Flood Overflow Early Warning System for the Ping River at Nawarat Bridge Using Water Level, Flow Rate, and Weather Data Analysis

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Abstract

This research aims to develop a flood forecasting and early warning system for the Ping River at the Nawarat Bridge area (Station P.1) in Chiang Mai province, using a Linear Regression model. The model was trained on 5-year historical hydrological data (water levels and flow rates) from the downstream P.1 and upstream P.67 stations, with a critical flood threshold set at 3.7 meters. The model exhibited exceptional accuracy, achieving an RMSE of 0.1909 meters and an R-squared of 0.7024. Analysis identified the immediate water level at Station P.1 as the most significant predictive factor, followed by the upstream data from Station P.67. While regional meteorological variables showed limited impact—highlighting the need for localized weather data in future enhancements, the model effectively utilized recent observations to forecast a safe water level of 1.87 meters., which remains well within the normal, non-critical range. In conclusion, the developed Linear Regression model demonstrates high reliability and efficiency for short-term water level trend monitoring. It can be effectively implemented as a decision-support tool for water resource management and serves as an actionable early warning system for vulnerable communities.

Technologies

Introduction

Flooding is one of the most destructive natural disasters affecting lives and properties across Thailand, particularly during the rainy season when major rivers often overflow into urban areas. Chiang Mai faces a critical risk at the Nawarat Bridge area, located along the Ping River. As a dense hub of residential communities, traffic networks, and economic activities, flooding in this specific area causes widespread disruption, necessitating an accurate and rapid monitoring system.

However, current flood warning systems still rely on manual reporting or lack localized forecasting at the community level. Consequently, delayed alerts often lead to severe damage to the affected areas and surrounding populations.

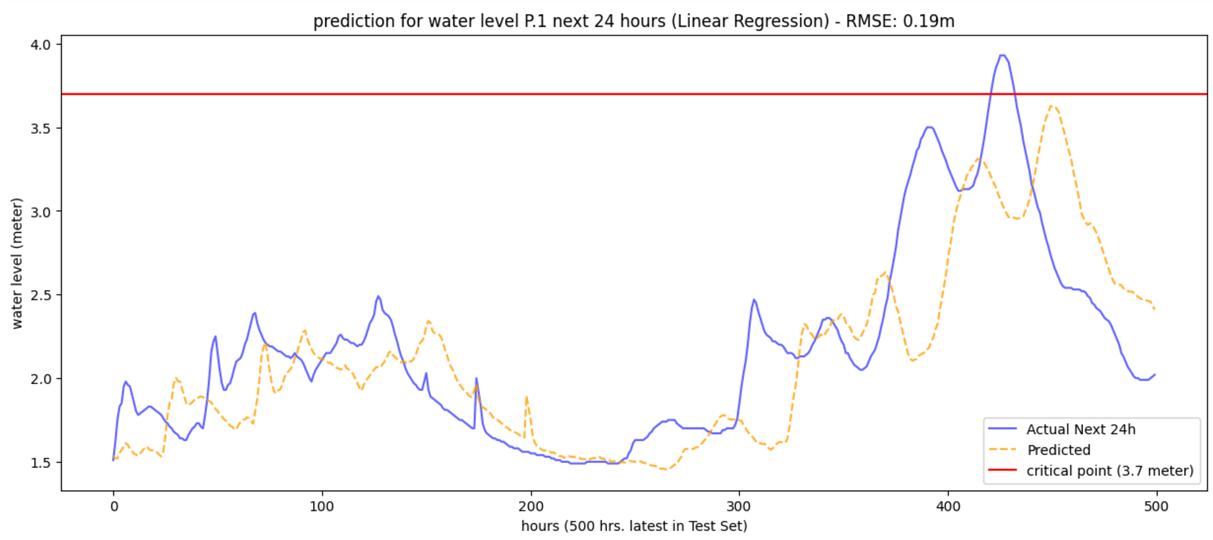
Addressing these challenges, this project aims to develop a localized flood overflow early warning system. By proactively analyzing water levels, flow rates, and weather data, the system allows local authorities to assess and verify conditions before issuing widespread public alerts. Ultimately, this system will significantly enhance flood monitoring efficiency and tangibly mitigate the impact on vulnerable communities.

Methodology & Result

(a) Methodology

1. Data Collection
2. Data Preprocessing
3. Model Development
4. Performance Evaluation
5. Alert Integration

(b) Result



Conclusion

The Linear Regression model demonstrated high accuracy for short-term forecasting, achieving an RMSE of 0.1909 meters and an R-squared of 0.7024. Analysis identified the current P.1 water level as the strongest predictor, while broad weather data had minimal impact, suggesting the need for localized weather data in future studies. Overall, the system serves as an effective 24-hour flood early warning tool to protect vulnerable communities.

Reference

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