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WEATHER MONITORING SYTEM USING ARDUINO

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ABSTRACT
A reliable weather monitoring system is crucial in the agricultural sector to support informed decision-making and efficient farm management. The proposed solution involves a simple yet effective setup using an Arduino UNO-based system to measure key weather parameters such as temperature and humidity. These environmental conditions are detected using appropriate sensors integrated into the system. The collected data is then transmitted via Bluetooth, allowing users to access real-time weather information directly on their smartphones. This system aims to monitor, record, and display vital weather data to aid agricultural practices.

Keywords:
Climate control, Weather analysis, Temperature Moderation, Moisture Control, Humidity Control, Arduino

INTRODUCTION
The weather monitoring device is designed to track key environmental variables such as temperature, humidity, air pressure, and rainfall. Weather monitoring plays a vital role in our daily lives, and this system allows individuals to access real-time weather data without relying on traditional forecasting organizations. The device uses various sensors, including the DHT11 sensor, to measure temperature and humidity. Collected data can be stored for future reference and accessed instantly through a smartphone via a wireless connection. This system offers a convenient and efficient way to monitor weather conditions anytime and anywhere [1].
Weather forecasting is the application of science and technology to predict the atmospheric conditions at a specific location. While humans have attempted to forecast the weather informally for thousands of years, formal methods have been in practice since the 19th century. Modern forecasting involves collecting quantitative data on the current state of the atmosphere and applying scientific knowledge of atmospheric processes to predict future conditions [1, 3].
Weather patterns are primarily influenced by differences in air pressure, temperature, and moisture between different regions. These differences often arise due to variations in solar radiation, which depends on geographical factors such as latitude. Because the atmosphere behaves as a chaotic system, even minor changes in one area can lead to significant and unpredictable impacts elsewhere. This inherent complexity limits the accuracy of forecasts, especially beyond a few days. Although ongoing research in meteorology continues to improve prediction models, it remains theoretically impossible to produce reliable day-to-day forecasts more than about two weeks in advance [2].
Traditionally, weather forecasting was based on observable phenomena such as changes in barometric pressure and sky conditions. Today, it relies heavily on sophisticated computer-based models that simulate atmospheric behavior using a wide range of variables. Despite advancements in automation, human expertise remains vital for interpreting model outputs, selecting the most reliable forecast, and accounting for known model biases through pattern recognition and contextual understanding [1, 4].

LITERATURE SURVEY
Survey 1: Arduino-Based Weather Forecasting Station
This study presents the development of a smart weather forecasting station that uses an Arduino-based processor to monitor weather conditions throughout the day. Traditional weather forecasting systems, typically managed by national meteorological departments, are often complex and costly for private use. To address this, the

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proposed system offers a cost-effective and user-friendly solution. It processes data from various sensors—temperature, humidity, pressure, and rainfall—and provides users with approximate weather forecasts on a daily, weekly, or monthly basis [3].

Survey 2: Arduino-Powered Smart Weather Monitoring System

This project focuses on designing a smart weather monitoring system that integrates real-time data acquisition with a two-dimensional control mechanism. A variety of sensors are employed to measure and control environmental parameters, primarily temperature and humidity. The collected data is displayed internally and on an LCD panel for user interaction. The system is capable of monitoring specific locations and can occasionally adjust environmental settings based on predefined parameters. The result is a responsive system that displays accurate, real-time weather conditions [4].

Survey 3: Real-Time Standalone Data Acquisition System for Environmental Monitoring

This research highlights the importance of real-time environmental monitoring for applications in agriculture, industry, and residential settings. Using an Arduino UNO microcontroller, the system collects data from both analog and digital sensors to measure temperature, humidity, dew point, light intensity, and gas concentrations. The LabVIEW 2015 platform serves as the user interface, providing intuitive visualization of the collected data. The system also supports Wi-Fi-enabled data transmission to a cloud account, allowing users to access weather information remotely from anywhere in the world. This standalone system is ideal for comprehensive and continuous environmental monitoring [5].

Survey 4: IoT-Based Data Logger for Weather Monitoring Using Arduino-Based Wireless Sensor Networks

This study proposes an automated weather monitoring system utilizing embedded systems and Internet of Things (IoT) technology. The system is designed to provide real-time and dynamic climate statistics for a specific location. Built around an Arduino-based wireless sensor network, it integrates sensors to measure environmental parameters such as temperature, humidity, and the presence of gases. The captured data is transmitted wirelessly to a remote database or application, where it can be visualized in the form of graphs and tables. Additionally, the system includes features for real-time alerts, enhancing its usefulness for continuous environmental monitoring and timely notifications [6].

PROPOSED METHODOLOGY

Today, many advanced systems are available for continuous weather monitoring. However, these systems are usually designed for large-scale implementation, covering entire cities or states. Deploying such complex systems for small areas is not practical due to their high cost, complexity, and maintenance requirements.

To address this issue, we propose a compact and cost-effective weather monitoring system tailored for small-scale environments. Our system uses three sensors to measure key environmental parameters, including:

- Temperature
- Humidity
- Light Intensity
- Dew Point
- Heat Index
- System Functionality

The sensor data is read and processed by an Arduino microcontroller. The Arduino:

- Stores the readings in a text file for future analysis.
- Displays real-time data on an onboard LCD screen for quick reference.

This setup enables local weather tracking and pattern recognition over time. The recorded data is essential for understanding localized climate behavior and is stored in a database for further study.

Hardware Components

DHT11 Sensor

Used to measure temperature and humidity. It collects data directly and is controlled via Arduino code.

Wind Speed Sensor

Generates power based on wind flow, which is sent to pin A1 on the Arduino. The wind speed is then calculated using predefined formulas within the Arduino software.

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LDR (Light Dependent Resistor) Module
Detects light intensity falling on the photoresistor. Based on the light level, the system determines whether it is day or night, and this information is shown on the LCD.

System Configuration
All sensors and modules are powered via 5V and GND from the Arduino board. The full wiring and layout of the system are shown in Figure 9, which outlines the complete connection scheme.

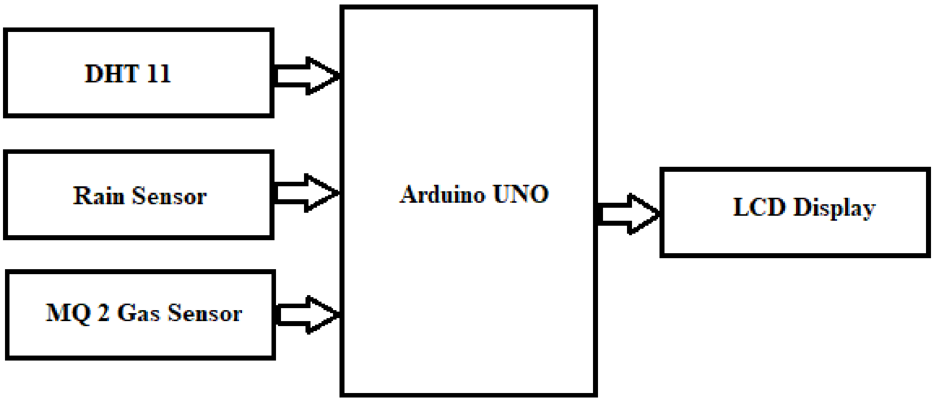

Figure 1. Block diagram

This system incorporates the following key components:

- DHT11 sensor for measuring temperature and humidity.
- Rain sensor to detect the presence and intensity of rainfall.
- MQ135 gas sensor to assess air quality by detecting harmful gases like CO_2, ammonia, and benzene.
- I2C LCD display for real-time data visualization, using only two Arduino pins for communication (SDA and SCL).

The Arduino continuously collects data from all sensors and processes the readings to be displayed. This setup enables users to monitor critical environmental conditions at a glance, making it suitable for use in homes, schools, farms, or remote outdoor installations.

Working of Proposed System

- Start the System

Power on the Arduino using USB or battery.
Arduino initializes all sensors (DHT11, rain sensor, gas sensor) and the I2C LCD display.

- Read Temperature and Humidity

The DHT11 sensor sends temperature (in °C) and humidity (in %) data to the Arduino.
Arduino stores and processes the values.

- Read Rain Sensor Data

The rain sensor provides either:
A digital signal indicating whether rain is detected or not, OR
An analog value indicating the intensity of rain.
Arduino reads the value to determine the presence or absence of rain.

- Read Gas Sensor Data

The MQ135 gas sensor outputs an analog signal.
Arduino reads this value to determine air quality (e.g., clean, moderate, or polluted), based on threshold values.

- Process and Interpret Data

Arduino compares sensor readings with pre-defined thresholds to interpret:
If temperature or humidity is too high/low.

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If it is raining.
If air quality is good, moderate, or poor.

- Display Data on I2C LCD

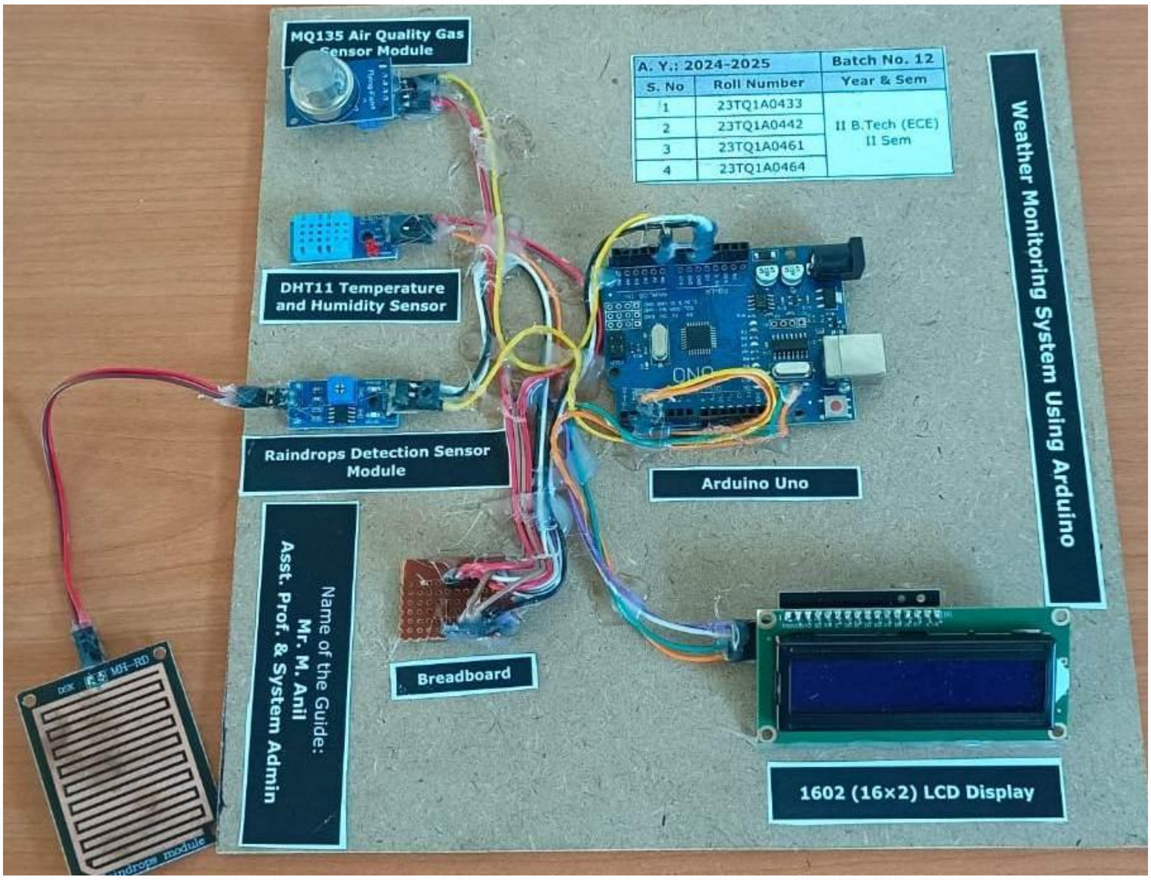
The Arduino sends formatted sensor readings to the I2C LCD.

- Repeat Continuously

After a short delay (e.g., 2–5 seconds), the system updates readings.
The loop repeats indefinitely, allowing real-time monitoring.

RESULTS AND DISCUSSION

The software is made up of a free-running programmed that modifies data from the DHT 11 sensor. Written on an Arduino sketch, the programmed code is then uploaded to the Arduino Uno development device. The Arduino sketch IDE software is used to create the hex file.



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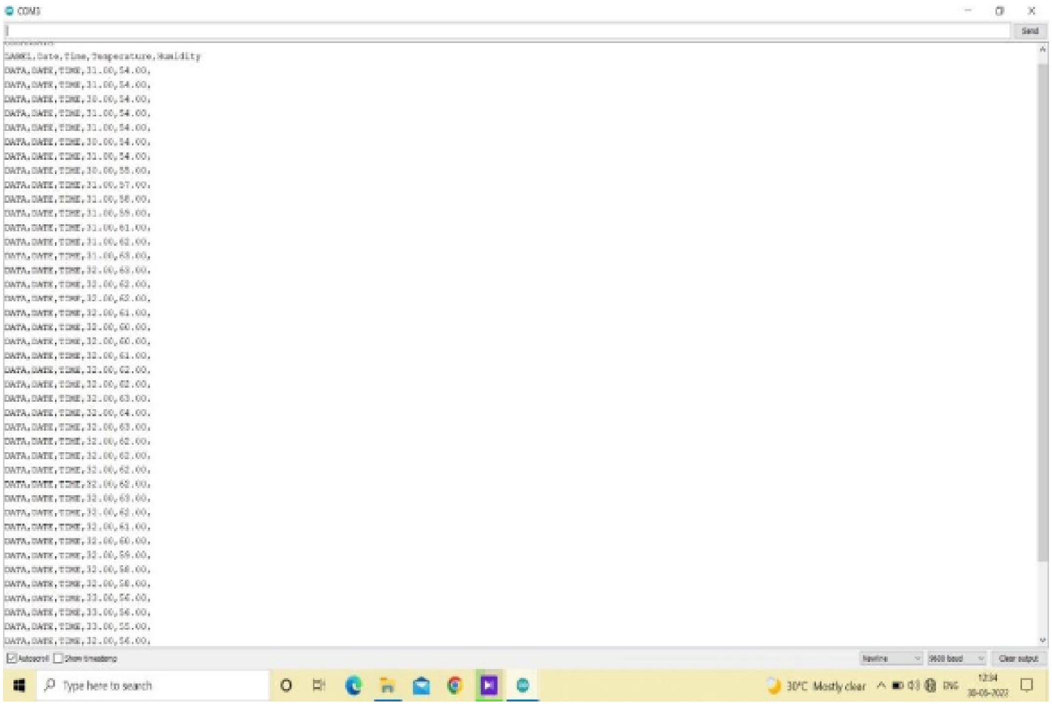

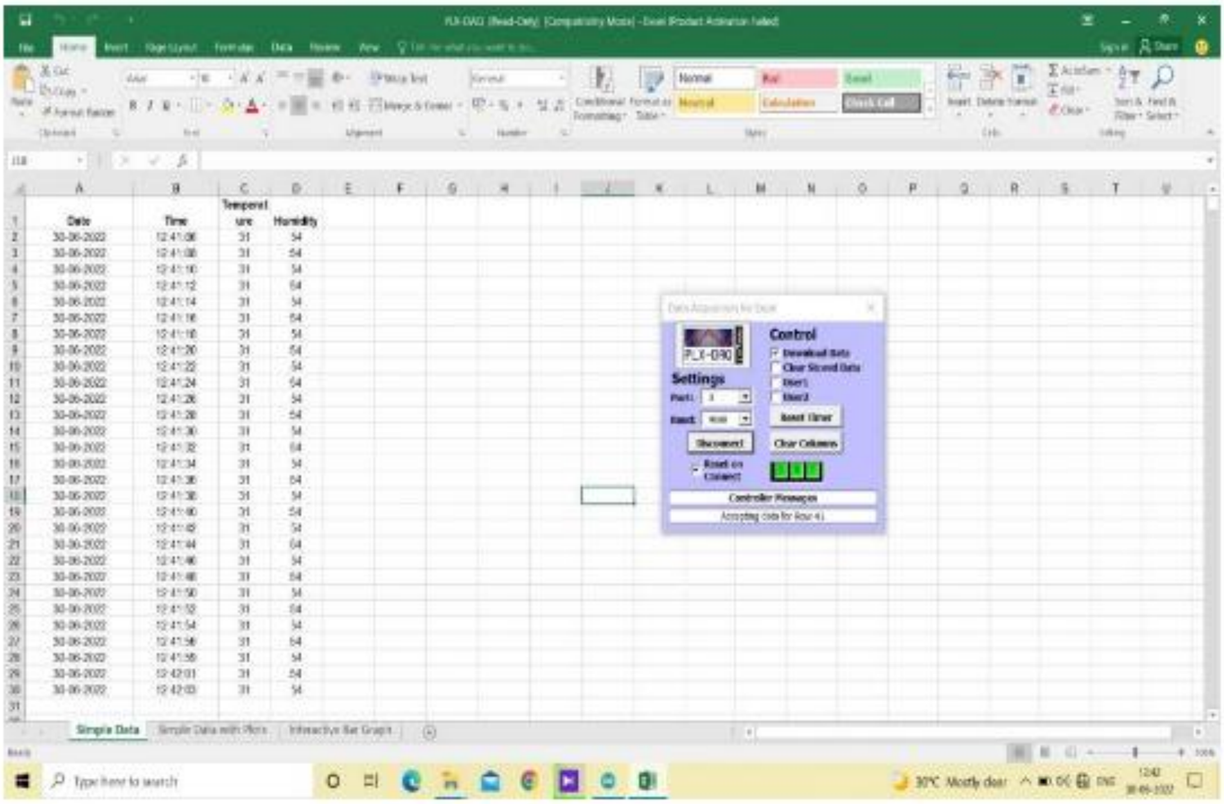

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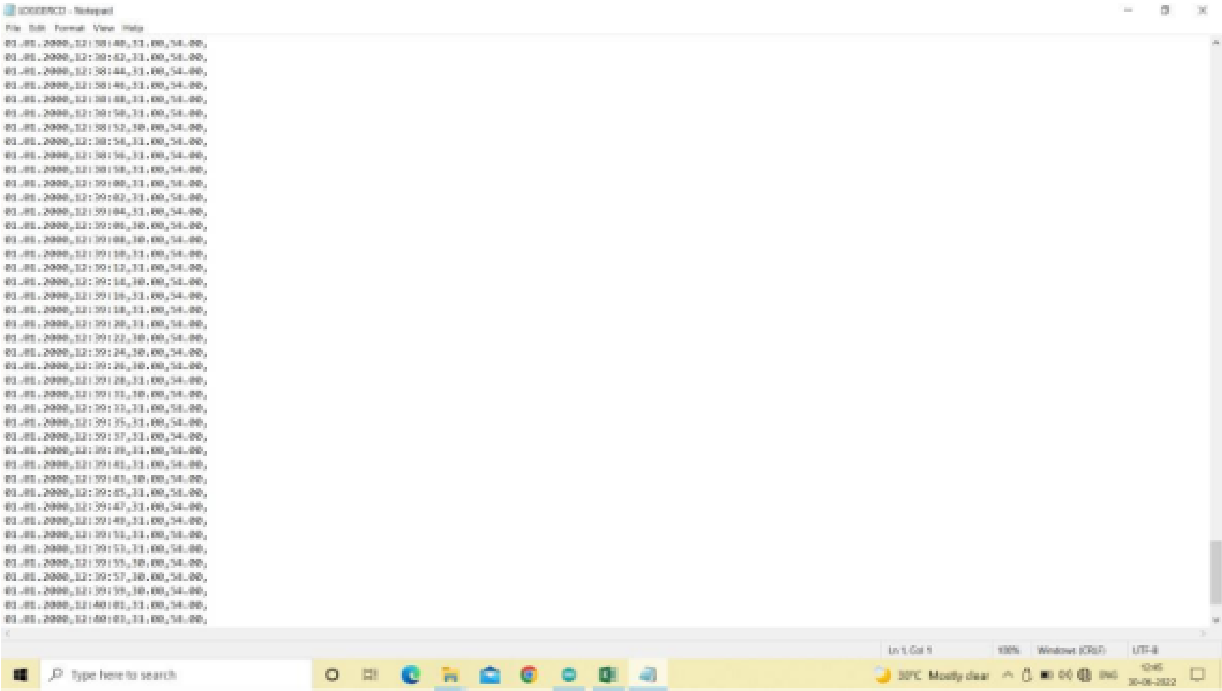

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CONCLUSION

This paper presents a simple, low-cost system designed to accurately measure key climate components. Such a system is highly valuable, especially for organizations and businesses that rely heavily on weather data to make informed decisions. By providing real-time weather insights, the system enhances weather prediction processes and helps in effective site management based on changing environmental conditions. Functioning as a supervisory controller, the system monitors fluctuations in weather or other environmental factors and enables responsive control through feedback mechanisms. In conclusion, the proposed system can be divided into two main applications: For organizations and companies — especially those that plan and manage operations influenced by weather conditions, such as transportation networks, and agriculture. These sectors depend heavily on accurate weather monitoring to optimize their activities. For practical daily use — including applications in agriculture to assist farmers dealing with unpredictable climate changes, as well as managing conditions in homes and markets. This versatile system offers a reliable and affordable solution to adapt operations and activities based on real-time weather data.

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