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IoT Based Weather Monitoring System

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Abstract—*The described system combines a data collection method and control system based on two research fields to build a sizable database system that is dependent on the used characteristics to produce the provided data. The innovation underlying this is called the Internet of Things (IOT), a cutting-edge and effective method that ties everything in the world of things together in a network. In the submitted effort, we will keep an eye on the Pune region's live weather parameter. The system is concerned with tracking changes in the weather and environment, including those related to temperature, humidity, illuminance, precipitation, and airborne carbon monoxide concentrations. The necessary hardware consists of an ESP8266 Wi-Fi module, MQ-135 rain sensor, an Arduino UNO, DHT11, and LDR. The information collected by these sensors is transmitted to the website, where it is shown through graphical statistics. Anyone on the planet may readily access the data that has been uploaded to the website. This web pages' data collection can also be utilised as a reference in the future. The design also includes a buzzer, which is utilised as an alarm system to notify people when any parameter reaches a high level or when the weather suddenly changes dramatically.*

INTRODUCTION

An essential part of weather management and monitoring is to anticipate and forecast the weather, which enables data to be collected to create a more in-depth picture of a country's climate and patterns within it. The current economic and technological advancements, which seldom have any noticeable effects on the environment, have raised major questions about pollution and climate change. According to the international panel on climate change (IPCC), human actions have an undeniable and steadily growing impact on the climate cycle, with recent alterations that are unseen of across centuries or millennia. The market for weather monitoring systems is expected to increase from 20000 crores in 2021 to 26000 crores in 2026, at a growth rate of 5.1% each year for the anticipated timeframe.

The effects of the state of the environment brought about a number of difficulties in a variety of industries, including agriculture, manufacturing, construction, and more. In contrast to other businesses, farming productivity is most significantly impacted by the weather. It can affect all farming operations done throughout the planting period, including crop growth, overall production, bug occurrences, water and fertilizers requirement, and pest occurrence. In other words, open- air farming depends heavily on the weather and is vulnerable to its gloomy conditions, particularly in the modern era when climate change causes unpredictable weather that is out of people's control. The Internet of Things (IOT) is the technology underlying this system. After the internet, the internet of things is seen as an innovation and financial wave in the global data economy. The expansion and improvement of Internet- based systems, increases communication between people and people, as well as between individuals and objects or objects and object.

The phrase "Internet of Things" (IoT) refers to networks of real-world items that have sensors, programming, and other technological components that allow them to communicate with other online systems and devices and exchange data. Thus, the IoT concept aims to make the internet considerably more pervasive and impossible to escape. For farmers, an application case where they may ensure higher agricultural productivity and lessen weather hazards is provided by the IoT weather reporting system. The weather station powered by the Internet of Things (IoT) is beneficial for monitoring the weather in places like rain forests and volcanoes. The best approach to safeguard crops and ensure a high and healthy yield is to be informed of current meteorological conditions such air and dew temperature, precipitation, and humidity. Severe weather events like drought, flood, hail, or cold may instantly stress plants, which can result in failing output and higher costs.

Accurate weather forecasts are required in order to control and guarantee a profitable crop output. Farmers that depend heavily on the weather have a lot to gain from this information, which is accessible on any medium (radio, TV, mobile, or computer). Weather and crop growth are tightly

intertwined. Certain crops must germinate and develop at specific temperatures, either high or low, in order to begin. On the other hand, temperatures and humidity are frequently utilized to forecast the presence of certain insect pests and diseases. We keep an eye on the Pune region's live weather parameters. The hot, semi-arid (BSh) climate of Pune is close to the tropical wet and dry climate (Aw). Pune takes up 5.10% of the state of Maharashtra's total land area. At the base of the Sahyadri Mountains in western Maharashtra, the Pune district's terrain is divided into three triangles. This approach can be employed to monitor and manage the consequences that changes in climate have on people, plants, and animals.

We are keeping an eye on a variety of characteristics in this system, including temperature, humidity, and rainfall, light intensity, and air pollution. All sensors are positioned in various areas to gather data and forecast the behavior of a certain region of interest. To monitor, regulate, and maintain a specific environment, the following parameters' real-time values will be updated via an IoT dashboard. The necessary parameters are remotely monitored over the internet, and the sensor data is stored in the cloud in order to display the predicted trend on the web browser. We have made advantage of thing speak's cloud services. If the pollution level rises over a specific threshold at any time, the buzzer is utilized to alert people. The environment becomes interacting with other objectives by applying embedded intelligence. This is among the applications that IoT- based weather monitoring focuses on.

METHODOLOGY

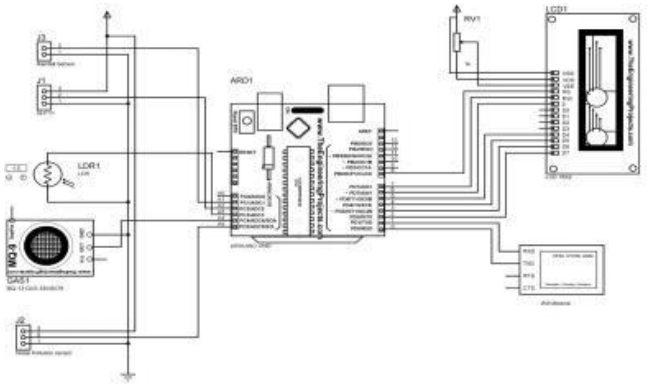

Figure 1: Circuit Diagram.

The system consists of an ATmega328 microcontroller housed in an Arduino UNO, with 14 digital pins, 6 analogue pins, 1 serial transmission port, 1 SPI port, and 12C ports. The brain of the device is the Arduino UNO. All of the linked sensors are in the same numerical sequence as the sensor we used in our project to determine the number. DHT11 temperature sensor, which provides statistics on both temperature and humidity. The smoke detector was deployed, which will tell us of the pollutants in the neighborhood. Light intensity is measured and rain is identified using both the weather reader and the LDR sensor. We used ESP8266, a Wi-Fi module that will assist us in connecting to the internet. To begin with, the Wi-Fi module is wired to the TX pin of an Arduino UNO and runs on 3.3 volts. It aids in connecting to the global web using AT commands and then assists in uploading data to the cloud once connected. The sensors are primarily analog, such as the rainfall sensor, gas sensor, and LDR, so these sensors will wired to the analogue port of the Arduino UNO because it has six analogue inputs. The Arduino UNO's primary function is to transform the analogue data to digital and provide us with the result. We will be utilizing Thingspeak's cloud-based services. If the amount of pollution ever rises above a certain threshold, an alarm will be utilized as an alert.

HARDWARE DESCRIPTION

Arduino UNO:

Figure 2: Arduino UNO

The system's brain is the microcontroller. The controller is connected to all of the sensors. All sensor values are taken by the microcontroller via the Wi-Fi module, the microcontroller is connected to the internet. After that, all of the data is posted to the server.

LDR Sensor

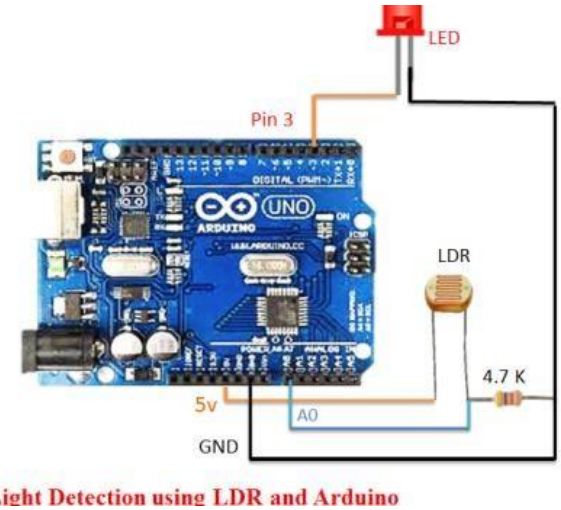

Figure 3: Interfacing of Arduino with LDR

An LDR is a changeable resistor that is light-controlled. Its susceptibility to light diminishes as the light's intensity rises. The resistance of the most prevalent LDR variety decreases as the amount of light striking the instrument increases. The following resistances are frequently present in an LDR's resistance:

Daylight = 5000 ohm
Dark = 20000000 ohm

Rain Sensor

Figure 4: Rain Sensor

A simple instrument for detecting rain is the rain sensor module. As a raindrop passes through the rainy board, it may be utilized as a switch, and it can also be used to gauge how hard the rain is falling. The module has a separate rain board and control board for convenience's sake, a power indication LED, and a potentiometer- controlled adjustable sensitivity. The analogue output is utilized to monitor decreases in rainfall volume. The LED is going to light up when the induction panel has no raindrops and the DO production is high when connected to a 5V power supply. The switch indication will illuminate when just a little amount of water is dropped and DO production is low. After you remove the water droplets and return the output to its original state, it will be at a high level.

DHT11 – Temperature and Humidity Sensor

Figure 5: DHT11 Sensor

A set of temperature and humidity sensors with a digital data output that is standardized is part of the DHT11 Temperature & Humidity Sensor. It guarantees great dependability and outstanding long-term stability by utilizing the unique gathering of digital information approach, temperature and humidity sensor technology. This sensor plugs to a resistive-type measuring element and an NTC temperature gauging element are combined by a high performance 8-bit microcontroller to offer excellent quality, quick reaction, interference immunity, and cost effectiveness. Thermistor sensor is utilized on the basis that resistance lowers as temperature rises and vice versa.

MQ-135 Sensor

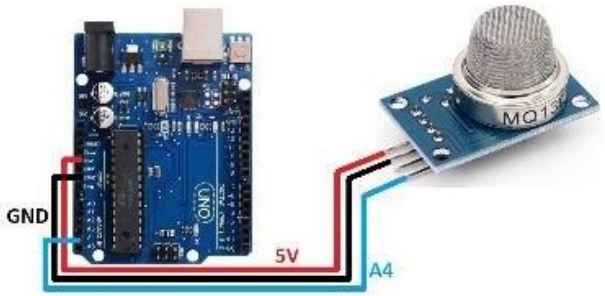

Figure 6: Interfacing of Arduino with MQ-135 Sensor

To gauge the degree of air pollution in a given location, MQ 135 air quality sensor is utilized. The sensing element is encased behind a steel frame that makes up the gas sensor module. With connecting leads, electricity is applied to this sensor device. The gases that are near the sensing element get ionized and are captured by the sensing element. This current, also known as heating current, passes across them.

Sound Sensor

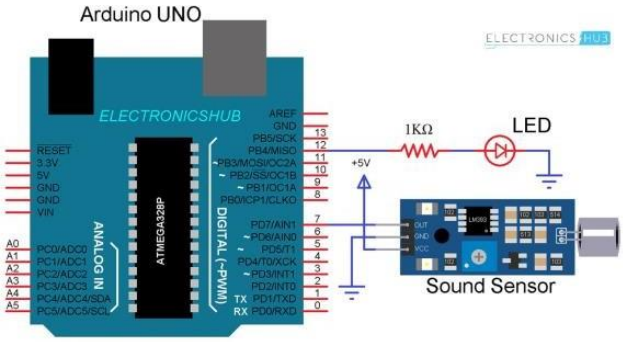

Figure 7: Interfacing of Arduino UNO with sound sensor

The sensor measures the level of noise pollution, and it provides that information to the microcontroller. Noise pollution is measured using acoustic sensors. The sound sensor module, which frequently measures sound strength, provides a straightforward listening technique. Applications involving security, switches, and monitoring can all utilize this module. For ease of use, its precision may be quickly modified. The input source for the amplifier, peak detection and buffer is a microphone. The sensor completes the required processing when it senses sound after processing an output signal voltage that is relayed to a microcontroller.

ESP8266 Wi-Fi Module:

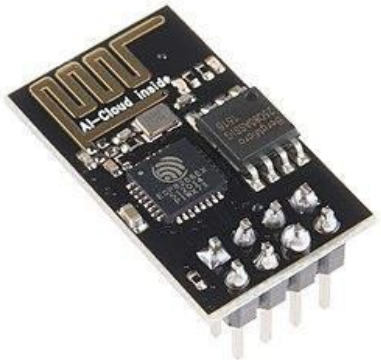

Figure 8: ESP8266 Wi-Fi Module

A self-contained SOC with an integrated TCP/IP protocol stack, the ESP8266 Wi-Fi Module enables any microcontroller to connect to your web connection. All Wi-Fi networking duties can be transferred to ESP8266 from another application processor or a website running an application. Microcontrollers may join to 2.4 GHz Wi- Fi using IEEE 802.11 bgn thanks to the ESP8266 module. It can be used with an RTOS-based SDK to function as an independent MCU or with ESP-AT firmware to provide Wi-Fi access to external host MCUs.

RESULT

"The IOT Based Weather Monitoring System" monitors and control various parameter such as temperature, humidity, air pollution, rainfall and Light intensity. The necessary parameters are remotely monitored over the internet, and the sensor data is stored in the cloud in order to display the predicted trend on the web browser. We have made advantage of thingspeak's cloud services. If the pollution level rises over a specific threshold at any time, the buzzer is utilized to alert people. Following Fig shows a prototype development for a weather monitoring system with some parameters.

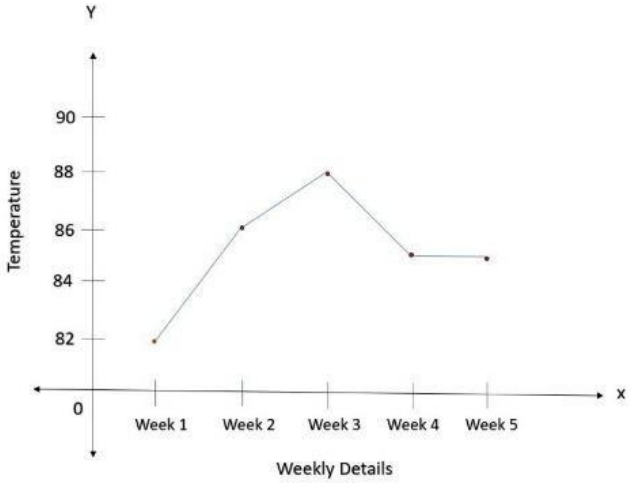

Figure 9: Temperature Vs Time

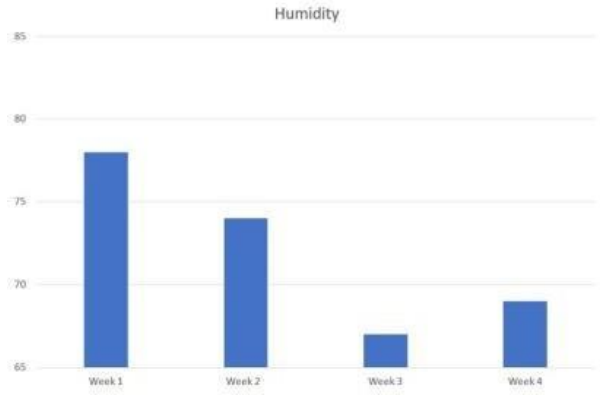

Figure 10: Humidity Vs Time

Figure 11: Air Quality Index Vs Time

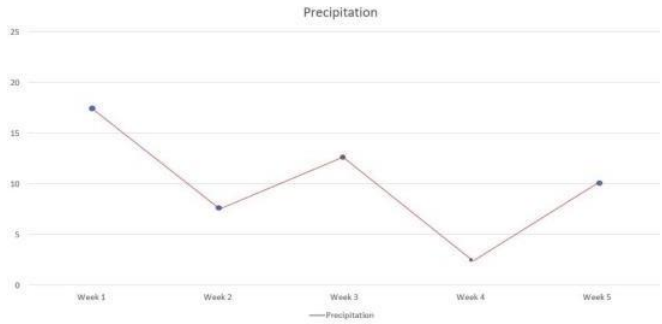

Figure 12: Precipitation Vs Time

CONCLUSION

Given that weather is a transient air condition, it is important to predict short-term weather as precisely and rapidly as feasible. Maintaining implanted devices in the natural setting for surveillance allows the environment to defend itself. We can make the environment more realistic by placing sensing devices there, allowing the environment to communicate with other things over a network. Using a number of devices, the suggested method gathered information about the surroundings, analyzed it, and then made it accessible to the user via a wireless connection. This info will be helpful for upcoming research and it is simple to share with other consumers. As is well known, weather influences have a significant impact on human activities. This system will offer

a significant means of saving real-time weather parameters and assist farms, businesses, regular people, and others whose everyday lives are impacted by weather and its parameters. This device is affordable, uses little electricity, and can be further developed to watch.

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