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Weather Monitoring System Using Wi-Fi

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Abstract: ***This paper presents a weather monitoring system for monitoring parameters such as temperature, pressure, humidity, rainfall, wind speed and direction. All the necessary parameters to be monitored are sensed using various sensors. For temperature pressure and humidity measurement readily available sensors have been used whereas wind-speed, wind-direction and rainfall have been measured using rotary encoder, opto-coupler, tipping bucket technique respectively. The measured data is processed using microcontroller based system and made available wirelessly on the server for storage and access continuously. The system is totally automatic thus minimizing human error. This kind of monitoring system can be used in industries, agriculture, metrological department etc for data acquisition and analysis.***

Keywords: Weather monitoring, WiFi, Sensors, Controllers

1. Introduction

There is an important role of monitoring weather conditions in human life. Therefore, collection of information about the temporal dynamics for changing weather becomes very important. The effective gauging of weather can be possible by collecting and analyzing data related to environment temperature, humidity, air pressure, airflow direction, velocity and rainfall over a wide area.

The weather monitoring system in the olden days were generally based on electromechanical and mechanical instruments which suffered from the drawbacks like poor rigidity, need of human intervention, associated parallax errors and permanence. Sensors for measuring indoor climatic conditions and environment were developed by Kang and Park [1] in 2000. Combination of these sensors with data acquisition system had proved to be a better approach for monitoring temperature relative humidity and pressure in 2005 [2]. In 1993 Vlassov introduced the usage of surface acoustic wave's devices such as temperature sensor [3]. This demanded the development of a microcontroller based embedded system for weather monitoring purposes. Such a system should monitor and provide data for remote examination. The collected data by weather monitoring system can easily be transferred to a PC via a serial port to make subsequent data analysis or graphical and digital storage and thus automatic data collection is possible without giving up PC resources.

The wireless weather monitoring system has advantage over wired system that the physical presence of a person is not necessary. This improves the accuracy and repeatability in data measurement and analysis for its acceptance [4]. Further, wireless system can be easily configured for its connectivity with other devices such as smart phones and web servers to exploit their applications. Now days, automated weather stations are available to provide weather related information on commercial basis for various applications [1-4] such as agriculture, industries, weather forecasting etc.

To design wireless weather monitoring system one needs to think of its sensing capabilities for data acquisition, processing capabilities for data processing and wireless connectivity for data communication and storage for storing acquired data [2]. For smart cities and villages using digitalization making weather conditions accessible to general public using smart gadgets such as smart mobiles becomes evident. Internet of things (IoT) helps to make various services smarter by making them available through internet by acquisition of data and its control. Many of the developing countries like India can be evolved due to this technology to offer transparent and good services to their citizens using embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and their convergence with IoT.

In this paper it has been proposed to design a wireless weather monitoring system using Wi-Fi that can be used in the field of agriculture for collecting agro meteorological information for smart villages, dams in civil engineering etc.

2. Design of the Proposed System

2.1 System Architecture

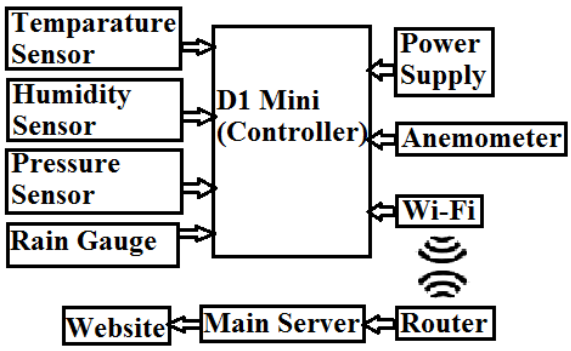

Figure 1: Block diagram of the proposed system

The proposed weather monitoring system using Wi-Fi is as shown in Fig. 1. It consists of transmitter and receiving sections. The transmitter section includes the controller, various sensors and Wi-Fi module whereas receiving section includes router, webserver and website.

2.2 Working of the System

The various sensors such as temperature sensor, pressure sensor, humidity sensor reads the atmospheric temperature, pressure and humidity respectively. Rain gauging has been done using tipping bucket technique. This technique measures the number of times a calibrated bucket is emptied from rain water, every time the bucket is filled to the calibrated mark and then emptied one tip is implied thus all the tips are added and multiplied by 0.02mm which is the total amount of rainfall. For every tip one pulse is send to the pin of the microcontroller. The number of pulses is measured by the microcontroller. The anemometer is used to sense wind speed and wind direction. The signal conditioning block is required for getting accurate wind velocity. The signal conditioning consists of an optocoupler. This output is given to a Schmitt trigger which is a bi-stable circuit. In this circuit when the input rises above a certain threshold, the output increases to a steady maximum and decreases to almost 0 when the input voltage falls below another threshold value.

All the sensor outputs are received by the controller and processed in necessary format. These are then transmitted using Wi-Fi to main server. The databases of all these sensed parameters are maintained on main server and are routed and displayed continuously on the website with a refreshing rate of 10 seconds. The database is created using Mysql. A PHP script is written to display the data on the website.

2.3 Specifications of the proposed system

1	Voltage Requirement	3.3/5 V DC
2	Current Requirement	1 A
3	Temperature Range	0 ° C to 50 ° C
4	Humidity	30 to 90%of RH at 0 °C
5	Tipping bucket	1 Tip = 0.02mm
6	Pressure	Max-110800Pascal
7	Memory	4Mb-Flash Memory
8	Wi-Fi module Freq.	2.4GHz

3. Results and Discussions

The measured calibrated readings of various sensors are shown in Table 1 and snapshot of the displayed database is shown in Figure 2. Also the displayed parameters on the website is shown in Table2 and snapshot of the displayed data on website is shown in Fig. 3

Table 1: Measured database parameters
*T- temperature, P- Pressure, H- humidity, R- Rainfall

Day	*T*	*P*	*H*	*Wind*		*R*
				Direction	*Speed*	
1	28	948.8	18	North	0	0
2	28	948.8	18	North- east	0	0
3	28	948.8	18	North-east	1.2	0.02
4	28	948.8	18	North-east	1.2	0.02
5	28	948.8	18	North-east	1.2	0.02
6	28	948.8	18	East	3.2	0.04
7	28	948.8	18	East	4.6	0.06
8	28	948.8	18	South-east	5	0.08

ID	log	Temperature	Pressure	Humidity	Wind_Direction	Wind_Speed	Rainfall
1	2016-05-08 23:50:56	28	948.8	18	North Direction	0	0
2	2016-05-08 23:51:34	28	948.8	18	North Direction	0	0
3	2016-05-08 23:52:59	28	948.8	18	North East Direction	1.2	0.02
4	2016-05-08 23:53:09	28	948.8	18	North East Direction	1.2	0.02
5	2016-05-08 23:53:33	28	948.8	18	North East Direction	3.2	0.04
6	2016-05-08 23:54:24	28	948.8	18	East Direction	3.2	0.04
7	2016-05-08 23:54:54	28	948.8	18	East Direction	4.6	0.06
8	2016-05-08 23:55:44	28	948.8	18	South East Direction	5	0.08
9	2016-05-08 23:56:05	28	948.8	18	South East Direction	5	0.08
10	2016-05-08 23:56:23	28	948.8	18	South East Direction	6.7	0.08
11	2016-05-08 23:57:09	28	948.8	18	South Direction	3.2	0.1
12	2016-05-08 23:58:03	28	948.8	18	South West Direction	3.2	0.1
13	2016-05-08 23:58:22	28	948.8	18	West Direction	3.2	0.1
14	2016-05-08 23:59:06	28	948.8	18	North West Direction	2.2	0.12
15	2016-05-08 23:59:57	28	948.8	18	North Direction	5.6	0.14

Figure 2: Snapshot of measured database parameters

Table 2: Displayed parameters on website

Temperature	28 degrees
Humidity	18%
Pressure	948.8mb
Wind direction	North Direction
Wind speed	5.6m/s
Rainfall	0.14mm

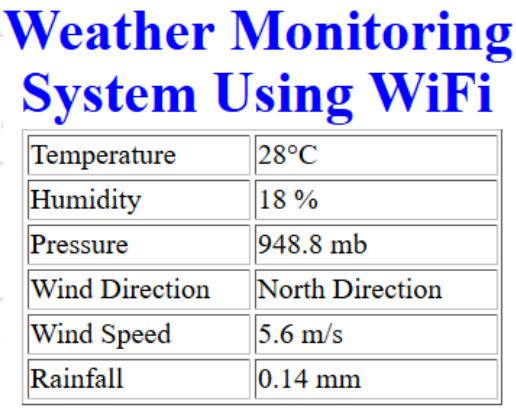

Figure 3: Snapshot of displayed parameters on website

The measured parameters such as temperature, pressure, humidity were compared with google weather and found in close agreement.

4. Applications

- Used for agricultural purposes where the agriculture is Completely dependent on the weather conditions.
- Used in opening and closing of dam gates based on the Weather conditions.
- Used for trekking purposes as the people who climb need to keep a track of the atmospheric pressure conditions.
- Used in windmills for generation of wind energy.
- Used in the loading and unloading of shipments on dock.

5. Conclusions

The proposed system can be used to monitor weather parameters accurately over a wide area without taking satellite images. This system provides a cheap, easy and real time solution to monitor the weather parameters. The system helps in reducing the human error. Since all the parameters are displayed online, it can be made available to general public for smart cities. The Wi-Fi interface with embedded application can be useful for exploiting an IoT application.

6. Future Scope

This system can include weather forecasting based on the previous data collected and stored. Satellite images could be included to give a more accurate weather forecast as the images would include Cloud Motion vectors (CMV), Water Vapor Wind (WVW), Quantitative precipitation estimate (QPE), Sea surface temperature (SST) etc. The system can be modified to help farmers to find out the best time for each crop and specific climatic conditions for proper pest control.

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