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PREDICTION OF RICE BLAST DISEASE USING INTEGRATE SMOTE WITH MULTILAYER PERCEPTRON

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Abstract

Agriculture is the primary source of income for the major population of India. Agriculture generates 17% of the total GDP of India and India is the second-largest producer of rice and wheat. Rice (Oryza sativa) is a major food crop for many parts of India. India has the largest area under ricecultivation; hencericeis the important crop of the country.Riceis such amajor cereal crop, which provides 20% of total energy and leads as the main food for more than 50% of the world's population. Rice production has been challenged by recent changes in crop production technologies, that also has impact on disease occurrence. Thus, crop management includes extensive use of fertilization, repeated flooding increases the disease problem,increased mono culture of rice helps in support to fpathogens from one crop to another crop.The Rice crop in India has affected by many pathogens. Among 36 rice diseases, rice blast is the disease caused by Magnaporthe Oryae, is the major destructive disease of paddy crop.This disease having significant threat to the production of paddy crops all over the country.Rice blast continuesto beacryptic problem in several rice-growing regions(tropicaland temporal) where the pathogen spreads exponentially and is difficult to manage by the farmers and thus reduces yield of paddy crop in the field.

In India, rice blast is a major concern due to favourable weather conditions during the crop season. Climate plays major role in the disease appearance, multiplication, and spread of the fungus. Along with climatic factors,the varieties of seeds also influence the occurrence of riceblasts, primarily the climate factors have a strong influence on the occurrence of blast disease even though a sufficient amount of nutrients are present in the plant. Thus, rice blast disease will occur and develop when certain weather conditions continue for the given period.Forecasting models that make predictions of possible blast disease occurrence may give important information to the producers of rice to manage the disease.This Project the rice blast disease prediction using data balancing technique based multilayer perceptron.

Introduction

Rice Blast Disease Prediction is a crucial area of research and application in the field of agriculture that focuses on the early detection and forecasting of one of the most devastating diseases affecting rice crops worldwide, known as rice blast [1]. This fungal disease, caused by the pathogen Magnaporthe oryzae, poses a significant threat to global food security, as rice is a staple crop for billions of people.Predictive models and systems have been developed to mitigate the impact of rice blast by providing farmers with early warnings and guidance for disease management.

The prediction process typically involves a combination of various data sources and technologies. These may include remote sensing through satellites or drones to monitor field conditions, weather data to assess environmental factors conducive to disease development, genetic information about rice varieties to determine susceptibility [2], and historical disease outbreak data for trend analysis. Machine learning and data analytics play a pivotal role in processing and analyzing this wealth of information. These models are trained to recognize patterns and correlations between different variables, enabling them to make accurate predictions about the likelihood of rice blast outbreaks in specific regions or fields.

Early detection and prediction of rice blast are instrumentalin implementing timely and targeted disease control measures. Farmers can receive alerts and recommendations on when to apply fungicides or adopt other preventive strategies to minimize crop damage and yield loss. Further more,this approach promotes more sustainable and environmentally friendly agricultural practices, as it allows for the of people around the world whil precise and optimized use ofresources [3].So,Rice Blast Disease Prediction is a multi face tedand technology-driven end eavorthat leverages various datasources and advanced analytical tools to anticipate and manage the threat of rice blast disease. By providing farmers with early warnings and actionable insights, it contributes to the protection of rice crops, ensuring food security for millions Promoting sustainable farming practices.

EARLIERWORK

Discovery of the Pathogen (Magnaporthe oryzae): The causal agent of rice blast, Magnaporthe oryzae, was identified in the early 20th century. Researchers focused on understanding the biology and life cycle of the fungus.

Genetic Studies: Early work involved studying the genetic diversity of both the rice plant and the blast fungus. Researchers aimed to identify resistant and susceptible varieties of rice and understand the genetic basis of resistance.

Breeding for Resistance: Traditional breeding methods were employed to develop rice varieties with resistance to blast disease. This involved crossing resistant varieties with high-yielding but susceptible varieties to create new cultivars with improved resistance.

Cultural Practices: Farmers adopted various cultural practices to manage rice blast, such as adjusting planting density, optimizing irrigation, and practicing crop rotation. These practices aimed to create conditions less favorable for the fungus.

Chemical Control: Fungicides were introduced for the control of rice blast. However, their long-term effectiveness is limited due to the potential development of resistant strains of the fungus and environmental concerns.

Biological Control: Researchers explored the use of beneficial microorganisms and antagonistic fungi to control rice blast. This approach aimed to harness natural predators of the fungus to reduce disease incidence.Pathogen Monitoring and Surveillance: Scientists developed methods for monitoring the spread of the rice blast pathogen. Early detection and timely intervention were considered crucial for disease management.

Understanding Host-Pathogen Interaction: Researchers delved into the molecular and cellular interactions between the rice plant and the blast fungus. This included studying the mechanisms of infection and the plant's defense responses.

Development of Resistant Transgenic Varieties: Advances in genetic engineering led to the development of transgenic rice varieties with enhanced resistance to rice blast. Genes encoding antifungal proteins or proteins involved in the plant's defense mechanisms were introduced into the rice genome.

International Collaboration: Given the global importance of rice production, international organizations, research institutions, and governments collaborated to share knowledge and resources to combat rice blast collectively.

PROPOSED METHOD

The proposed system for Rice Blast Disease Prediction, integrating Synthetic Minority Over-sampling Technique (SMOTE) with a Multilayer Perceptron (MLP), offers a multifaceted approach to enhance predictive accuracy and overcome challenges associated with imbalanced datasets The advantages of this proposed system include:

- Data Preprocessing and Quality Assurance
- Imbalanced Dataset Handling:
- Optimized Hyperparameter Tuning
- Regularization Techniques

- Model Interpretability Measures
- Computational Efficiency:
- Dynamic Adaptation to Disease Patterns
- Robust Evaluation Metrics

METHODOLOGY

Managing rice blast disease involves an integrated approach that combines various strategies. Here is a general methodology for the management of rice blast disease:

Disease Surveillance and Monitoring:

Regularly monitor rice fields for signs and symptoms of blast disease.Use remote sensing technologies, drones, or satellite imagery for large-scale surveillance.Establish a system for reporting and recording disease occurrences.

Resistant Variety Selection:

Choose rice varieties with known resistance to specific strains of the blast fungus.Incorporate genetic diversity in rice crops to reduce the risk of widespread susceptibility.Stay updated on the latest developments in resistant varieties through breeding programs.

Cultural Practices:

Optimize planting density and spacing to improve air circulation and reduce humidity around plants.Practice crop rotation to break the disease cycle.Adjust irrigation practices to avoid creating conditions favorable for the fungus.Ensure proper drainage to minimize waterlogged conditions.

Fungicide Application:

Use fungicides as a preventive measure during critical growth stages.Rotate fungicides with different modes of action to reduce the risk of resistance development.Follow recommended application rates and timings based on local conditions.Consider the environmental impact and adhere to safety guidelines.

Biological Control:

Introduce or encourage natural enemies of the blast fungus, such as predatory fungi or bacteria.Explore the use of biopesticides containing beneficial microorganisms.Implement conservation biological control by maintaining habitats that support natural enemies.

Host Plant Resistance Enhancement:

Implement marker-assisted breeding techniques to develop rice varieties with improved resistance.Explore genetic modification technologies like CRISPR to enhance specific resistance traits.Promote the cultivation of resistant varieties through extension services.

Integrated Pest Management (IPM):

Adopt an integrated approach that combines cultural, biological, and chemical control methods.Tailor strategies to local conditions and rice cultivation systems.Monitor and assess the effectiveness of different control measures.

RESULTANDANALYSIS

	Unnamed: 0	label	StnPres	StnPresMax	StnPresMin	Temperature	T Max	T Min	RH	RHMin	...
0	1512	0	-1.365290	-0.923222	-1.339543	1.015785	0.978746	0.759838	0.660148	1.433364	...
1	1585	0	0.693535	0.428618	0.734369	0.198946	-0.342005	0.499561	1.124277	1.354817	...
2	1917	1	0.530605	0.340771	0.508779	0.640481	0.545067	0.608010	-0.984304	-0.606880	...
3	1665	1	0.500980	0.291968	0.450560	0.618404	0.111387	0.976736	0.079986	0.412242	...
4	2435	1	-0.098892	-0.064293	-0.073369	0.706711	0.623918	0.889977	0.079986	0.333695	...
...	...	...	...	...	...	...	...	...	...	...	...
3546	770	0	0.730564	0.428618	0.705250	0.044409	0.347940	-0.302961	-1.312401	-1.708550	...
3547	2479	1	-0.128517	-0.093573	-0.167972	0.066486	0.131100	-0.129443	-0.268110	-0.608880	...
3548	3365	1	-2.646505	-1.679667	-2.634822	0.750864	0.978746	0.868287	0.776180	1.040625	...
3549	31	0	0.360272	0.243165	0.370517	-1.169810	-0.913674	-1.148862	-1.544466	-1.551454	...
3550	2309	1	-1.209769	-0.810976	-1.143067	0.993708	0.564780	0.911867	-0.152078	-0.137593	...

3551 rows × 175 columns

Figure4:sample datasetusedforiceblastdisease

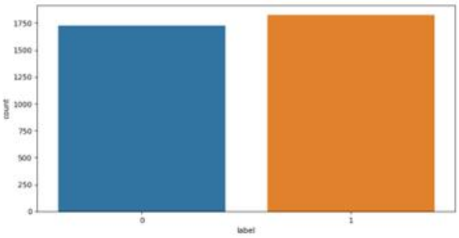

Figure5:Countplotforlabelcolumnofadataset

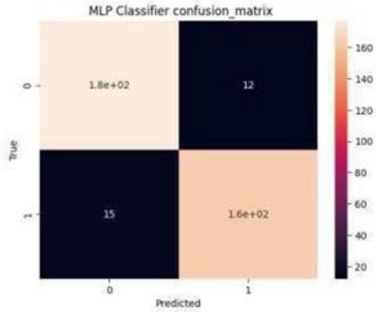

Figure6:confusionmatrixof MLPClassifier

For the majority of Indians, agriculture is their main source of revenue. India is the world's second- largest producer of wheat and rice, and agriculture contributes 17% of the country's overall GDP. A significant food product for many regions of India is rice (oryza sativa). Rice is an essential crop in India because it was grown there on the largest scale. Providing 20% of all energy and serving as the primary food source for more than 50% of the world's people, rice is a significant cereal crop. Recent advancements in crop production technology had put a strain on rice output and had an effect on disease occurrence as well Thus, intensive fertilization is akey componentof crop management, while repetitive flooding exacerbates the disease issue and expanded rice monoculture aids in the spread of pathogens from one crop to another. Numerous pathogens had harmed India’s rice harvest. The most destructive of the 36 rice illnesses was rice blast, which was brought on by Magnaporthe Oryae.The output of paddy crops throughout the nation was seriously threatened by this disease. Rice blast was still a perplexing issue in several rice-growing regions (tropical and temporal), where the pathogen spreadsexponentially and was challenging for farmers to controlled, lowering paddy crop output in the field. Due to favourable weather during the crop season, rice blast in India was a major worry. The fungus that caused the illness manifests, multiplies, and spreads as a result of climate. Although the plant had enough nutrients, the climate factors had a significant impact on the frequency of rice blasts in addition to the climatic factors.

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