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Arduino based Weather Station

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Abstract

Weather monitoring is an essential aspect of modern smart cities, agriculture, and environmental research. Traditional weather stations are costly and not easily accessible for small-scale applications. This paper presents the design and implementation of an Arduino-based weather station that monitors temperature, humidity, and atmospheric pressure in real time. Using low-cost sensors such as DHT11/DHT22 and BMP180, combined with Arduino Uno and LCD/IoT modules, the system provides accurate weather data at an affordable cost. Experimental results validate its efficiency and reliability in real-time applications.

Keywords: Arduino, Weather Station, IoT, Temperature, Humidity, Atmospheric Pressure

I. Introduction

Weather plays a crucial role in agriculture, transportation, disaster management, and daily life. Accurate and localized weather information is critical for farmers, researchers, and environmentalists. However, commercial weather monitoring systems are expensive and often not suitable for small-scale or educational applications.Recent advancements in microcontrollers and low-cost sensors have enabled the development of compact, economical, and efficient weather monitoring devices. Arduino-based systems are widely used due to their open-source nature, ease of programming, and compatibility with a wide range of sensors.

This work aims to design a cost-effective Arduino-based weather station capable of measuring environmental parameters like temperature, humidity, and atmospheric pressure, with future scalability to cloud-based IoT platforms.

2. Literature Review

Previous research highlights various approaches to weather monitoring:

- Smith et al. (2019) developed a solar-powered weather station using Raspberry Pi for precision agriculture.
- Gupta & Sharma (2020) implemented an IoT-enabled Arduino weather station integrated with ThingSpeak for cloud data logging.
- Kumar et al. (2021) proposed an energy-efficient wireless weather station for remote rural areas.

These works demonstrate the trend toward low-cost, real-time monitoring. However, many designs require higher processing power or complex networking. This paper focuses on a simple, reliable, and low-cost Arduino-based solution.

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SYSTEM DESIGN

Hardware Components

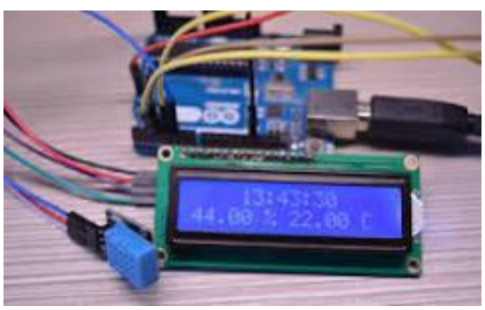
- Arduino Uno – Microcontroller for data processing.
- DHT11/DHT22 Sensor – Measures temperature and humidity.
- BMP180/BME280 Sensor – Measures atmospheric pressure.
- 16x2 LCD Display – Displays real-time readings.
- Wi-Fi Module (ESP8266) – Optional, for IoT integration.
- Power Supply – USB or battery.

System Block Diagram

- Here’s a conceptual diagram you can use (I can generate it as an image if you like):
- Here’s a conceptual diagram you can use (I can generate it as an image if you like):

```
css
CopyEdit
[Sensors: DHT11, BMP180]
          ↓
    [Arduino UNO]
          ↓
   [LCD Display] —— [Wi-Fi Module (optional)] —— [IoT Cloud / PC]
          ↓
     [Power Supply]
```

Circuit Diagram (schematic)



Connections:

- DHT11 → Arduino digital pin 7
- BMP180 (I2C) → Arduino SDA (A4), SCL (A5)
- LCD 16x2 → Arduino digital pins (RS=12, E=11, D4=5, D5=4, D6=3, D7=2)
- Wi-Fi ESP8266 → TX/RX pins

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SOFTWARE IMPLEMENTATION

- **Arduino IDE** used for programming.
- Libraries:
  - `DHT.h` for temperature/humidity.
  - `Adafruit_BMP085.h` for BMP180.
  - `LiquidCrystal.h` for LCD interface.
- Code flow:
  1. Initialize sensors and LCD.
  2. Read data from sensors.
  3. Display readings on LCD.
  4. Transmit data to IoT platform (optional).

RESULTS

The prototype successfully measured environmental parameters:

Parameter	Sensor Used	Accuracy	Range	Observed Value (Sample)
Temperature	DHT11	±2°C	0–50°C	29.4 °C
Humidity	DHT11	±5% RH	20–90% RH	58 % RH
Pressure	BMP180	±1 hPa	300–1100 hPa	1002 hPa

Graphical plots of real-time data (temperature vs. time, humidity vs. time) can be drawn for visualization.

APPLICATIONS

- **Agriculture:** Soil and crop monitoring.
- **Smart Cities:** Localized weather updates.
- **Disaster Management:** Predicting storms, floods.
- **Education:** Low-cost learning tool for students.

CONCLUSION

This paper presented a cost-effective Arduino-based weather station capable of measuring and displaying real-time temperature, humidity, and atmospheric pressure. With IoT integration, the system can be expanded to provide remote monitoring and data analytics. Future enhancements may include solar power, additional sensors (rainfall, wind speed), and AI-based weather prediction.

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