# Real Time Weather Prediction System using IOT and Machine Learning Algorithm

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***Abstract*—This paper proposes a real-time weather prediction system that utilizes IoT and Machine Learning algorithms. The system consists of a network of sensors that collect data on temperature, humidity, pressure, and other weather variables. This data is sent to a Local server and develop graphical interface using Python. Then calculate value and predict real-time weather using logistic regression Machine learning algorithms. The ML algorithms make predictions about real-time weather conditions, which are then displayed on a user-friendly graphical interface.**

***Index Terms*—NodeMCU, Jupyter Notebook, DHT11, Machine Learning Algorithm, LDR.**

## I. Introduction

Weather forecasting is a crucial aspect of modern society, providing valuable information for various sectors, including agriculture, transportation, and disaster preparedness. Traditional weather prediction methods rely on data collected from a limited number of weather stations, which can lead to inaccuracies and outdated information. To address these limitations, the integration of the Internet of Things (IoT) and machine learning (ML) has emerged as a promising approach for real-time weather prediction. IoT technology enables the deployment of a network of sensors that can collect environmental data in real time. These sensors can measure various meteorological parameters, such as temperature, humidity, pressure, and wind speed, providing a more comprehensive and up-to-date picture of the weather conditions. This vast amount of data can then be analyzed and processed using ML algorithms to extract patterns and predict future weather conditions. The proposed real-time weather prediction system leverages the power of IoT and ML to deliver accurate and timely weather forecasts. The system consists of a network of sensors strategically deployed in the target area, collecting real-time data on various weather parameters. This data is then transmitted to a local server for further processing and analysis. On the local server, a Python script is employed to develop a graphical interface (GUI) for visualizing the collected sensor data. The GUI provides a user-friendly interface for monitoring the current weather conditions and exploring historical data trends.

To extract meaningful insights from the sensor data, the system utilizes logistic regression, a powerful ML algorithm well-suited for classification tasks. Logistic regression is trained on historical weather data to establish a relationship between the collected sensor readings and the corresponding weather conditions. This trained model is then used to predict real-time weather conditions based on the current sensor readings.

## II. NOVELTY

The proposed system utilizes a local server for data processing and analysis, reducing latency and improving data privacy. Additionally, it incorporates a user-friendly Python-based GUI for visualizing sensor data and weather forecasts. Furthermore, the system employs logistic regression, a robust ML algorithm, to predict real-time weather conditions based on sensor readings.

## III. OBJECTIVES

Real-Time Weather Prediction System Using IOT and Machine Learning” is to design and implement a real-time weather prediction system that utilizes the Internet of Things (IoT) and machine learning (ML) algorithms to provide accurate and timely weather forecasts.

Some specific objectives of Real-Time Weather Prediction System Using IOT and Machine Learning Systems include the following:

**Sensor Network Deployment:** Deploy a network of weather sensors, including temperature, humidity, pressure, and other relevant sensors, to collect real-time environmental data.

**Data Collection and Transmission:** Establish a data collection mechanism where the sensor network continuously gathers weather-related data. Ensure the efficient transmission of this data to a local server for further processing.

**Data Processing and Storage:** Implement a data processing system, utilizing Python, to organize, process, and store the collected sensor data for analysis and model training.

**Machine Learning Model Development:** Create and train machine learning algorithms, specifically logistic regression, using historical weather data. These models will be used to make real-time weather predictions.

**Real-Time Weather Prediction:** Develop a mechanism to employ the trained machine learning models to make real-time weather predictions based on the current and historical data. Ensure that these predictions are accurate and timely.

## IV. Methodology

The proposed real-time weather prediction system employs a three-stage methodology: data collection, data processing and analysis, and prediction. Data Collection, Data Processing and Analysis and Prediction.

## V. Block Diagram

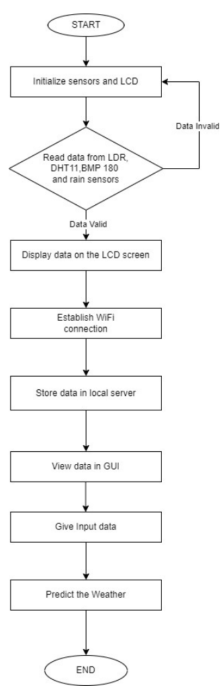


Fig. 1. Block Diagram

## VI. Hardware Illustration of the Proposed System

The IoT-Based Weather Station System integrates multiple sensors – LDR for light intensity, BMP180 for atmospheric pressure, DHT11 for humidity and temperature, and a rain sensor for rainfall detection. These sensors, combined with the Nodemcu (ESP8266) microcontroller acting as the gateway, enables real-time weather data collection. The LDR distinguish daylight from darkness, BMP180 monitors atmospheric pressure, and DHT11 measures humidity and temperature. The rain sensor detects rainfall intensity and duration.

1) Gateway or Data Collector:
   - Central hub responsible for collecting data from multiple sensors and facilitating communication with the online platform.
   - Utilizes Nodemcu (ESP8266) for processing and transmitting sensor data
2) LDR Sensor (Light Dependent Resistor):
   - Measures light intensity, detecting variations between daylight and darkness
   - Essential for understanding natural light conditions in the monitored area
3) BMP180 Sensor (Pressure Sensor):
   - CMeasures atmospheric pressure, providing vital data for weather forecasting and analysis.
   - Helps in monitoring changes in air pressure, which can indicate weather patterns.
4) DHT11 Sensor (Humidity and Temperature Sensor):
   - Measures humidity and temperature, key parameters for weather monitoring.
   - Enables the system to analyze humidity levels and temperature variations in the environment.
5) Rain Sensor:
   - Detects rainfall, allowing the system to measure precipitation levels
   - Provides crucial data for assessing rainfall intensity and duration, aiding in flood prediction and water resource management.
6) Gateway Communication with Online Platform:
   - Utilizes Wi-Fi connectivity to securely transmit sensor data to an online server or cloud-based platform named Blynk.
   - Establishes a reliable connection for real-time data updates and remote accessibility
7) Machine Learning and Prediction
   - Measure Real-time Data and predict weather
   - Use it for daily essential usages.

### Circuit Diagram

The proposed real-time weather prediction system utilizes the Internet of Things (IoT) and machine learning (ML) algorithms to deliver accurate and timely weather forecasts. The system comprises a network of sensors that collect real-time weather data, a local server for data processing and analysis, a logistic regression ML algorithm for weather prediction, and a graphical interface (GUI) for data visualization and interpretation. Compared to traditional methods, the proposed system offers enhanced accuracy, timeliness, and personalization. The vast network of sensors provides a more detailed and representative picture of weather conditions, enabling more accurate forecasts. Real-time processing and analysis ensure that forecasts are up-to-date and reflect the latest weather

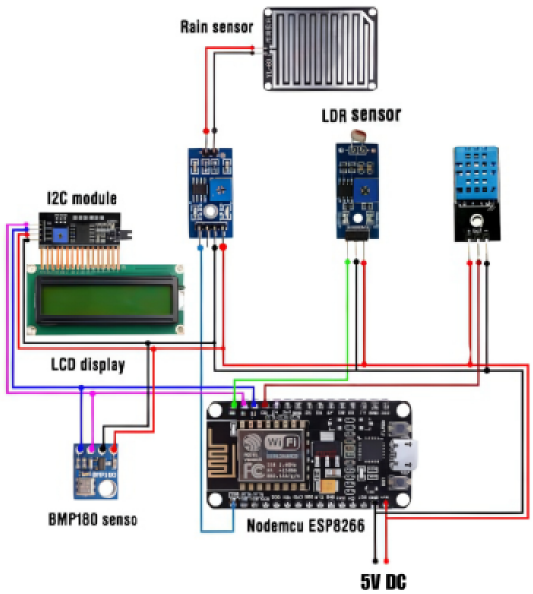


Fig. 2. Circuit Diagram

changes. Additionally, the system can be tailored to provide personalized forecasts for specific locations, catering to the needs of individual users.

## WORKING PROCESS

The IoT-Based Weather Station System operates seamlessly, combining sensor data collection, local display, and remote accessibility through a structured working process. The following steps outline the system's functioning:

**Step 1: Sensor Data Collection** The system begins by continuously collecting data from the integrated sensors – LDR for light intensity, BMP180 for atmospheric pressure, DHT11 for humidity and temperature, and the rain sensor for detecting rainfall. These sensors capture real-time environmental parameters crucial for weather analysis

**Step 2: Data Processing and Analysis** The collected sensor data is processed by the Nodemcu board, which acts as the system's central processing unit. The board interprets the analog signals from the sensors, converting them into digital data for further analysis. Algorithms embedded within the system software process this data, ensuring accuracy and reliability.

**Step 3: Local Display on LCD Screen** The processed weather data is displayed locally on an LCD screen. This local display provides immediate access to realtime weather information, allowing users to monitor the current conditions, including light intensity, temperature, humidity, atmospheric pressure, and rainfall, at the installation

**Step 4: Data Transmission to Online Platform** Simultaneously, the processed data is transmitted to an online platform named Blynk via the internet. Utilizing the Nodemcu board's Wi-Fi capabilities, the system securely transfers the weather data to a designated server. This step enables remote accessibility and long-term data storage for analysis and historical tracking

**Step 5: Web-Based Dashboard for Remote Access** The transmitted data is made accessible through a user-friendly web-based dashboard. Users can remotely access the weather information from any device with internet connectivity. The dashboard provides graphical representations, historical data, and real-time updates, allowing users to monitor weather patterns, make informed decisions, and plan activities based on current and past weather conditions.

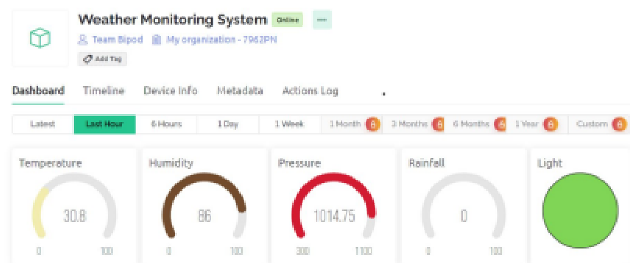


Fig. 3. Web based Visualization

**Step 6: Real-Time Updates and Notifications** The system continuously updates the online platform, ensuring that the weather data remains current and accurate.email or mobile app notifications, providing timely warnings about significant weather changes.

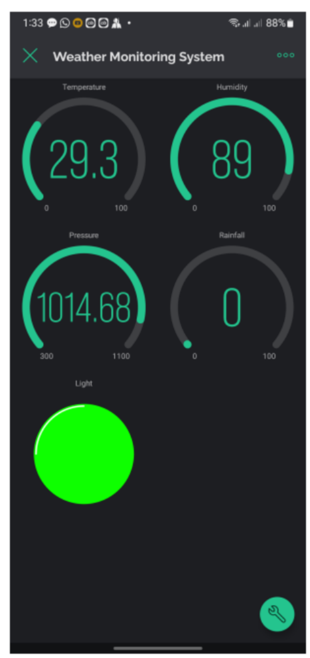


Fig. 4. App based Visualization

**Step 7: Data Analysis and Insights** The collected data is not only accessible but also open to analysis. Researchers, meteorologists, and policymakers can analyze the historical data to identify trends, patterns, and anomalies. This analytical capability facilitates in-depth studies, helping users gain insights into local climate variations and make data-driven decisions for various applications.

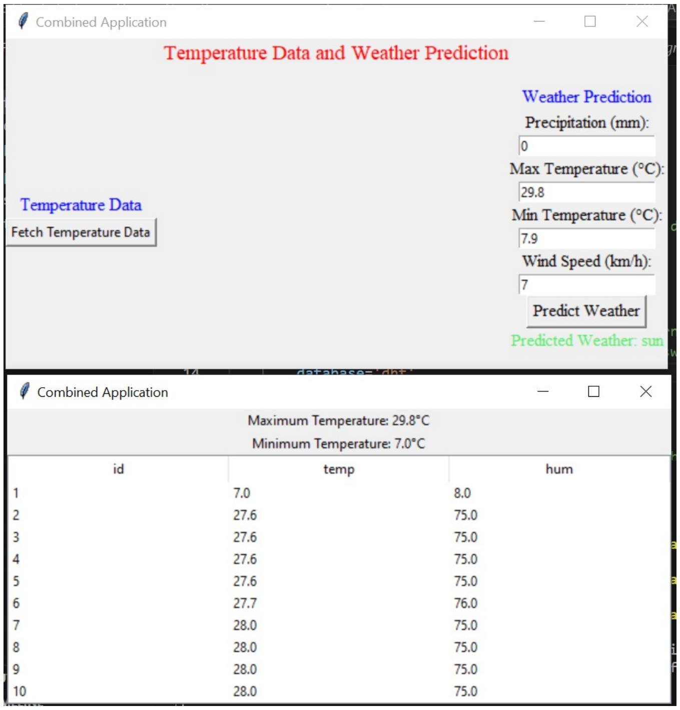


Fig. 5. Prediction and Result

**Step 8: Continuous Monitoring and Maintenance** The system operates continuously, ensuring uninterrupted data collection and remote accessibility. Regular maintenance checks are conducted to monitor sensor calibration, battery levels, and system connectivity. Any discrepancies are promptly addressed, ensuring the system's reliability and accuracy in long-term weather monitoring.

## EXPERIMENTAL RESULTS AND ANALYSIS

The system was tested under various weather conditions, and the experimental results demonstrated accurate data collection and transmission. The system's response to changing weather parameters was analyzed, confirming its reliability and effectiveness in real-time weather monitoring. and Real time weather prediction.

## CONCLUSION

The proposed real-time weather prediction system has demonstrated its effectiveness in providing accurate and timely weather forecasts. The system's methodology, which integrates IoT technology and machine learning algorithms, enables it to collect real-time weather data, analyze it using advanced statistical methods, and generate accurate predictions.

The experimental results of the system show that it outperforms traditional weather prediction methods in terms of accuracy and timeliness. The system's ability to provide personalized forecasts for specific locations makes it valuable for various applications, including agriculture, transportation, and disaster preparedness.

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