IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 10, October 2016

"Data Acquisition of Weather Parameters and Wireless Monitoring"

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Abstract: Weather forecasting is the application of science and technology to predict the state of the atmosphere for a given location. Human beings have attempted to predict the weather informally for millennium and formally since the nineteenth century. Weather forecasts are made by collecting quantitative data about the current state of the atmosphere on a given place and using scientific understanding of atmospheric processes to project how the atmosphere will evolve on that place. Wireless technology has been tremendously growing day by day. The need of wireless technology is that it replaces the conventional methods including long wires for communication and thereby increasing the redundancy of the whole system. The measurements of temperature, atmospheric pressure and relative humidity remotely by using the appropriate sensors are not only important in environmental or weather monitoring but also crucial for many industrial processes. A device for weather monitoring will be described in this project to monitor and display the, Temperature (^{0}C), Humidity in RH% (^{0}C), Light Intensity, Atmospheric Pressure in KPa, Vibration or Acceleration, Wind Speed, Wind Direction, Rainfall in mm, O_2 Contents in air, CO_2 contents in air using analogue and digital components. The analogue outputs of the sensors are connected to a microcontroller through an ADC for digital signal conversion and data logging.

Keywords: Microcontroller, Sensors, ADC.

I. INTRODUCTION

Climate plays an important role in human life. Weather monitoring holds great importance and have uses in several areas ranging from keeping track of agricultural field weather conditions to industrial conditions monitoring. Weather monitoring would help in keeping track of different climatic behaviors including temperature, humidity, light intensity etc. Weather monitoring System can be either wired or wireless one. In case of wireless communication, the connectivity will be more convenient and user friendly and weather monitoring would not require physical presence of the person at the location. Wireless communication is the transfer of information over a distance without the use of wires. The primary motivation behind taking up this project is the large utility of the wireless weather monitoring in varied areas ranging from agricultural growth and development to industrial development.

Sensors are essential components in many applications, not only in the industries for process control but also in daily life for buildings safety and security monitoring, traffic flow measuring, weather condition monitoring and etc. In weather monitoring, for instance, parameters such as temperature, humidity and pressure need to be measured, thus sensors have always been given the task for doing so. Weather or climate plays an important role in human life. The thermal comfort of human being is known to be influenced mostly by six parameters, i.e. air temperature, radiation, air flow, humidity, activity level and clothing thermal resistance. The advancement in technology has made these small and reliable electronic sensors capable of monitoring environmental parameters more favorably. Combination of these sensors with data acquisition system has proved to be a better approach for temperature and relative humidity monitoring.

1.2 Motivation:

The primary motivation behind taking up this project is the large utility of the wireless weather monitoring in varied areas ranging from agricultural growth and development to industrial development. The weather conditions of a field can be monitored from a distant place by farmers and won't require them to be physically present there in order to know the climatic behavior at the location by using wireless communication.

In Maharashtra mostly Marathwada and Vidarbha region contains the highest number of people affected by droughts. Although this can easily be mitigated through the provision of timely, reliable and relevant weather forecasts, the sparse network of weather stations in most of these regions makes this difficult.

1.3 Research Problem Definition:

In this 21st century, weather monitoring holds great importance and have uses in several areas ranging from keeping track of agricultural field weather conditions to industrial conditions monitoring. Weather monitoring would help in keeping track of different climatic behaviors including temperature, humidity, light intensity, Wind

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speed ,wind direction etc. Weather Monitoring System can be either wired or wireless one. In case of wired communication, the connectivity will be inconvenient and not user friendly and weather monitoring would require physical presence of the person at the location as well as the data need to take manually. This is the basic research problem along with the parameters measured is very few. While in case of wireless communication technique, the connectivity will be more convenient and user friendly. Weather monitoring would not require physical presence of the person at the location and data will automatically display on the monitor at remote place. Wireless communication is the transfer of information over a distance without the use of wires. The distances involved may be short (a few meters as in television remote control) or long (thousand kilometers for radio communications). In this proposed system we try to overcome certain part of the research problem using more numbers of the parameters and wireless communication technique

II. LITERATURE REVIEW

1. Nisha Gahlot, Varsha Gundkal, Sonali Kothimbire, Archana Thite, Electronics & Telecommunication, PGMCOE, Pune, India, " Zigbee based weather monitoring system", "The International Journal Of Engineering And Science (IJES) Volume 4Issue 4 Pages PP.61-66 2015 ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805.

This System design consists of transmitter as well as receiver. The Proposed block diagram of transmitter and receiver is shown in fig.1. Transmitter section consist of different type of sensing unit such as temperature, humidity, rain quantity measurement, wind direction, wind flow as well as the sun intensity. Microcontroller for time domain multiplexing i.e. multiplexing the data obtained from different type of sensor as well as for converting the analog data into digital one. After the research in the agriculture field researches found the yield of agriculture goes on decreasing day by day. Use of technology in the field of agriculture plays important role in increasing the production as well as in reducing the extra man power efforts, some of the researches tried for betterment of farmers and provides the systems that use technologies which are helpful for increasing the agriculture yield. Some of such researches carried out in field of agriculture are summarized.

2. K C Gouda1, Preetham V R and M N Shanmukha Swamy, "Microcontroller Based Real Time Weather Monitoring Device With GSM", "International Journal of Science, Engineering and Technology Research (IJSETR), Volume 3, Issue 7, July 2014".

The main goal of this research is to develop and implement a simple and low cost wireless weather station that get the weather conditions at the remote station and transmit the data to a wireless receiver board connected to the RS-232 port of the PC. GSM is the wide spread communication all over the world and can communicate from any remote area so GSM is the better choice to communicate the weather parameter in this device. C program was written for the transmitter to extract the data, process and transmit the data format to the receiver. Finally, the hardware and software implemented full-fill the goal are successful. The system is highly optimized, portable and robust.

3. P.Susmitha and G.Sowmyabala Dept. of ECM K L UNIVERSITY Guntur (Dt), India, "Design and Implementation of Weather Monitoring and Controlling System", "International Journal of Computer Applications (0975 – 8887) Volume 97– No.3, July 2014.

The design and implementation of weather monitoring & controlling system is the model with the ability to perform data acquisition on temperature, gas, humidity and accelerometer sensors attached. And it can give these sensors data to ADC Port of LPC1768. It can also upload the data continuously to excel sheet in LABVIEW with the help of RS232 Cable and also receives SMS with the help of GSM.

4. Mr. A. Pritviraj, Assistant Professor, Electronics Communication Engineering, Nehru College of Engineering and Technology, Pampady, Trichur, India, "A Real Time Weather Monitoring System With Fm Channel"," IJAICT Volume -1, Issue-1, May 2014".

This paper uses one of the applications of wireless communication. We know nowadays people are travelling all around the world, from one place to other. But sometimes bad weather conditions may affect the travelers badly. so there arises a need of a system to monitor the weather conditions and to indicate the travelers properly. This system can be made possible by using the wireless communication method with MCU and RF data modem. This wireless communication method uses wireless transmission to indirectly realize data acquisition and an FM channel to indicate the travelers about the weather conditions.

5. Dushyant Pande, Jeetender Singh Chauhan, Research Scholar, Dept. of Instrumentation & Control Engineering, Graphic Era University, Dehradun, India, "International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 5, May 2013". Paper under the title "A real time hardware design to automatically monitor and control light & temperature".

In this Paper temperature and light intensity monitoring and control is done with the help of two sensors. One is the temperature sensor and the other one is the light sensor. The temperature and light intensities are displayed on the LCD screen and also we can set the desired values of light and temperature with the help of provided keypad. The entire decision making is done with a help of a microcontroller. This type of system can be installed in any place where we need to maintain light and temperature intensities approximately constant.

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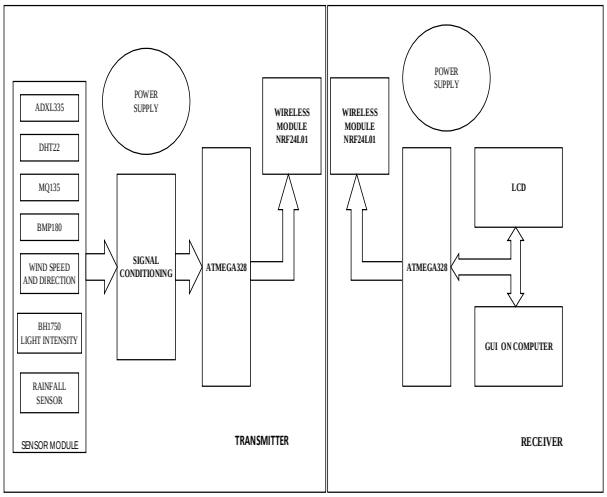
III. SYSTEM MODELING



3.1 Block Diagram of System

ATmega 328

The Atmel AVR ATmega328 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, ATmega328 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. ATMEGA 328 development Board is made from double sided PTH PCB board to provide extra strength to the connector joints. Power supply for the board ranges from 7 to 15V DC. It has built-in reverse polarity protection. It also has 7805voltage regulator. The heat sink dissipates the heat so that it can supply 1Amp current continuously without being over heated. It has switches for reset and power. All the ports are connected to standard 10 pin FRC pins.

SENSORS USED:

1. Temperature and Humidity Sensor (DHT22)

The DHT22Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti- interference ability and cost-effectiveness.

2. Pressure Sensor (BMP180)

The ultra-low power, low voltage electronics of the BMP180 is optimized for use in mobile phones, PDAs, GPS navigation devices and outdoor equipment. With a low altitude noise of merely 0.25m at fast conversion time, the BMP180 offers superior performance. The I2C interface allows for easy system integration with a microcontroller.

3. Vibration Sensor (ADXL335)

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis. The ADXL335 is available in a small, low profile, 4 mm × 4 mm × 1.45 mm, 16-lead, plastic lead frame chip scale package.

4. Design Wind Speed Propellers

Mechanical measurements of wind speed in the form of a propeller comprising 3 fruit bowl mounted on the radius centered on the vertical axis or all of the bowl is mounted on a vertical axis. Entire bowl facing a circumferential direction so that when the wind blows the rotor rotates on a fixed direction. Rotational speed of the rotor depends on wind speed. Proximity sensor is a device used to sense the speed of rotary vane bowl. The focal point of the sensor plate and the center of the propeller bowls connected by a shaft, propeller is shown in Figure bellow:

Fig. 3.2 Wind speed propeller

5. Gas Sensors (MQ-135)

MQ-135 gas sensor has high sensitivity to Propane, Butane and LPG, also response to Natural gas and CO_2. The sensor could be used to detect different combustible gas, especially methane; it is with low cost and suitable for different application. Good sensitivity to Combustible gas in wide range. Long life and low cost.

6. Light Intensity Sensor (BH1750)

Photo diode of approximately human eye response. Integration op-amp for converting from PD current to voltage. ADC for obtainment digital 16 bit data. Internal Oscillator (Typ 320 Hz). It is clock for internal logic**.** It is based on I2C bus i.e Serial data & serial clock.

7. Rainfall Module

Rainfall measurement is done by using the water level sensor. This sensor is directly connected to the analog to digital channel of the microcontroller. We design the

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rainfall module based on the standard instrument used for the rainfall measurement.

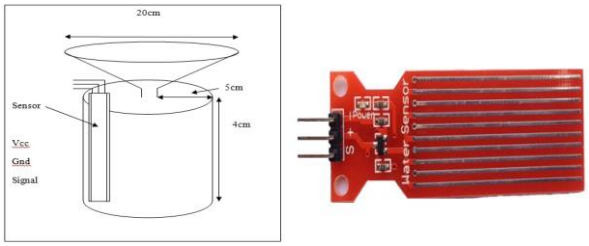

Fig.3.3 Rainfall Module

Transceiver Section (nRF24L01):

nRF24L01 is a single chip radio transceiver for the world-wide 2.4 - 2.5 GHz ISM band. The transceiver consists of a fully integrated frequency synthesizer, a power amplifier, a crystal oscillator, a demodulator, modulator and Enhanced Shock Burst protocol engine. Output power, frequency channels, and protocol setup are easily programmable through a SPI interface. Current consumption is very low, only 9.0mA at an output power of -6dBm and 12.3mA in RX mode. Built-in Power Down and Standby modes makes power saving easily realizable.

Fig: 3.9 nRF24L01+ Module

IV. PERFORMANCE ANALYSIS

4.1 Working principle:

The working principle of this work describes the interdependent functionality of the components and their output. Firstly, all the components are initialized by supplying the required power of +5v. There are temperature sensors, depending on the temperature, hot air or cool air introduced to maintain the temperature threshold value, which is preset. If the temperature is too low for the particular area hot air is blown in to bring the temperature to moderation. Otherwise, if the temperature is too high, cold air is blown and thereby raising the temperature to the required level. This is how temperature is manipulated. Secondly, there is an LDR which work based on light intensity. When the sunlight is too much or not enough for t he plant to handle. This helps in recording the natural light incident on the area. The natural light intensity may wary from time to time. This is important in agricultural applications, where light is required for the growth of plants and some plants may not grow well in low light. On the other hand, when the light intensity is high throughout the year, such areas or places are suitable to set up solar power stations. Light intensity along with other parameters such as temperature, humidity, Atmospheric pressure, Vibrations etc. can be used in predicting weather forecast without the use of any satellite data. The gathered data is serially fed into a computer, which uses the com port to communicate with the Arduino device and the data recorded is stored in a text file. The text file can be directly imported to an excel file with the functionality of a macro. The imported data is then sorted and formatted, and charts are then plotted with the imported data. This is the primary objective of the present work.

4.2 Validation

Table 4.1 Validation at Weather Monitoring Station

Parameters	Observations		
	Hydrology Project, Aurangabad	Proposed System	%Error
Temperature	Thermometer 1 39.5 ^{0}C Thermometer 2 32.0^{0}C	37.70^{0}C	+-2^{0}C
Humidity	34%	38%	4%
Date and Time	3 June 2016 1:00PM		

Table4.2 Validation at Laboratory

Parameters	Observations		
	ACE Techno services (NABL Certified), Aurangabad	Proposed System	%Error
Temperature	1) 12.8 ^{0}C 2) 22. 7 ^{0}C 3) 38.9 ^{0}C 4) 47.6 ^{0}C	12.3 ^{0}C 22.4 ^{0}C 38.5 ^{0}C 47.1 ^{0}C	+-0.5^{0}C
Humidity	1) 27.3 % 2) 52.0 % 3) 79.8 % 4) 87.6 %	26.23 % 50.41% 78.32% 86.44%	+-5%
Light Intensity	1)10 lx 2) 505 lx 3)1002 lX 4)1525 lx	12 lx 507 lx 1004 lx 1524 lx	+-2lx
Date and Time	16 July 2016 2:06PM		

Fig4.1 Results on LCD

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V. CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

This project deals with designing a simple and low cost weather monitoring system using temperature sensor, atmospheric pressure sensor, vibration sensor, wind speed, wind direction, gas sensor, Rainfall sensor and ATMEGA-328 microcontroller unit will monitor weather conditions of the Aurangabad city and transmit it to a computer/laptop at distant location through wireless transmitter. It will be also helpful in making Aurangabad as smart city.

5.2 Future Scope

In this system we can use rasberrypi controller to create the server to display all the parameters online on computer. We can install maximum number of the systems in single city which will helpful to monitor the weather condition of entire city at one place.

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