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Portable Weather Station with GUI

Shreyas Inamdar[1], Sumit Mukherjee[2], Siddhant Nimbalkar[3]

Department of Electronics, Terna Engineering College, Nerul, Maharashtra

ABSTRACT

In this paper, various weather phenomena of the surrounding area like temperature, humidity, air quality and soil moisture will be collected by the different sensors and these parameters will get displayed on the LCD screen. Data collected by these sensors will be sent to the microcontroller and stored in SD card for the purpose of offline storage. The microcontroller will be interfaced with a LCD module for displaying the various weather parameters. A Wi-Fi module will also be interfaced with the microcontroller for establishing a wireless connection between the microcontroller and PC/Mobile Phone. The data from the microcontroller will get uploaded on a cloud server for further analysis.

***Keywords*- Sensors, LCD, Wi-Fi, Wireless**

1. INTRODUCTION

Weather is a state of the atmosphere. It can be clear or cloudy, hot or cold, dry or wet, etc. Most of the weather phenomena occur in the tropospheric layer of the atmosphere. Weather is driven by air pressure, temperature and moisture differences between one place and another. On Earth's surface, temperatures usually range ±40 °C (−40 °F to 100 °F) annually. Over thousands of years, changes in Earth's orbit can affect the amount and distribution of solar energy received by the Earth, thus influencing long-term climate and global climate change. It has become quite necessary to monitor day-to-day weather. For this purpose, a weather monitoring system is required. The basic purpose of a weather monitoring system is to monitor the state of the atmosphere for a given location. In order to monitor the weather, various types of sensors are required. Sensors are essential components in many applications in industry. In weather monitoring, parameter such as temperature, humidity, air quality, soil moisture are measured with help of sensors. [1]

2. PROBLEM DEFINITION

2.1 Problem Statement

In various industries, there is a requirement of temperature, humidity, air quality, etc measurement for various processes. In industry such as chemical, textile and food processing industries consideration of parameters such as temperature, humidity, air quality, etc. is important Also, many a times, farmers do plantation of crops without checking the condition of the land whether it is suitable or not for farming which leads to wastage of resources.

2.2 Scope

A device will be created which will display various environmental parameters of the surroundings which will help in checking whether the surrounding parameters are suitable or not for various industrial processes. Also, a database can be created which will store various details of different type of crops. As we have a soil moisture sensor in our device, it can be used to measure the moisture level of a particular agriculture land. Depending on the moisture level of that particular land, the device will show which type of crop can be planted on that land. This will be very helpful to the farmers.

3. LITERATURE SURVEY

Kamarul Ariffin Noordin et al proposed a device for weather monitoring to monitor and display the temperature, pressure and relative humidity of the atmosphere using analog and digital components. The analog outputs of the sensors are connected to a microcontroller through an ADC for digital signal conversion and data logging. An LCD display is also connected to the microcontroller to display the measurements. For analysis and archiving purposes, the data can be transferred to a PC with a GUI program through a USB link. [2]

Kirankumar G.Sutar et al proposed a weather monitoring system which enables the monitoring of weather parameters like Temperature, Humidity and Light intensity. Sensor module includes the sensors like

temperature, humidity and light sensor. The system is developed using ZigBee wireless module. [3]

K C Gouda1 et al proposed a device for real time weather monitoring of temperature, atmospheric pressure, relative humidity and dew point temperature of the atmosphere via GSM network, using analogue and digital components. The analogue outputs of the sensors are connected to a microcontroller through an ADC for digital signal conversion. An LCD display is also connected to the microcontroller to display the measurements. For analysis and archiving purposes, the data can be transferred over GSM and receiver section is connected to PC. Received data is further processed to generate graphical display using weather modeling algorithms. [4]

Kiranmai Nandagiri et al proposed a weather monitoring system which contains DHT sensor by which temperature and humidity will be monitored. The data from the sensors are collected by the micro controller and also micro controller sends the sensors data in to the Arduino Software (IDE) by using the Serial Communication. [5]

S. H. Parvez et al proposed an economical system that ensures flexibility, portability, scalability and user friendly operations. The design incorporates sensors and equipment to assess temperature, humidity, atmospheric pressure, wind speed, precipitation, presence of rain, UV index, dust density, ambient light intensity and presence of different gas in the atmosphere. To measure wind speed and precipitation, conducive mechanical structures are designed which can be made from locally available materials. The system utilizes solar energy which makes it a stand- alone system. Measured data through the developed system can be uploaded to the web server and sent to the user through web page or through text messages. [6]

Tajedinn Abdelgawi Baker et al proposed a device for remote real-time measurement and monitoring of weather parameters. Three levels are included in the system: the microcontroller for information processing using atmega32 with a control program for real time measurement, processing and monitoring, GSM unit to provide wireless communication via cell phones for monitoring of weather parameters, with the aid of sensors (temperature, humidity, wind speed, pressure sensors). RF transmitter is used to collect and transmit data from field to the controller which includes RF receiver. The System operates in two modes: the first one is for real time transmitting of data through fixed time intervals, these intervals are set via key pad according to the user requirement and GSM sharing between the different sensors. A real time clock (RTC) is used for time adjustment. The second mode is used in case of regular collection of data as well as rain fall expectation, where the data is to be collected in regular intervals. In this mode the user can exclaim the system about the weather parameters then the user will receive a real time feedback SMS explaining the weather conditions [7]

M. Benghanem et al proposed the development of wireless data acquisition system (WDAS) for weather station monitoring is described. It is based on the Emitter/Receiver architecture and it does not require the physical connection of the monitored systems to the data collection server. The proposed system consists of a set of sensors for measuring meteorological parameters (solar radiation, temperature, humidity, pressure, wind speed & direction, rain fall, etc.). The collected data are first conditioned using precision electronic circuits and then interfaced to a PC using RS232 connection via wireless unit. The LabVIEW program is used to further process, display and store the collected data in the PC disk. The measured parameters are available on-line over the internet to any user. [8]

Priya Kamble et al proposed a wireless sensor network system for landslide detection in Konkan railways in Ratnagiri district of Maharashtra, a region known for heavy rainfall, steep slopes and frequent landslide. When water level in soil exceeds certain levels, resistivity of soil decreases. So, potential gets developed across the electrodes of water potential sensor. The node station measures the water potential and temperature of the soil. After that, data is sent to the gateway and sleep mode is called which ensure energy saving. Since, a sampling period will be around 15 minutes and active mode takes only couple of milliseconds, the end station is able to work more than a year on two AA batteries. Use of WSN for this application increases systems efficiency. [9]

4. PROPOSED SYSTEM

A Portable Weather Station will be built which will collect various weather phenomena of the surrounding environment. This device will then display those parameters in real-time. Data collected by these sensors will be sent to the microcontroller and stored in SD card for the purpose of offline storage. The microcontroller will be interfaced with a LCD module for displaying the weather parameters. A Wi- Fi module will also be interfaced with the microcontroller for establishing a wireless connection between the microcontroller and PC/Mobile Phone. The data from the microcontroller will get uploaded on a cloud server for further analysis.

Features:-

1. This device is small, portable and less expensive compared to other devices.
2. This device can be used in industry such as chemical, textile and food processing industries where consideration of parameters such as temperature, humidity, air quality, etc. is important
3. As the data is stored in cloud, we can access it using various wireless devices for further analysis which is very convenient.

5. METHODOLOGY

5.1 System Design

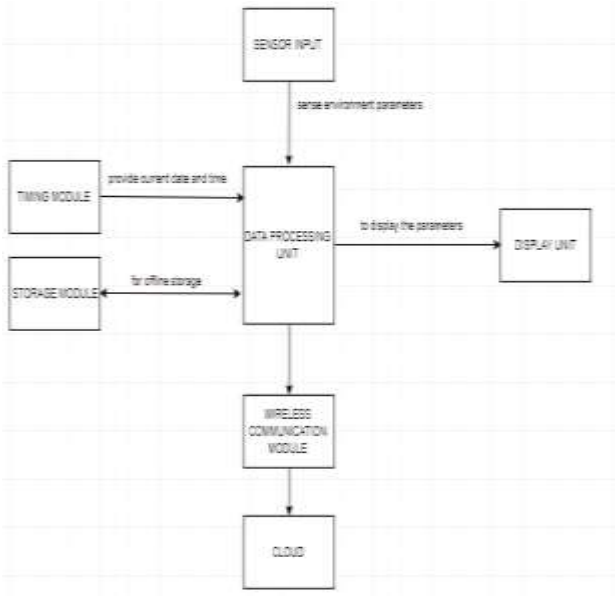

Fig. 1 Block diagram of proposed system

5.2 System Component Selection

MSP 430: The MSP430 can be used for low powered embedded devices. The current drawn in idle mode can be less than 1 µA. The top CPU speed is 25 MHz .It can be throttled back for lower power consumption. The MSP430 also uses six different low- power modes, which can disable unneeded clocks and CPU. Additionally, the MSP430 is capable of wake- up times below 1 microsecond, allowing the microcontroller to stay in sleep mode longer, minimizing its average current consumption. The device comes in a variety of configurations featuring peripherals:internal oscillator, timer including PWM, watchdog, USART, SPI, I²C, brownout reset circuitry and 10/12/14/16/24-bit ADCs. [10]

Fig. 2 MSP 430 development board

DHT 11: The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It is fairly simple to use, but requires careful timing to grab data. Compared to the DHT22, this sensor is less precise, less accurate and works in a smaller range of temperature/humidity, but it is smaller and less expensive. [11]

Fig. 3 DHT11 Temperature and Humidity sensor

MQ 135: Air quality sensor for detecting wide range gases, including NH3, NOx, alcohol, benzene, smoke and CO2. Ideal for use in office and factory. MQ135 gas sensor has high sensitivity to ammonia, sulfide and benzene steam, also sensitive to smoke and other harmful gases. It is with low cost and particularly suitable for air quality monitoring application. [12]

Fig. 4 MQ135 Air quality sensor

Soil Moisture Sensor: Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. [13] will be interfaced with the MSP 430G2553 development board.

Along with these sensors, a Real-Time Clock (RTC), a LCD display, a Wi-Fi module and a SD Card will also be interfaced with the microcontroller.

All these interfacing devices will be coded in C Programming language using Energia Software. After coding each of the interfacing devices, hex files will be created for each specific code. After this, the hex files will be loaded into the microcontroller.

Thus, all the sensor parameters will get displayed on the LCD along with date and time. And this data will also get stored in SD Card as a means of offline storage of data.

Various parameters will get displayed on a desktop-based graphical user interface (GUI) which will be created using Microsoft Visual Studio.

Through the Wi-Fi module, the sensor parameters will be transferred on cloud for further analysis

5.3 Procedure

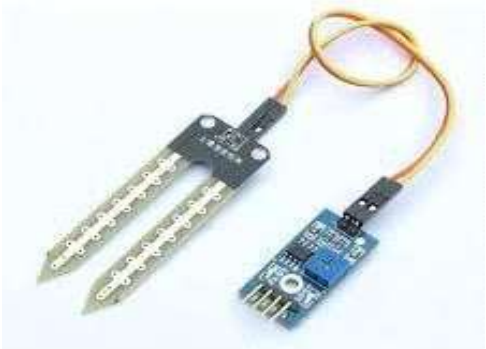

Fig. 5 Soil moisture sensor

6. APPLICATION

The proposed device will be used in various industries for detecting whether the environmental parameters are within the standard range. This device can be used in industries such as chemical, textile and food processing industries where The sensors which we will use will sense parameters such as temperature, humidity, air quality and soil moisture.

These parameters will be converted from analog to digital signal with analog to digital converter (ADC). The output of ADC i.e. the digital signal will be given to the microcontroller i.e. MSP430. This microcontroller will save the data and display it using LCD display. Data will also be stored in cloud (Google drive/drop box) by using Wi-Fi module.

Therefore, this data can also be accessed using mobile phone or laptop for further analysis. A DHT11 Temperature and Humidity sensor, MQ135 Air Quality sensor and a Soil moisture sensor consideration of parameters such as temperature, humidity, air quality, etc. is important. As the data is stored in cloud, we can access it using various wireless devices for further analysis which is very convenient. This device will display the details about the crops which are to be planted depending on the soil moisture level of that particular area of land.

7. CONCLUSION

Various weather phenomena of the surrounding area like temperature, humidity, air quality and soil moisture will be collected by the different sensors and these parameters will get displayed on the LCD screen. Data collected by these sensors will be sent to the microcontroller and stored in SD card for the purpose of offline storage. The microcontroller will be interfaced with a LCD module for displaying the various weather parameters. A Wi-Fi module will also be interfaced with the microcontroller for establishing a wireless connection between the microcontroller and PC/Mobile Phone. The data from the microcontroller will get uploaded on a cloud server for further analysis.

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