Weather Forecasting Using IoT and Edge AI

Abstract

Weather prediction is a vital aspect of various industries, including agriculture, transportation, and disaster management. While traditional weather models rely on numerical simulations, they often require **high computational resources** and lack real-time adaptability. This project proposes an **IoT and Edge AI-based weather forecasting system** that improves prediction accuracy while minimizing computational costs.

IoT-based **smart weather stations**, equipped with **temperature, humidity, and pressure sensors**, continuously collect meteorological data. These stations communicate with **Edge AI devices** such as **NVIDIA Jetson Nano and Google Coral**, which process weather patterns locally, reducing latency. Unlike cloud-dependent models, Edge AI enables real-time forecasting, making it suitable for remote areas with limited internet access.

The forecasting model utilizes **Convolutional LSTMs (ConvLSTMs) and Transformer-based architectures** to analyze historical weather trends. Additionally, **geospatial satellite data from NASA and ESA** is integrated to improve storm and rainfall predictions. A **GAN-based data augmentation technique** is employed to generate synthetic weather scenarios, enhancing the model's robustness against limited training data.

To further refine predictions, a **self-adaptive Reinforcement Learning agent** continuously updates weather models based on new data. This approach enables the system to adapt dynamically to climate change patterns. Future advancements include **AI-powered climate monitoring for early disaster detection** and **drone-based aerial monitoring of weather conditions**.