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A STUDY ON PADDY CROPS DISEASE PREDICTION USING DATA MINING TECHNIQUES

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Abstract

Agriculture is one of the principal economic activities of the Tamilnadu on agriculture for their livelihood. Paddy cultivation in the Tamilnadu state contributes considerably to the gross national income of the state. Such Paddy crops are affected by the attack of insect pests. Therefore paddy field insect pest identification is an important task to the sustainable agricultural development in the Tamilnadu, particularly in Cauvery basin. The studies of plant trait/disease refer to the studies of visually observable patterns of particular crops. Nowadays crops face many traits/diseases. Damage of the insect is one of the major trait/disease. Insecticides are not always proved efficient because insecticides may be toxic to some kind of birds and animals. It also damages natural animal food chains. A common practice for plant scientists is to estimate the damage of plant (leaf, stem) because of disease by an eye on a scale based on percentage of affected area. It results in subjectivity and low throughput. This paper provides advances in various methods used to study paddy diseases/traits using image processing and data mining. The methods studied are for increasing throughput & reducing subjectiveness arising from human experts in detecting the paddy diseases are stored and give the solution to the diseases. Different characteristics of paddy crops are grouped by an "associative rule mining".

Keywords: Data Mining, Image Processing, Paddy, Disease, Android Technology

1. INTRODUCTION TO DATA MINING

Mining process is more than the data scrutiny which in addition spans additional disciplines like Data Warehousing, Statistics, Machine learning and Artificial Intelligence [5]. Significantly useful patterns or meaning in

raw data has earlier been called KDD (Knowledge Discovery in Databases), data mining, and knowledge discovery[3] Knowledge discovery is the "non-trivial process of identifying ultimately understandable patterns in data." Data mining "consists of applying data Analysis and discovery algorithms that produce particular patterns over the data". Data mining is typically a bottom-up knowledge engineering strategy, Knowledge discovery involves the additional steps of target data set selection, data preprocessing, and data reduction, which occur prior to data mining. In the following, the performance view about data mining proposed by agarwal et.al and the association rules classification predicted for medical data mining given by deepika et.al, along with uniqueness of data mining is being presented. Agarwal et al. [2] proposed three basic classes of data mining problems. Association rules are used to spot relationships among a set of items in databases. These relationships are not based on natural properties of the data themselves, but rather depend on co-occurrence of the data items. Each and every data mining method serves a different reason depending on the modeling purpose. They are divided into two types namely classification and prediction. Classification models predict definite labels, while prediction models predict continuous-valued functions. Decision Trees and Neural Networks use classification algorithms while Regression, Association Rules and Clustering use prediction algorithms.[4].

II. INTODUCTION TO PADDY CROPS

India is an agricultural country; wherein about 70% of the population depends on agriculture. Farmers have wide range of diversity to select suitable paddy crops. However, the cultivation of the paddy crop for optimum yield and quality produce is highly technical. It can be improved by the aid of technological support. The management of perennial paddy crops requires close monitoring especially for the management of diseases that can affect production significantly and subsequently the post-harvest life.

The image processing can be used in agricultural applications for following purposes:

1. To detect diseased leaf and stem
2. To quantify affected area by disease.
3. To find shape of affected area.
4. To determine color of affected area
5. To determine size & shape of paddy crop. Etc.

In case of paddy the disease is defined as any impairment of normal physiological function of crops, producing characteristic symptoms. A symptom is a phenomenon accompanying something and is regarded as evidence of its existence. Disease is caused by pathogen which is any agent causing disease. In most of the cases pests or diseases are seen on the leaves or stems of the plant. Therefore identification of plants , leaves, stems and finding out the pest or diseases, percentage of the pest or disease incidence , symptoms of the pest or disease attack, plays a key role in successful cultivation of paddy crops.

It is found that diseases cause heavy crop losses amounting to several billion dollars annually. Following two examples shows that how some diseases have shattered the economies of nations. i) Sheath blight of paddy crops[1,2]:

A. Symptoms of Sheath blight

The symptoms of Sheath blight disease are:

Figure 1. symptoms of Sheath blight disease to the Paddy Crops.

1. Sheath blight disease usually appears in the later growth stages of the plant.

2. Initial symptoms usually develop as lesions on sheaths of lower leaves near the water line when plants are in the late tillering or early internode elongation stage (approximately 10 – 15 days after flooding) varies from place to place.

The fungus affects the crop from tillering to heading stage. Initial symptoms are noticed on leaf sheaths near water level. On the leaf sheath oval or elliptical or irregular greenish grey spots are formed. As the spots enlarge, the centre becomes greyish white with an irregular blackish brown or purple brown border.

Lesions on the upper parts of plants extend rapidly coalesing with each other to cover entire tillers from the water line to the flag leaf. The presence of several large lesions on a leaf sheath usually causes death of the whole leaf, and in severe cases all the leaves of a plant may be blighted.

Figure 2: Symptoms of Sheath blight disease to the Paddy Crops(Closer View)

The infection extends to the inner sheaths resulting in death of the entire plant. Older plants are highly susceptible. Plants heavily infected in the early heading and grain filling growth stages produce poorly filled grain, especially in the lower part of the panicle.

B.Pathogen

The fungus produces septate mycelium which are hyaline when young, yellowish brown when old. It produces large number of spherical brown sclerotia.

Management

1. Grow resistant varieties like **SAMBA MAHSURI**, **IR-36, ADT 18, 32** etc.

- Deep ploughing in summer and burning of stubbles.
- Spray Carbendazim 500 g/h
- Soil application of P.fluorescens @ of 2.5 kg/ha after 30 days of transplanting (product should be mixed with 50 kg of FYM/Sand and applied).
- Foliar spray P.fluorescens at0.2% at boot leaf stage and 10 days later

C. Symptoms of Brown spot disease of rice.

Figure 3. Symptoms of Sheath blight disease to the Paddy Crops

Figure 4. Symptoms of Sheath blight disease to the Paddy Crops.

Stem rot of rice (Picture 4) is the other disease that serves as an indicator of potassium deficiency. We also think low potassium in soil may play a role in increasing the severity of rice bacterial panicle blight. Past research has indicated that Cercospora leaf spot, sheath blight, sheath rot, and blast may be observed more frequently in fields with excessive nitrogen fertilization.

Symptoms

The fungus produces short, linear brown spots mostly on leaves and also on sheaths, pedicels and glumes. The spots appear in large numbers during later stages of crop growth.

Pathogen

Conidiophores are produced in groups and brown in colour. Conidia are hyaline or sub hyaline, cylindrical and 3-5 septate.

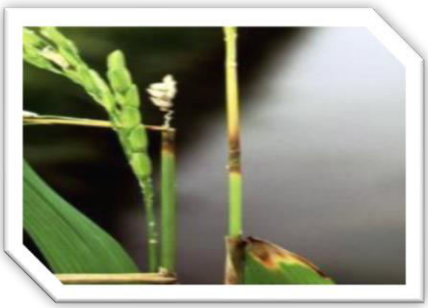
Management

Spray Carbendazim 500 g or Mancozeb 2 kg/ha.

Table 1.1: List the common name, scientific name and the images of affected paddy crops.

S.No	Scientific name:	Common name	Description	Image
1.	Zinc deficiency	Bronzing	Linear reddish-brown lesions on leaf, purple-brown blotches on older plants leaves yellow to bronze lower leaves floating on water surface, seedlings dying and disappearing below water surface	
2.	Erwinia chrysanthemi	Crown rot or foot rot	Soft rot of crown area extending into lower internode, fetid odor of soft rot, tillers dying one at a time, roots dying and turning black, adventitious roots produced at node above crown area. A similar crown discoloration may be caused by misapplication of a hormonal herbicide such as 2,4 -D to early.	
3.	Pyricularia oryzae	Leaf blast	Lesions varying from small round, dark spots to oval spots with narrow reddish-brown margins and gray or white center, spots becoming elongated, diamond-shaped or linear with wit pointed ends and gray dead areas in the center surrounded by narrow reddish-brown.	
4.	Cochliobolus miyabeanus	Brown spot	Round to oval, dark-brown lesions with yellow or gold halo; as lesions enlarge, they remain round, with center area necrotic, gray and the lesion margin reddish-brown to dark brown.	
5.	Cercospora oryzae	Narrow brown leaf spot	Long narrow brown or reddish-brown lesions parallel With leaf veins; usually restricted to area between veins; lesions may occur on leaf sheaths.Under very favorable conditions Lesions can expand across veins and leaves may be killed.	

6.	Rhizoctonia solani	Sheath blight	Lesions consist of alternating wide bands of whit, greenish-gray to tan with narrow bands of reddish-brown or brown; Lesions begin at base of blade, spreading from leaf sheath or from infection point on leaf Fungal mycelium may be seen under very moist conditions. Fungal survival structures called sclerotia may form on leaf surface. Under favorable conditions bird nest area of dead tissue may form.	
7.	Microdochium oryzae	Leaf scald	Lesions consist of wide bands of gray dying tissue alternating with narrow reddish-brown bands. Band patterns in chevrons from leaf tip or edges. Sometimes lesions are tan blotches at leaf edges with yellow or golden boarders.	
8.	Entyloma Oryzae	Leaf smut	Small black linear lesions on leaf blade lesions may have dark gold or light brown halo, leaf tip dries and turns gray as plants approach maturity, lesions may be present on upper sheath.	
9.	Alternaria padwickii	Stackburn or Alternaria leaf spot	Round or oval white or pale tan spot with marrow red or reddish-brown margin; often two adjacent spots coalesce to form an oval double spot; lesions with small black fruiting structures in the center.	
10.	Mycovellosiella oryzae	White leaf streak	Long narrow lesions with white center and brown boarders. Very similar to narrow brown leaf spot.	

11.	Aphelenchoides besseyi	White tip	Leaf tips turn white with a yellow area between healthy and diseased tissue; white areas sometimes occur on leaf edges.	
12.	Xanthomonas oryzae pv.oryzae	Bacterial leaf blight	lesions near the leaf tip or margin and start as water soaked in appearance; lesions, several inches long, turn white to yellow and then gray due to saprophytic fungi.	
13.	Gaeumannomyces graminis	Crown sheath rot	Black to brown diffuse lesions on the sheath near the water line, perithecia necks protruding from the upper surface with a thick fungal mat between the leaf sheath and culm. Under severe conditions causing lodging	
14.	Cercospora oryzae	Cercospora net blotch or Cercospora sheath rot	Reddish-or purple-brown,netlike pattern on the sheath	
15.	Pyricularia oryzae	Collar blast	Collar of flag leaf brown, leaf blade detaches from sheath as lesion dries	

16.	Pyricularia oryzae	Node blast	Culm node turns black or node shrivels and gray as plants approach maturity; nodes turn dark to blue gray with fungal conidia culms may break and plants lodge	
17.	Pyricularia oryzae	Rotten neck blast	Node and surrounding area at base of panicle discolored brown; stem of panicle shrivels and may break; node purplish or blue-gray with fungal spores; panicle white or gray, florets do not all fill and turn gray; panicle branches and stems of florets gray-brown.	
18.	Various fungi	Head blight, scab	Internodal area above or below node turns light brown to tan-brown; kernels in lower panicle do not fill	
19.	Pyricularia oryzae	Panicle blast	Single or several florets on a panicle branch turn light brown to Straw colored; floret stem with brown lesion; grain stops developing; florets turn gray Distribution	
20.	Sclerophthora macrospora	Downy mildew	Panicles irregular, unable to emerge from leaf sheath, and becoming twisted; the panicle is small, normally remaining green longer than usual; no seed.	

III. LITERATURE SURVEY

Brendon J. Woodford , Nikola K. Kasabov and C.Howard Wearing in paper titled "Fruit Image Analysis using Wavelets"[4] proposed wavelet based image processing technique and neural network to develop a method of on line identification of pest damage in pip fruit in orchards. Three pests that are prevalent in orchards were selected as the candidates for this research: the leaf-roller, codling moth, and apple leaf curling midge. Fast wavelet transform with special set of Doubenchies wavelet was used to extract the important features. To retrieve the related images, the search is done in two steps.

The first step matches the images by comparing the standard deviations for the three color components. In the second step, a weighted version of the Euclidean distance between the feature coefficients of an image selected in the first step and those of the querying image is calculated and the images with the smallest distances are selected and sorted as matching images to the query.

Stereomicroscopic method and Image analysis method is compared for usefulness of image analysis as an efficient and precise method to measure fruit traits like size, shape dispersal related structures by Mix & Pico[5].In general fruit length obtained with image analysis was significantly greater than that recorded with a stereomicroscopic. Only fruit length estimates did not differ between the two methods. Nevertheless there was a highly significant correlation between fruit length estimates obtained from both methods for all species of study. This indicates that both stereomicroscopic and image analysis accurately discriminated fruits of different sizes. But it was concluded that image analysis has following advantages:

1) the high amount of fruit parameters obtained with one single measurement 2) the minimization of human errors 3) the reduction of time needed to obtain large data sets concerning fruit trait variability 4) the possibility to estimate variability in traits of fruits with complicated shapes.

Pests leaves distinctive outward effects on plants like rolling the leaves or destroying the whole plant. The sucking pest reduces the moisture content of the leaves. All these effects change the chlorophyll content of a plant with corresponding variation in its spectral image. Ahsan and Umer studied the possibilities for detecting these effects by using various remote sensing techniques for acquisition of spectral image by satellite imagery, airborne images from chartered or model planes [6].

A novel approach is proposed [7] for integrating image analysis technique into diagnostic expert system. A CLASE (Central Lab. of Agricultural Expert System) diagnostic model is used to manage cucumber crop. The expert system finds out the diseases of user observation. In order to diagnose a disorder from a leaf image, four image processing phases are used: enhancement, segmentation, feature extraction and classification .They tested three different disorders such as Leaf miner, Powdery and Downey. The proposed approach has greatly reduced error prone dialogue between system and user.

In [8], the authors have proposed a system to detect whiteflies, aphids and thrips on the infected crops in greenhouse. Images of the infected leaf are captured by a camera and pre-processed using image processing techniques such as converting images from RGB to gray scales and filtering in order to obtain an enhanced image set of pests. In feature extraction, some properties of the image are considered. A variety of region properties and gray covariance matrix properties such as entropy, mean, standard deviation, contrast, energy, correlation and eccentricity are extracted from those images. The classification was performed by the use of support vector machines. The authors claim that the prototype system proved rapid detection of pests and exhibits the same performance level as a classical manual approach.

In [7], the authors have proposed a system for tea insect pests classification using correlation-based feature selection (CFS) and incremental back propagation learning network (IBPLN). The authors have created a database concentrating on eight major insect pests from the records of different tea gardens of North-Bengal districts of India. The database consists of 609 instances belonging to eight classes described by 11 attributes (signs and symptoms); all of which are nominal. The classification was performed using artificial neural networks. The classification results were compared with the original feature set and reduced feature set. Their study demonstrates that CFS can be used for reducing the feature vector and CFS+IBPLN combination can be used for other classification problems.

Santanu &Jaya described a software prototype system in paper [14] for disease detection based on the infected images of various rice plants. They used image growing, image segmentation techniques to detect infected parts of the plants. Zooming algorithm is used to extract features of the images .Self Organize Map(SOM)neural network is used for classifying diseased rise images.

In [15] fast & accurate novel method is developed which is based on image processing for grading of plant disease. They segmented leaf region using Otsu segmentation. The plant diseases are graded by calculating the quotient of disease spot & leaf area.

Grape leaf disease is detected in [16] from color imagery using hybrid intelligent system. They used self

organizing maps &back propogation neural networks to recognize colors of grape leaf.

This information is used to segment grape leaf pixels within the image. Then the grape leaf disease segmentation is performed using modified self organizing feature maps with genetic algorithms for optimization &support vector machines for classification. The segmented image is filtered using Gabor wavelet which allows the system to analyze leaf disease color features more efficiently. The support vector machines are then applied to classify types of grape leaf disease.

Ying & others studied methods of image preprocessing for recognition of crop diseases in [17] . They used cucumber powdery mildew, speckle & downy mildews as study samples & reported comparative study of effect of simple filter and median filter. They stated that Leaves with spots must be pre-processed firstly in order to carry out the intelligent diagnosis to crop based on image processing and appropriate features should be extracted on the basic of this.

In [18] the design &development of an expert system with two different methods for diagnosing plants Diseases were presented:1) step by step descriptive method 2)graphical representation method. It is reported that the expert system with the graphical representation is more favourable .it is found that the graphical representation requires few description from users. The proposed system saved a lot of time & effort in identifying plant disease.
Images features extraction is very important for the grading process of flue-cured tobacco leaves. In Paper[19] a system based on machine vision techniques is proposed for the automatic inspection of flue-cured tobacco leaves. Machine vision techniques are used in this system to solve problems of features extraction and analysis of tobacco leaves, which include features of color, size, shape and surface texture. The experimental results show that this system is a viable way for the features extraction of tobacco leaves, and can be used for the automatic classification of tobacco leaves.

Paper [20] present a method to monitor plant disease which caused by spores. The color image is first converted in to gray image so as to carry the analysis and processing, such as histogram.

Method for fast & accurate detection & classification of plant diseases is proposed in [22]. They used Otsu segmentation , K-means clustering &back propagation feed forward neural network for clustering & classification of diseases that affect on plant leaves. A feasible methods for detecting soybean rust and quantifying severity is explored[22]. The images of soybean leave with different rust severity were collected by using both multispectral CCD camera and portable spectrometer. Three parameters i.e. ratio of infected area, lesion color index and rust severity index were extracted from the multispectral images and used to detect leaf infection and severity of infection.

Hian Chye Koh and Gerald Tan, explain about the data mining applications in healthcare management. In particular, discusses data mining and its applications within healthcare in major areas such as the evaluation of treatment effectiveness, management of healthcare, customer relationship management, and the detection of fraud and abuse along with an illustrative example of a healthcare data mining application involving the identification of risk factors associated with the onset of diabetes [4].states that Data mining techniques have been used in medical research for many years and have been known to be effective in extracting information from medicinal data [7]. A Hybrid Data Mining Method has helped, for example, with a medical classification of chest pain. A hybrid methodology that combined data mining techniques (such as association rules and classification trees) was used in order to solve problems faced by emergency departments such as long waiting time, congestion, and delayed patient care. The methodology has also been applied to analyze emergency data collected from a hospital. The results are expected to help physicians make more accurate classification of chest pain diseases.

Abdullah, Ahmad and Ahmed [8] demonstrate that association techniques can be used to yield association rules in medical billing data. Their motivation in this research work is to uncover patterns of resemblance between medical bill and purchase bills. The Association technique in particular, has been applied through the apriori algorithm, in numerous medical projects. A research by [9] studies how data mining techniques are used for the data analysis and knowledge discovery in medical sciences using the apriori algorithm and a self developed algorithm. The author claims to have used realistic values from a medical database which makes their output reliable, efficient and precise for decision making. Specifically results may be used for analyzing and improving performance by the medical staff.[10] stated that so many medicinal plants are available and used by mankind from the time immemorial. But many of the medicinal plant species are facing threats of extinction due to over and improper exploitation, habitat loss, degradation of land, urbanization, etc. In this study, the hierarchical clustering technique of data mining was applied on the herbal gardens of India and classified in order to discover meaningful patterns such as what type of habit of medicinal plant species is present in which location of India.

IV. PROPOSED METHODOLOGY

In the below section we presented the origin of major patterns. The data warehouse consists of the information about the plants and their medicinal values. Primarily, the data warehouse is preprocessed to make mining process more competent. In the proposed study, we used the association rule mining algorithm for the classification of data.

A. DATA SET

Rice crop is one of the crops in India, due to its importance as the main food and for exporting. The rice cultivation area in India is approximately. Rice is the main grain crop of India. India ranks second in the world in production of rice. About 34% of the total cultivated area if the nation is under rice cultivation. Out of the total production of food grains, production of rice is 42%. Rice is cultivated in areas having annual average rainfall of 125 cm and average temperature of 23 degree Celsius. Major Rice cultivating areas are north east India, eastern and western coastal regions and river basin of Ganga. West Bengal, Punjab and Uttar Pradesh are the major rice producing states. Besides, Tamil Nadu, Karnataka, Orissa, Haryana, Bihar, Chhattisgarh, Assam and Maharashtra also produce rice. Many affecting diseases infect the Indian rice crop: some diseases are considered more important than others. In this case we focus into the most important diseases for example “blast,” “helminthosporiose,” “stem rot” and “foot rot”.

Table 1. Attributes and their possible values

Attirbute	Possible Values
Variety	SAMBA MAHSURI, IR-36, ADT 18, 32
Age	Possible Values
Parts	Leaves, Leaves spot,Nodes spanicle,grains, plants,Leave sheeth, Stems
Appearance	Spot, Oval, Fungal
Color	Brown, Brownish, Grey, Olive, Whitish,Yellow
Temperature	Real Values
Disease	Blast, Rot, Stem Rot, foot rot, Kernel Smut Brownish spot

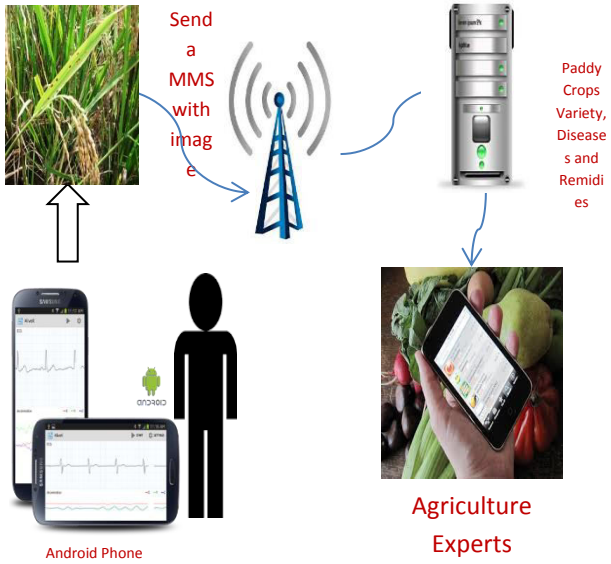


Figure 5 : Proposed Design of Paddy Crops Diseases Detection System

B.Benefits to Farmers

- Easy access to specialized Agriculture services by rural, under served, semi urban and in remote areas
- Early diagnosis and quick treatment
- Reduced visits to fields
- Reduced travel expenses
- Reduced burden of disease

V. CONCLUSION

The study is done in this paper provides a new insight in detection of the diseases of plant . The scope in doing research in this field is as follows:

1) There are two main characteristics of plant disease detection using machine-learning methods that must be achieved, they are: speed and accuracy. Hence there is a scope for working on development of innovative, efficient & fast interpreting algorithms which will help plant scientist in detecting disease.

2) Work can be done for automatically estimating the severity of the detected disease.

3) The main outcome of this project is an android based software tool to find and cure paddy diseases for farmers

4) This work proposes two databases which contain paddy disease syndromes images and treatment experiences which can further extendable.

5) In technical, to be proposed two novel algorithms for image analysis and finding the correlation between attributes of the databases.

Why I have decide to invent a New Image Compression Algorithm?

- Computationally expensive: Most of the existing compression algorithms were designed and tested on PC not in mobile phone.
- Unsuitable for MMS/SMS transmission: Mobile phone based wireless application often requires transmission of paddy crops images over existing MMS and SMS protocols.
- Requirement of decompression for further analysis on compressed paddy crop images:
- Finally, the main objective of existing paddy image compression techniques is to achieve high compressibility by having redundancy free output.

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