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Efficient IOT based weather station

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Abstract: In this paper, a new approach to practical and meaningful utilization of technology within a smart weather station system is presented. Weather station gives efficiency with instruments as well as equipment for measuring atmospheric data about the weather forecast conditions. Weather checking of the environment is essential because weather changes uncertainly every day. From weather updates, first understand the outside condition. So, we can take preparation according to weather. Weather also plays a vital role in human physical and psychological health. For these reasons, we always need to know about the current weather information. In this case, a weather station makes our life way easier by updating us about current weather states. We can easily see weather updates and information from weather stations by using apps. This paper has developed and tested a weather station based on NodeMCU Board and Blynk – IoT technology, which measures the meteorological data, including temperature, pressure, humidity, and rainfall.

Keywords: *Weather Station, Meteorological parameters, ESP8266, Blynk – IoT and Sensors*

I INTRODUCTION

Monitoring weather environment is a continuous work, to be forecasted earlier about the conditions of environment. Weather monitoring is automated and is used in many places. Environmental weather variables like Temperature, atmospheric pressure, Relative humidity and wind speed. The Internet of things (IoT) is the connection of physical devices using internet network. Real-time weather monitoring system based on a mobile application using Automatic Weather Station (AWS). The system connects to the AWS with several sensors for collecting data. There are some default parameters we need to monitor. The Botfather is used with the Telegram software and the data is sent to the concerned people through cloud.

Internet of Things is a novel paradigm combining telecommunications and any kind of device or applications using sensors, tags, microcontrollers and ARM processors. This paper proposes an implementation of weather monitoring system using Internet of Things (IoT). An Arduino IDE based implementation is proposed to monitor PM2.5, PM 10, temperature, humidity and the air quality index (AQI) of the Particulate Matter pollutants available. Internet of Things is playing a leading role in providing solutions to many applications with the support of software, internet and embedded systems. There are various IoT devices available in the market ranging from micro controllers to microprocessors. The microprocessors in IoT are normally ARM processors like Raspberry Pi and Intel Edison. There are many technologies developed for weather monitoring using IoT devices and are discussed in section.

II HISTORY OF PROJECT

In the previous years, a single master-multi slave microcontroller communication method has been developed. The microcontroller is able to communicate using unicast communication, i.e. the master gave orders to one slave address via the master-slave network that has star topology. Then the slave who has the same address which is requested will

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respond or take action in accordance with the master command. Modbus Protocol is the rules of data communication with the master-slave technique. In these communications there is only one master and one or several slave which form a network. Master only do one communication at a time. Slave will only communicate if there is a command (query) from the Master and cannot communicate with another slave. Addressing modes used by the Modbus there are 2, i.e., unicast and broadcast.

III LITERATURE SURVEY

A. IoT Based Weather Monitoring System for Effective Analytics Ferdin Joe John Joseph International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8 Issue-4, April, 2019 Internet of Things (IoT) is adding value to products and applications in the recent years. The connectivity of the IoT devices over the network has widely reduced the power consumption, robustness and connectivity to access data over the network. IoT is powering many frontiers of industries and is seen as a promising technology to take Big Data Analytics to a level higher. Weather monitoring system as a module is an issue among IoT research community and it has been widely addressed.

B. IoT Based Low-cost Weather Station and Monitoring System for Precision Agriculture in India Rajinder Kumar M. Math; Nagaraj V. Dharwadkar 2018 2nd International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC) 2018 2nd International Conference In recent times it is seen that the climatic and weather conditions not only in India but also in other countries have become uncertain and unpredictable, which may have devastating effects on the agriculture production. India being an agricultural country, most of the farmers largely relies on monsoons and agricultural production is weather dependent. The environmental factors like temperature, humidity, moisture, precipitation and many other parameters keep on changing rapidly and unpredictably. This unpredictable nature, variability of climatic or weather conditions makes the life of farmers quite miserable as they are unable to take proper decisions at the right time.

C. An IoT based weather information prototype using Wemos, Ravi Kishore Kodali; ArchanaSahu 2016 2nd International Conference on Contemporary Computing and Informatics (IC3I). The Internet of Things (IOT) describes the interconnection of devices and people through the traditional internet and social networks for various day-today applications like weather monitoring, healthcare systems, smart cities, irrigation field, and smart lifestyle. IOT is the new revolution of today's internet world which monitors live streaming of the entire world's status like temperature, humidity, thunderstorm, earthquake, floods etc. that can stagger an alarm to human life.

D. Repeated data management framework for IoT: A case study on weather monitoring and forecasting S. Narasimha Swami; C. N. Sowmyarani 2018 4th International Conference on Recent Advances in Information Technology (RAIT) Internet of Things (IoT) is a networking paradigm, which connects People, Pets, Plants, Things and smart objects over the internet. IoT plays a very important role in every aspect of the life such as Environmental monitoring, Health monitoring, Crop monitoring, Vehicle monitoring and other applications. The objective of the proposed system is to monitor the environment periodically by analyzing the collected data from the sensors and managing the analyzed data.

E. IoT based Disaster Monitoring and Management System for Dams (IDMMSD) Albert JoshyVarghese; Abin Thomas Jolly; Astile Peter; Bhavana P Rajeev; K S Sajitha; Deepa Elizabeth George 2019 1st International Conference on Innovations in Information and Communication Technology (ICIICT). Dams are of major importance, primarily because of

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their use for generating hydroelectricity and irrigation purposes. This has resulted in the construction of a number of dams in potential areas over the years. As there are a lot of risk factors associated with the existence of these dams, it has become the need of the hour to develop a proper monitoring and regarding the opening of the shutters thereby management system for maintaining a safe water level in dams.

F. The Development of Automatic Weather Station XData Logger by Microcontroller Netduino M. H. Asghar, A. Negi, and XN. Mohammadzadeh. International Journal of Software Engineering and its Application, 2020 They have planned, developed and verified a little cost weather station using raspberry pi. It monitors the weather information, as well as wind direction, air speed, air temperature, atmospheric pressure, humidity, solar radiation and rain. Weather information is sent a database server and is stored in memory card via Wi-Fi network. For visualization of the weather information of a remote place, a web application interface is used. This system provides real-time weather updates like other expensive weather station. It is very small in size, little in price, reliable and relaxed to use which can be effectively used in different applications.

G. The Development of Automatic Weather Station Data Logger by Microcontroller Netduino F.A. Hazain and B. Soweto International Journal of Software Engineering and its Application, 2020 They have developed an Automatic Weather Station data logger with the help of microcontroller Netduino. It can be used in any sector where weather is an important factor. This paper develops a telemetry system based on Netduino logger which can be placed on remote area, besides the number of I/O analog pin on Netduino is expanded by a switching channel method.

H. Weather Monitoring System with Remote Radio Frequency Wireless Communication Iswanto and H. Muhammad International Journal of Embedded System and Application, 2020. They have developed an Automatic Weather Station data logger with the help of microcontroller Netduino. It can be used in any sector where weather is an important factor. This paper develops a telemetry system based on Netduino logger which can be placed on remote area, besides the number of I/O analog pin on Netduino is expanded by a switching channel method. This research show that analog processing signal on Netduino has a change between its original values but which is not so significant.

IV METHODOLOGY

To improve the accuracy of the above-mentioned technique, we would be making the weather stations localized. Now we cannot have the whole unit at each and every area. This would incur a lot of expenses and area. To reduce that we would build a mini weather station on top of every building there is in the city. Suppose, if there are 1 million building, there will be 1 million mini weather stations incorporated on the top just like a Tata Sky antenna is installed. This would help in collecting data from each area of the city, to be specific each building.

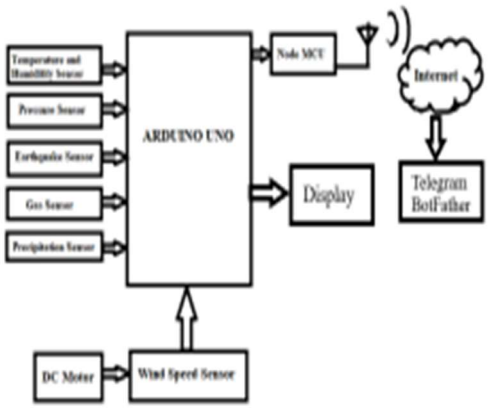

Fig 1. Block diagram of weather station

The proposed system monitors the hydrogen levels, pressure levels, wind speed, temperature and humidity (precipitation) of the environmental conditions. The system also detects the earthquake on the surface and also intimates the respective authorities. The Node

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MCU is connected to the respective authorities and when the threshold is crossed the customized message will be sent to the authorized person through the Wi- Fi module and the message will be displayed in the Telegram Botfather.

V HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements

• Arduino Uno • Precipitation sensor • Accelerometer/MEMS sensor • Atmospheric Pressure Sensor • Wind speed sensor • Gas sensor • Node MCU • DC motor

Software Requirements

• Arduino IDE • Embedded C • Telegram Bot Father

VI COMPONENT DESCRIPTION

A. Arduino Module

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs),6 analog inputs, a 16MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and are set button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

B. Precipitation sensor

A sensor that is used to notice the water drops or rainfall is known as a rain sensor. This kind of sensor works like a switch. This sensor includes two parts like sensing pad and a sensor module. Whenever rain falls on the surface of a sensing pad then the sensor module reads the data from the sensor pad to process and convert it into an analog or digital output.

C. DC Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor.

D. DHT11 sensor

Temperature Sensors measure the amount of heat energy or even coldness that is generated by an object or system, allowing us to “sense” or detect any physical change to that temperature producing either an analogue or digital output. They can be used to detect solids, liquids or gases over a wide range of temperatures. The DHT11 measures relative humidity. Relative humidity is the amount of water vapor in air vs. the saturation point of water vapor in air. At the saturation point, water vapor starts to condense and accumulate on surfaces forming dew.

E. Atmospheric pressure sensor

A pressure sensor works by converting pressure into an analogue electrical signal. The demand for pressure measuring instruments increased during the steam age. Nowadays we measure pressure electronically using pressure transducers and pressure switches

F. ADXL335 Accelerometer

ADXL335 Accelerometer module consists of six pins i.e. VCC, GND, X, Y, Z, and ST. Using the Accelerometer module with a microcontroller is very easy. Connect VCC and GND pins to 5V and GND pins of Microcontroller. Also connect X, Y, and Z pins to the Analog pins of Arduino.

G. LCD Display

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multisegment light-emitting diodes and seven segments.

H. Node MCU

The NodeMCU (Node Microcontroller Unit) is an open source software and hardware development environment that is built around

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a very inexpensive System-on-a-Chip (SoC) called the ESP8266. NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espress if Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added.

I. Telegram Botfather

Botfather is the one bot to rule them all. Use it to create new bot accounts and manage your existing bots. Send Message Chat bots are revolutionizing the way people interact with technology. In recent years, their simplicity and low cost have helped drive adoption across various fields and industries.

J. Embedded C

Embedded C is one of the most popular and most commonly used Programming Languages in the development of Embedded Systems. Embedded C is perhaps the most popular languages among Embedded Programmers for programming Embedded Systems. There are many popular programming languages like Assembly, BASIC, C++ etc. that are often used for developing Embedded Systems but Embedded C remains popular due to its efficiency, less development time and portability.

K. Arduino IDE

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board. Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package

VII IMPLEMENTATION

A. Flow Chart for Arduino UNO

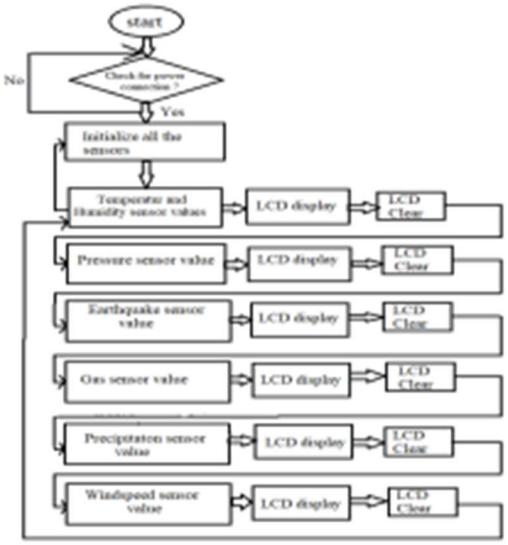

Fig 2(a). Flow chart for Arduino UNO

Steps

1. START
2. Check for the power supply connection, If No go back and check again for power connection.
3. If Yes then, Initialize all the sensors
4. Once all the sensors are initialized, the respective sensor values will be displayed on the LCD display one after the other.
5. END

B. ***Flow Chart for Node MCU***

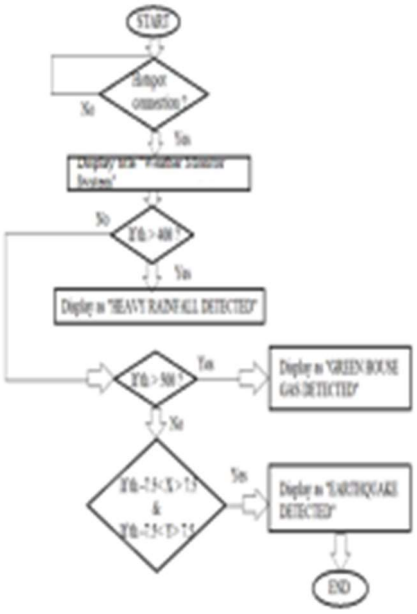

Fig 2(b). Flow chart for Node MCU

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Steps

1. START
2. Initially check for Hotspot connection, If No loop back to again for Hotspot connection.
3. If, Yes display weather monitoring station in Telegram Botfather account.
4. Check if the threshold value of precipitation sensor exceeds 400, If Yes then display as "HEAVY RAIN FALL DETECTED".
5. If No, check whether the threshold value of the gas sensor exceeds 500, If Yes then display as "GREEN HOUSE GAS DETECTED".
6. If No, check whether the threshold value of the earthquake sensor ranges between -7.57.5 & - 5.57.5, If Yes then display as "EARTHQUAKE DETECTED".
7. END

VIII RESULT

The sensors used in our project for sensing the weather parameters such as Temperature, Humidity, Pressure, Earthquake Detection, Green House Gas Detection and Precipitation are connected to the Arduino Uno board. The values detected by each sensor are displayed in the LCD display and the values get updated every 10 seconds as programmed in Arduino IDE software using Embedded C Language. In addition to this, we have programmed the device to send alert message to your Telegram Botfather account which is named as Weather Monitoring System. The alert message for Heavy Rain Detection, Earthquake Detection and Green House Gas Detection will be sent to the telegram. As a Wi-Fi module NodeMCU is used, which is connected to Arduino Uno board's Tx and Rx pins. Once the Node MCU is connected to the nearest hotspot the device and your mobile gets paired and we get the alert message. All the sensors are connected to the Arduino UNO analog inputs and the digital output of The Arduino UNO board is connected to the LCD display.

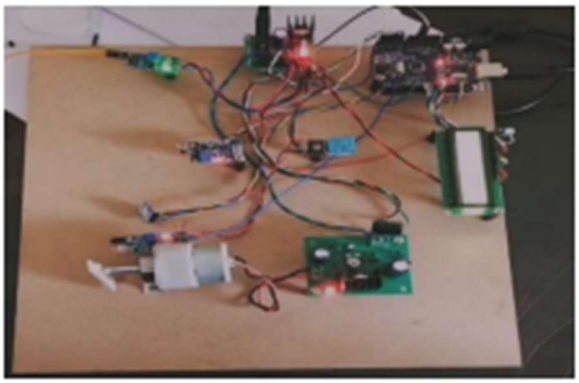

Fig 3. Weather Station when powered up

The main supply which is 230 volts to 240 volts AC is converted to 12 volts DC using an adaptor. The adaptor is connected to a DC to DC buck converter used in the model. The power supply will provide 3 volts to 5 volts to each component. Alert message is sent to the telegram Botfather account via the wifi module connected to the Arduino UNO board.

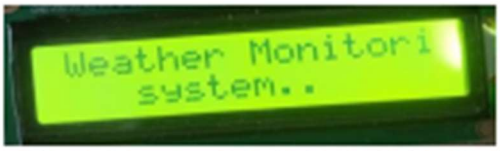

Fig 4. First message displayed

when model is powered up When the power supply is given to the model the first message to be displayed is shown in the figure above.

Fig 5. Pressure and Temperature output displayed.

The temperature output from the DHT11 sensor and the pressure output from the pressure sensor are displayed in the LCD screen.

Fig 6. Relative Humidity and Temperature output displayed.

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The relative humidity and the temperature output from the respective sensors are displayed in the LCD display.

Fig 7. Accelerometer output displayed

The output from the accelerometer is always displayed in x axis and y axis. When the sensor detects any vibration in the surface it displays the detected values.

Fig 8. Precipitation output displayed

This sensor will detect the rain fall and display the amount of rainfall hence called as precipitation sensor.

Fig 9. Wind speed output displayed

The speed of wind is detected using the DC motor by varying the intensity of the motor for the purpose of the model but in large scale wind mills are used to detect the wind speed based on the RPM (Revolutions per Minute).

Fig 10. Carbon monoxide output displayed

Fig 11. Alert message for green house gas detection displayed

Once the detected gas exceeds the threshold value it displays the alert message in the LCD display.

Fig 12. Alert message for Heavy Rain Detection displayed

Initially the precipitation value is zero. Once the droplets of rain falls on the sensor it detects and displays as Heavy rain fall detected in the LCD Display.

IX CONCLUSION AND FUTURESCOPE

A. Conclusion

The implementation of weather monitoring system using Node MCU done as per the specifications above and the data insights are generated in web based portal. The access to this data is available in the intranet with the current level of implementation and it could be made public when the data is made to store in cloud servers or other sources in the internet. This proposed system is the most compact unit for measuring weather parameters in regions suffering from the PM 2.5 pollution. This device in multiple nodes can be connected to the internet from various locations of study.This connectivity will aid the user to monitor the weather metrics corresponding to pollution over a centralized data analytics server.

B. Future scope

Adding of more sensors to monitor other environmentalparameters such as Soil PH Sensor, CO2 and oxygen Sensorwhile allowing the replacing of current sensors if a widerrange of measurements is desired. And also Integration ofadditional monitoring devices such as a Wi-Fi camera tomonitor growth of agricultural product. And also the data canbe uploaded to web server continuously.

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C. Possible Outcomes

The data monitored is collected at the web server. The system is designed in such a way that system can work 24x7 and give precise data of temperature, humidity, atmospheric pressure and wind speed on real time basis. It can also be used in precision farming. The same system setup can also give facility to operate different kinds of devices such as water pumps, located remotely using a Mobile phone from anywhere using internet connectivity. Using these system farmers can switch on and off their pump from their home or where ever they want using their mobile phone.

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