**ADAPTIVE WEATHER FORECASTING APP FOR PRECISE LOCATION-BASED PREDICTIONS**

**ABSTRACT**

In an era of dynamic climate patterns and increasing demand for hyper-localized weather insights, this project presents an adaptive weather forecasting application designed to deliver precise, location-based predictions. Leveraging machine learning techniques, ensemble methods, and probabilistic models, the app integrates multiple sources of meteorological data, including satellite imagery, atmospheric sensors, and historical weather trends, to enhance forecasting accuracy. The adaptive framework employs real-time data assimilation, utilizing Bayesian networks and graph-based metrics to optimize prediction reliability. The system refines its models through continuous feedback, ensuring it adapts to evolving weather patterns and microclimatic variations. By incorporating state-based testing methodologies, the application maintains robust performance and reliability across diverse environments. The system employs real-time data assimilation from multiple sources, including satellite imagery, atmospheric sensors, historical climate records, and crowdsourced weather reports. Bayesian networks and graph-based metrics enhance prediction reliability by dynamically adjusting forecast parameters based on evolving environmental conditions. This adaptive learning framework allows the app to refine its models continuously, improving accuracy through feedback mechanisms. The app dynamically adjusts predictions by incorporating both real-time environmental data and user feedback, allowing the model to learn and evolve with every interaction. This adaptive learning mechanism enhances the accuracy of short-term forecasts, especially for rapidly changing weather conditions such as sudden rainfall or temperature drops, which are often missed by conventional tools. Additionally, the app is designed with a user-centric interface, providing intuitive navigation, customizable alerts, and visually rich forecasts to engage users of all age groups and technical backgrounds. By combining high-resolution satellite imagery, atmospheric modelling, and contextual data inputs like topography and urban density, the application is capable of producing granular forecasts down to the neighbourhood or even street level. Emphasis is placed on minimal energy consumption and optimal responsiveness, ensuring both sustainability and efficiency.

**Key Words**:

* *Adaptive weather forecasting*
* *Hyper- localized predictions*
* *Probabilistic models*
* *Machine Learning techniques*
* *Bayesian networks*
* *Graph- based metrics*
* *Real- time data assimilation*

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