RiceBlast: Plant Syndrome Discovery Using Internet of Things and Artificial Intelligence Technologies

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***Abstract*— Rice blast is one of the most serious plant diseases. Rice blast disease, caused by Magnaporthe oryzae occurs in about 80 countries on all continents where rice is grown, in both paddy fields and upland cultivation. The extent of damage caused depends on environmental factors, but worldwide it is one of the most devastating cereal diseases, resulting in losses of 10–30% of the global yield of rice. An early detection of rice plant disease especially rice plant leaves disease detection can assist farmers to take necessary precaution at the early stage and can achieve better quality of crops. There are a numerous image processing approaches available today which can analyze rice plant leaves disease. Existing most approaches considered binary threshold based segmentation approach although input images are always RGB color images. To develop an automated system to identify and classify rice blast diseases it is always beneficial to use RGB color images as input and to provide analysis results in RGB color images as well. This study proposed a suitable frame work where enhancement, filter, color segmentation and color feature for classification steps were incorporated for identification.**

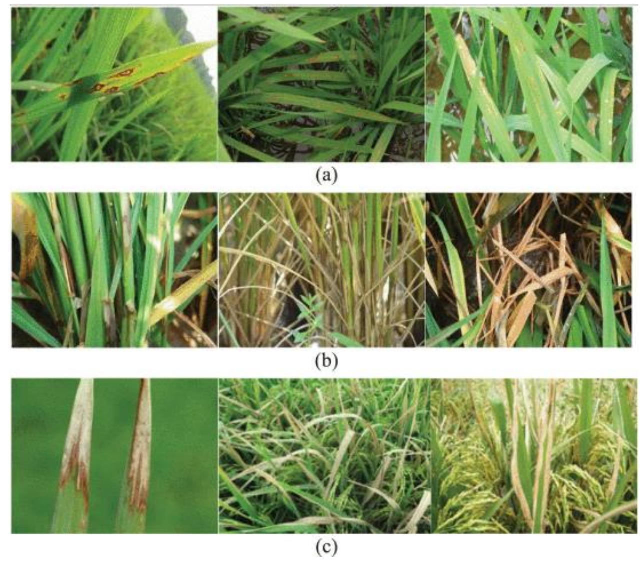
Index Terms— RiceBlast,Artificial Intelligence, Machine Learning

I. INTRODUCTION

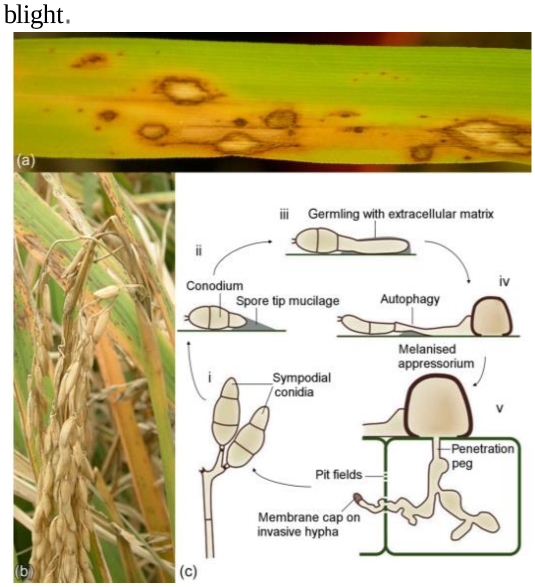
Mahatma Gandhi Once said **"if you give me rice, I'll eat today; if you teach me how to grow rice**, I'll eat every day." Rice is considered as a staple food for hundreds of millions of people in the world today. Rice crop failures potentially cause starvation. A major reason for rice crop failure is the attack of rice blast that is one of the most serious plant diseases [1] [2]. The fungus causing rice blast is *Magnaporthe oryzae* (or *Magnaporthe grisea*), which results in lesions on leaves (Fig. 1), stems, peduncles, panicles, seeds, and roots. For the first cultivation of a year in Taiwan, rice blast disease typically spreads over one- tenth of the total cultivated area in the rice crop.

Rice cultivation is the principal activity and source of income for about 100 million household in Asia and Africa (FAO, 2004). It is primarily a tropical and subtropical crop, but the best grain yields are obtained in temperate regions

The rice crop suffer from a number of diseases among them rice blast caused by one of the most devastating agricultural pathogens in the world, a fungus called Magnapor the grisea (Hebert) Barr [anomorph: Pyricularia grisea (Cooke) Sacc.], is one of the most important, causing significant losses in yield. Rice blast was probably first recorded as rice fever disease in China in 1637.



Part of the picture of rice diseases: (a) Picture of rice blast. (b)Picture of sheath blight. (c) Picture of bacterial blight.



Leaf blade and leaf shelf

It can also infect a number of other agriculturally important cereals including wheat, rye, Barley, and Pearl Millet causing diseases called blast disease or blight disease. M.grisea causes economically significant crop losses annually, each year it is estimated to destroy enough rice to feed more than 60 million people.

Rice blast progresses in four stages, commonly referred as leaf blast, collar blast, stem blast and grain blast

- In the first stage, leaf blast, symptoms may center with brown to black margins. Leaf blast can kill tender young plants.

- The second phase, collar blast, produces brown to black rotted looking collars. Collar blast appears at the junction of leaf blade and sheath. The leaf growing out of an infected collar may dieback.
- In the third phase, stem node blast, stem nodes of mature plants become brown to black and rotted. Usually, the stem growing from the node will die back.
- In the last phase, grain or panicle blast, the node or "neck" just below the panicle becomes infected and rots. The panicle about the neck, typically dies back.

II. PROPOSED METHOD

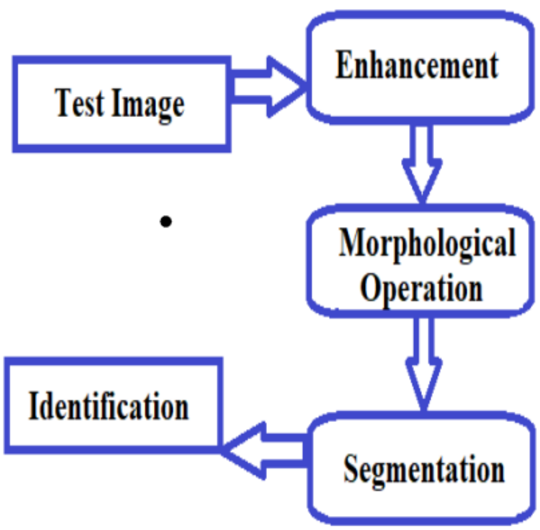


Fig. 1. Framework for rice blast analysis

The design of the proposed framework is demonstrated which includes enhancement, morphological operation, segmentation and identification.

A. Image Acquisition

Rice blast image dataset was collected from BAU (Bangladesh Agriculture University). The dataset has various types of image color contrast for which the collected dataset was divided in 3 different batches. Each batch contains around 100 RGB images and the size of each image was set to 350x350 and in .JPEG image format..

B. Pre-processing

In general image processing steps can be divided in 2 stages which include (1) Pre-processing and (2) Postprocessing. For this study a number of steps were incorporated during Pre-processing stage which includes: a. Enhancement b. Morphological operation and c. Segmentation.

a. Enhancement

To minimize contrast issues associated with the rice blast image dataset it is necessary to apply enhancement operation. Generally, RGB color model is suitable for hardware based approaches. Therefore; instead of using RGB images for this study, at the beginning RGB images were converted to HSV color model. This is due to the fact that HSV color model has better capability for enhancement operation. From converted HSV images only V channel was considered for enhancement operation. Firstly, median filter operation with a small window of [3 x 3] was incorporated and then local histogram equalization approach was used for enhancement. Instead of global or general histogram enhancement operation this local histogram equalization approach reduces the possibility of creating a synthetic looking image [5]. Median filter was applied to preserve region edges. Finally the images were converted back to RGB images.

b. Morphological Filter

Operation In the related works section it has been mentioned that a number of studies incorporated filter operation to eliminate noises. This study also used noise reduction approach. Instead of using a conventional filter operation such as mean, median or Gaussian filter operation this study incorporated mathematical morphological operation to eliminate noise and resize the shape of the regions. Firstly, Mathematical morphological erosion operation with a diamond shape was incorporated. Secondly, top hat filter operation was incorporated to preserve the foreground regions. Lastly, median filter with a default kernel window [3 x 3] was implemented to preserve the region edges. This is due to the fact that, when median filter operation is carried out in real time it is cumbersome to get good results and the computational cost is high when the filter mask size is bigger.

c. Segmentation

Segmentation helps to fragment an image into a number of regions based on their associated characteristics. This is the last step of pre-processing stage. Most of the existing related studies performed threshold based binary segmentation and mostly Otsu's method was incorporated. This is a fast processing approach as it takes less time to compute the threshold value and it has simple mathematical expression and calculation [18]. Instead of using threshold based binary segmentation this study incorporated modified region growing approach proposed

A. Post-processing

This is second stage of this proposed framework where mainly 2 steps were used which includes (a) feature extraction and (b) Classification.

a. Feature Extraction

The basic purpose of feature extraction approach/approaches is to use the important features while ignoring the redundant features which may lead to inaccurate identification. To identify the region of interests (ROIs) features can be categorized in 3 different categories which include shape, size and color features.

As there is no such evidence found about rice blast shape and size therefore; this study only considered color feature from segmented images. According to [12] rice blast color is whitish. In this study this whitish color was considered as a color feature and to identify the region of interest (ROIs).

b. Identification of Region of Interest (ROI)

The region of interests (ROIs) was identified using color feature. Classification is used to check whether it is possible to increase the accuracy or not. After identification it was found that in most cases the identified regions are accurate. However; still there are some images regions where some anomaly found and thus in this study CNN classifier was implemented.

III. Rice Blast Disease Dataset

Rice images with rice blast disease are obtained from the Institute of Plant Protection, Jiangsu Academy of Agricultural Sciences, Nanjing, China. The Institute mainly conducts research in the mechanism and the technologies in controlling the disease and insect pests of such crops as rice, wheat, cotton, rape, fruit and vegetables in Jiangsu Province and across China. To avoid duplicates and ensure label quality, each image in our dataset is examined and confirmed by plant protection experts. There is no special requirement for rice blast disease images and their pixels, and no special preprocessing is done. All the rice blast images are patches of 128×128 pixels in size, extracted from original larger images with a moving window of a stride of 96 pixels. Then, the patches containing rice blast lesions are identified by domain experts and used as positive samples, and patches without lesions are used as negative samples. The final dataset includes 5808 image patches of which 2906 are positive and 2902 negative. Some positive and negative samples are shown in Fig. 1. In addition to scale, rotation, illumination and partial viewpoint changes, the dataset also has the following characteristics. First, the background of rice canopy texture, water body, and soil can cause great difficulty to recognition, as do dead leaves and other plant lesion. Second, rice blast lesion shape and location are not predictable. Overall, the combination of above factors poses significant challenges for rice blast disease recognition.

IV. Conclusion

With the development of technology of computer and machine vision advance, experts and scholars both at home and abroad have conducted extensive research on into the image analysis technology. In the most recent years, have witnessed the increasingly widespread application of leaf lesion identification based on deep learning has been increasingly applied to the detection of crop diseases. In this paper, a rice disease image database is established for the fast detection of rice blast, bacterial blight, and blight, with 2DFM-AMMF noise reduction and Faster 2D-Otsu segmentation used. The final average accuracy rate is 97.2%. At present, the research conducted into threshold segmentation algorithm has been highly extensive, with many scholars improving and expanding it and to achieve some desirable outcomes. The Faster 2D-Otsu algorithm referred to in this paper has achieved excellent results in the application of segmentation of rice disease images. Besides, it has shown the capability to eliminate most of the background interference including rice ear and disease-free rice leaves, despite some rice ears that remain. Therefore, a further investigation is conducted into the application of threshold segmentation theory in the segmentation of plant leaf diseases for the sake of ensuring that the diseased parts of the picture are completely segmented with other interference being minimized, which is one of the next priorities for the following works. In addition, the automated rice disease detection has yet to be widely applied, and no thorough study has been performed on the real-time dynamic detection of rice diseases. A large majority of the existing methods of disease detection are focused on the detection of collected pictures. The method proposed in this paper also identifies diseases by monitoring the collected pictures, which makes it not suited to monitoring large-scale rice cultivation at present. Therefore, in the future, further investigation shall be conducted into how to apply this method to the dynamic detection of large-scale rice planting detection and disease. For the future, in the process of popularizing this method, there is a necessity to combine intelligent Internet facilities such as agricultural Internet of Things and mobile terminal processor to realize real-time monitoring and pest identification of grain storage warehouses, which is conducive to promoting the modernization and intelligence of the agricultural industry.

References

[1] **Vincent Lanoiselet about riceblast** www.agric.wa.gov.au/rice/rice-blast-disease

[2] Research by NLM www.pubmed.ncbi.nlm.nih.gov/32204416/