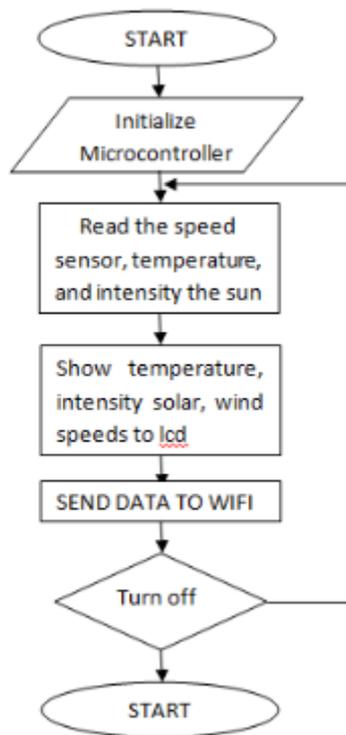


Figure 3: The Flow chart for the wireless based weather monitoring system

3.4 CIRCUIT DIAGRAM

The main components of the circuit below is the ATmega16 controller that will receive data from the output of the LM35 sensors, signal conditioners Optocoupler, and LDR. These three sensors are connected to one port ADC0, ADC1 and INT2. Port C is used as the data path to the viewer on the LCD. X-tal used is 11.0592 MHz x-tal lines of communication so that the error in the USART can reach 0%. This microcontroller output to port facilities on the USART RXD danTXD will be linked to the Kyl-1020U radio frequency to transmit data and received by the radio frequency IC Kyl-1020U with 232 max uses to pin female DB9 serial data transmission to a computer. So that the output or display can be displayed on the computer.

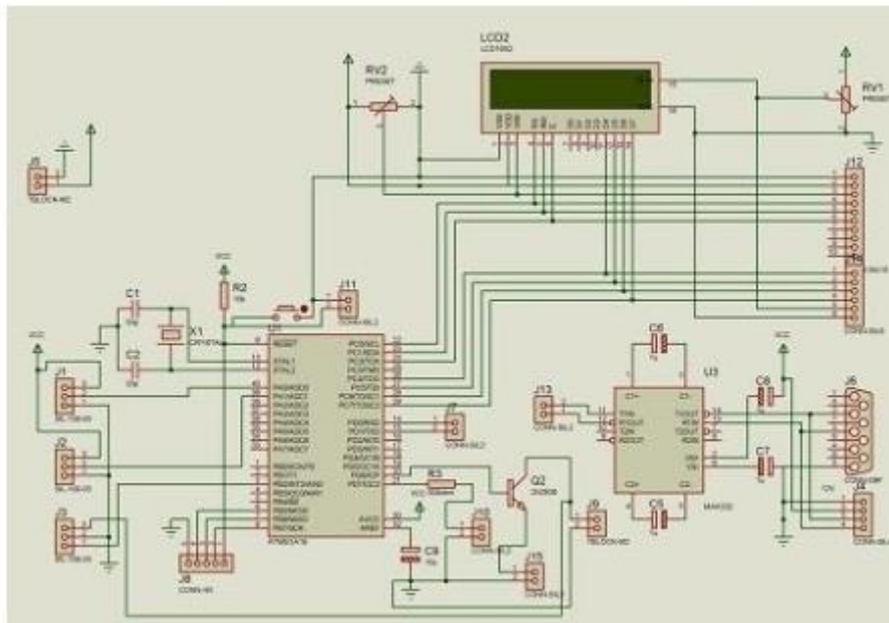


Figure 4 : The Circuit diagram for the wireless based weather monitoring system

4. RESULTS AND ANALYSIS

This chapter produces the results of the project’s objectives and discusses the hindrances encountered in achieving them and the limitations of the prototype with respect to the results achieved. The results of different weather conditions are displayed on the LCD screen and sent as text messages to the mobile users are displayed as screenshots in this chapter.



Figure 5: Implementation of the WIFI Weather monitoring system

4.1 RESULTS

4.2 ANALYSIS

The results obtained from this development are presented below with the pictorial view of the data base. The accuracy of the results obtained are certain and close to practical measurement with other measuring equipment and that the system is free from errors and its imperfection because of electromagnetic interference or noise disrupting the acquirement of data.

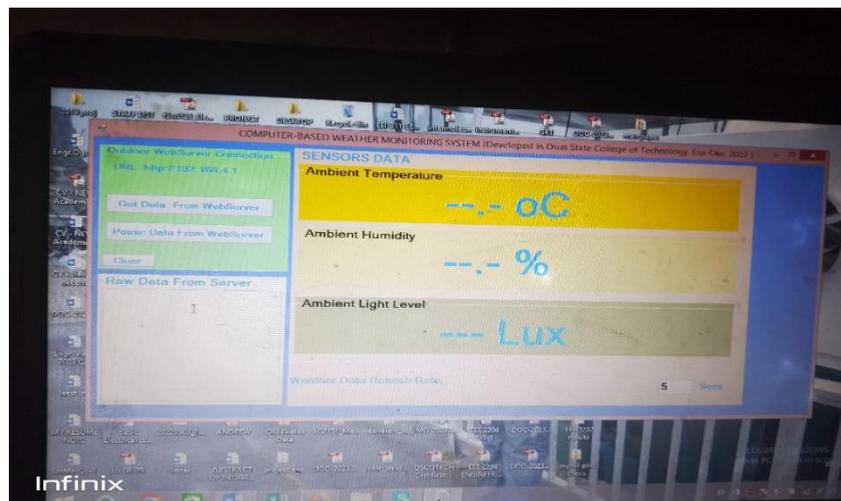


Figure 6: Interface of the Software developed.

Measurements are taken every hour on the clock. It is also able to take weather measurements for weather conditions that are highly essential for agricultural purposes and regular planning for social activities like rainfall, wind and pressure. The designed prototype has its sensors unprotected from external damage like dirt, water, or a fall.

Measurements are stored online on the internet for archiving data. The results obtained can be seen on the LCD screen and the interface of the software developed.

5. CONCLUSION

This tool serves as a Remote Weather Monitoring in real time by radio frequency wireless communications. The working principle of the system is able to sense the weather parameters; temperature, humidity, and light intensity of solar radiation in units of each sensor and then the data is sent via radio frequency via computer. Sensors used do not have resistance to vibration so if there is interference, vibration sensor values can be changed. It can be applied in science laboratories, industries and agriculture to monitor weather parameters by providing an accurate analysis of the weather in a cost effective manner. It also proves to be more useful in a smaller area for effective weather analysis and accurate results.

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