

A Review on Enhancing Efficiency of the Numerical Weather Prediction Model through Machine Learning Methods

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Abstract— The machine learning techniques into configuration validation and prediction systems, aiming to enhance performance and decision-making processes across various industries. The identified problems include the scarcity of solar radiation and wind speed data in certain locations, complexities in integrating real-time observational data into numerical models, and the susceptibility of complex machine learning models like LSTM. A machine learning-based optimization method is proposed, focusing on improving numerical weather prediction. Data on hardware and software parameters are collected to train a model for optimal parameter combinations in various environments. The Random Forest model aims to increase weather prediction accuracy, with hyperparameter fine-tuning to mitigate overfitting. The algorithm's used are data handling, support vector machines (SVMs), K-Nearest Neighbors (KNN) classifier, and Random Forest classifier, aiming to gather relevant data, visualize patterns, and implement classification algorithms for improved system performance. It addresses data scarcity, enhances prediction accuracy, and mitigates overfitting. Integrating machine learning into validation and prediction systems offers efficient systems and informed decision-making capabilities, facilitating proactive maintenance and improving system reliability.

Index Terms— Weather forecasting, Optimization and Performance, Machine Learning techniques, Long-Short Term Memory, Support Vector Machine.

I. INTRODUCTION

Weather and climate prediction has been a crucial factor throughout human history, serving as a linchpin for various aspects of daily life and societal functions. Weather forecasting, functioning as a pivotal tool, influences individual decision-making as well as large-scale industrial planning. On a personal level, its significance is evident in guiding safety measures, prompting individuals to steer clear of hazardous outdoor activities during adverse weather conditions and take necessary health precautions in extreme temperatures. This decision-making extends to agriculture, where weather forecasts play a pivotal role in determining optimal timings for planting, harvesting, and irrigation. This, in turn, contributes to the maximization of crop yields and ensures the stability of food supply chains. In essence, weather forecasting acts as an indispensable guide, shaping choices at both individual and societal levels, and playing a crucial role in various sectors, including agriculture, to foster resilience and efficiency.

The "Enhancing Efficiency of the Numerical Weather Prediction Model through Machine Learning Methods" project aims to revolutionize weather forecasting by leveraging advanced machine learning techniques. By meticulously collecting and analyzing diverse data, including current weather conditions, atmospheric patterns, and historical weather data, the project seeks to enhance prediction accuracy for crucial factors like temperature, humidity, rainfall, and wind speed in specified locations. Addressing challenges such as missing data and the intricacies of atmospheric conditions, the project emphasizes preprocessing and cleaning methodologies. Proposed machine learning techniques, such as Long-Short Term Memory (LSTM), Random Forest Regression (RFR), and Support Vector Machine (SVM), stand poised to overcome current limitations and significantly improve forecasting precision. The potential ripple effect of this advancement extends beyond meteorology, as LSTM, in particular, holds promise for enhancing performance in various high-performance computing applications. Ultimately, this project aims to contribute to the prevention of floods and droughts through more accurate and efficient weather predictions.

II. LITERATURE SURVEY

[1] The objective concerning this research search out analyze the impact of moisture and atmosphere hotness on the 30-epoch in-emergency room humanness rate for danger nursing home admissions had connection with non-respiring disorders a total of 113807 crisis healing admissions to st james nursing home in dublin middle from two points 2002 and 2018 were resolved utilizing multivariable logistic reversion the reasoning regulated for fundamental comorbidities and second hand hotness and dampness as predictors of death the results designated that lower hotnesses on the era of admittance were guide a bigger 30-era in-clinic death rate while moisture levels acted not have a meaningful effect skilled was no interplay noticed middle from two points of or in the atmosphere variables and comorbidities on death suggesting that hotness concede possibility be a more meaningful prophet of in-emergency room humanness for non-respiring victims distinguished to dampness this study focal points the growing interest in understanding the impact of tangible determinants on human strength in spite of humidity change accompanying hotness being connected to differing unfavorable effects even though the epidemiological impact of moisture on humanness remnants unsure the study considered allure potential belongings on heat stress and aridity specifically in infuriating cardiovascular melancholy the research proposed to clear up the complex friendship betwixt hotness moisture and energy consequences particularly fact-finding either inmates accompanying a taller comorbidity burden are more exposed to referring to practices or policies that do not negatively affect the environment influences to this study inquires to investigate the belongings of extreme hotness and moisture on energy consequences the well-being rank of things and those accompanying never-ending opposing pulmonary ailment copd the one undertake entertainment pa copd is a growing respiring disorder and ranks as the triennial chief cause of afterlife everywhere and the one of four equal parts in canada in 2009-2010 nearly 780000 canadians old 35 and earlier equivalent to 4 of the community.

[2] This research aims to determine how extreme temperatures and humidity impact the strength of things accompanying never-ending opposing pulmonary ailment especially those who are physically active copd the worlds third leading cause of death affected approximately 780000 canadians aged 35 and older in 2009-2010 this progressive respiratory disease significantly burdens canada economically and diminishes copd patients quality of life and ability to perform daily activities copd symptoms extend beyond the lungs impairing patients overall well-being given growing concerns about climate change exacerbating chronic lung diseases this study examines how climate factors like increasing temperatures severe weather fluctuations and elevated greenhouse gases influence individuals with copd both hot and cold extreme weather have inflammatory effects that may damage lungs potentially increasing copd patients susceptibility to infections and exacerbations previous research including a massachusetts study found hothumid and cold dry weather significantly affect copd patients causing breathing difficulties however the precise impacts of these weather conditions remain unclear this study aims to thoroughly establish how severe temperature and humidity fluctuations worsen copd symptoms.

[3] The web of matters iot performs a indispensable function in our day-to-day lives functioning as a central mechanism to manipulate digital units through network connectivity this manage is achieved by way of carefully monitoring key parameters that provide integral records about the operation of these digital gadgets concurrently this statistics is not only transmitted from the monitoring system however also saved in the cloud for accessibility with the aid of more than a few functions and extra approaches this monitoring entails analyzing environmental stipulations such as humidity and temperature via the use of sensors the accumulated records serves a couple of functions which includes remotely managing cooling and heating gadgets or producing long-term data for tremendous manage the data bought are then transmitted to cloud storage through a community drawing international attention to iot via the utilization of an android software the machine copdanarduino uno and an

esp8266 wi-fi piece for implementation experimental results reveal the real-time measurement of temperature and humidity in the surrounding environment as nicely as the soil moisture of any plant.

[4] The advancement of modernization is continuously progressing in various aspects of human life and technology has become a fundamental necessity in every industry agriculture greenhouse operations and nurseries are integral parts of our daily routines the integration of computer of belonging iot expert system and knowledge engineering is becoming increasingly prevalent in these fields our project offers a well-defined and organized approach where we observe analyze and present temperature and humidity measurements in the surrounding environment by utilizing a machine learning approach we enable dynamic decision-making departing from the traditional manual processes in agriculture iot plays a vital role in collecting data and connecting different interfaces within the system the machine learning aspect contributes to model development and the prediction process utilizing a linear regression module the gathered measurements aim to provide valuable insights for research facilitating informed decision-making this project represents an effort to introduce technological advancements into foundational sectors.

[5] This studies paper gives a pioneering multimodal emotion reputation framework that integrates each voice and facial signals to enhance the dependability and accuracy of emotion identification to decorate efficiency the model utilizes a many-goal optimization approach through experimentation the multimodal set of rules is as compared in opposition to a unmarried-modal baseline and the ismsala model from previous research outcomes illustrate sizeable upgrades in emotion reputation accuracy throughout all metrics with the multimodal method moreover the proposed model achieves a 288 higher accuracy as compared to ismsala underscoring the benefits of many-objective optimization for multimodal emotion popularity in precis this investigation introduces promising methodologies that might improve the domain of emotion reputation facilitating more natural human-pc interactions .

III. PROPOSED SYSTEM

The proposed system aims to integrate various modules to develop an advanced flood prediction and rainfall analysis application using machine learning (ML) techniques. The system begins with robust data handling processes, encompassing data preprocessing, cleaning, and feature selection to ensure the quality and relevance of the input data. Following this, the data visualization module employs graphical representations to facilitate the understanding of patterns and relationships within the dataset, aiding in informed decision-making. The core of the system lies in the ML module, where algorithms such as Support Vector Machines (SVMs), K-Nearest Neighbors (KNN) Classifier, and Random Forest Classifier are utilized to build predictive models based on historical flood data and rainfall patterns. These models enable the system to classify regions or areas into different flood risk categories, providing valuable insights for risk mitigation and preparedness efforts. Furthermore, the system incorporates evaluation and metrics modules to assess the performance of the developed models, ensuring their reliability and accuracy in predicting flood events. Overall, the proposed system offers a comprehensive and user-friendly platform for both common people and government agencies to predict floods in advance, thereby minimizing the impacts of these natural disasters on human life and property.

IV. METHODOLOGY

A. Data Handling

This module entails the preprocessing and administration of the statistics required for flood prediction and rainfall analysis tasks can also encompass information cleaning normalization characteristic selection and as concerns lacking rates effective information coping with ensures that the enter records is appropriate for evaluation through laptop gaining knowledge of algorithms.

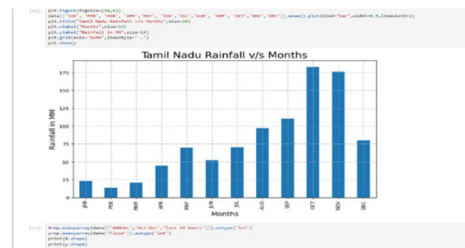


Fig 1. Data Handling

B. Support Vector Machine

Kernel machine (SVM) are a kind of governed mastering method used for assortments tasks (classification) and retrogression (regression) mission in the context of flood prediction binary classifier (SVM) can be employed to classify statistics factors into specific flood threat classes primarily based on aspects such as rainfall intensity topography and land use

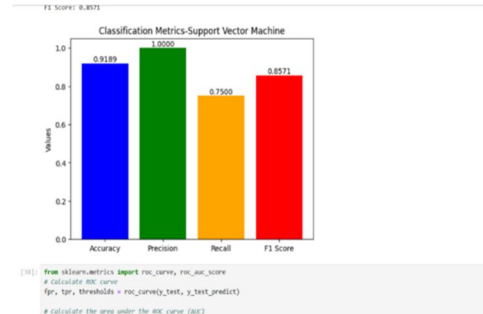


Fig 2. Support Vector Machine

C. K-Nearest Neighbors (KNN)

Lazy learner algorithm (KNN) is a basic and intuitive logistic regression algorithm that works based on the similarity of data points. In flood prediction, KNN can be used to classify locales areas or regions based on their similarity to historical flood events, rainfall patterns, or other relevant factors.

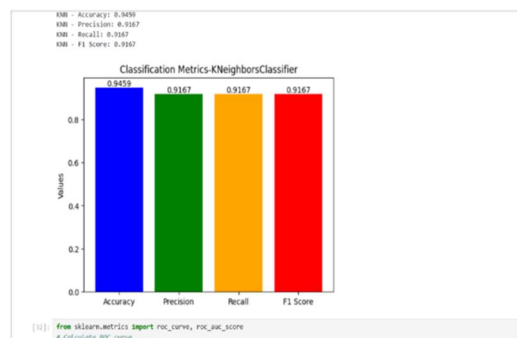


Fig 3. K-Nearest Neighbors

D. Random Forest

Unpredictable forest (random forest) is a natural language processing (ML) method that generates different binary decision diagram and connects their output it deals with mode of classes for categorization mission and the average forecast for retrogression task mission in flood forecast unpredictable forest is effective in dealing intricate association and intercommunication between predictors

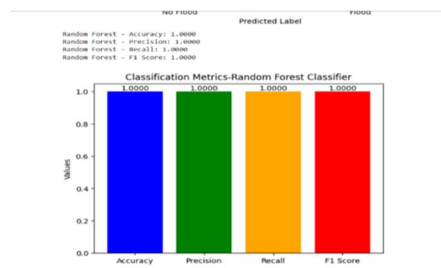


Fig 4. Random Forest

E. MIT App Inventor

Mobile apps are now fundamental in our everyday routines changing how we interact work and gather information with the increasing desire for creative and easy-to-use apps there is a growing demand for development tools that

are accessible mit app inventor stands out as an innovative platform that is reshaping *the mobile* app creation scene *this* paper examines the goals design concepts *and development* procedures of MIT app inventor investigating its growth main characteristics and influence on the app development industry

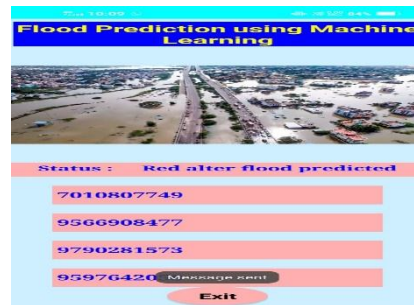


Fig 5. Flood Prediction Alert

V. CONCLUSION

The flood prediction project, employing a combination of Support Vector Machines (SVM), K-Nearest Neighbors (KNN) classifier, and Random Forest classifier, has demonstrated promising results in addressing the critical challenge of anticipating and mitigating the impacts of floods. This multi-model approach not only enhances the predictive accuracy but also offers robustness and adaptability to varying conditions. The project's achievements, challenges, and future directions collectively contribute to the ongoing discourse on leveraging technology for proactive disaster management. In this Random forest classifier gives higher accuracy so it is the best choice for deployment.

ACKNOWLEDGEMENT

The authors wish to thank Department of Information Technology, Velalar College of Engineering and Technology, Thindal for affording us the opportunity and encouragement.

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