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REVIEWING ROLE OF IMAGE ENHANCEMENT IN PADDY LEAF DISEASE DETECTION

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Abstract: In the field of agriculture, there is a requirement to detect and classify diseases from leaf images that are taken from plants. Finding the diseases of paddy leaf by making use of image processing mechanism would reduce the reliance on farmers in order to save the product related to agricultural activity. The research paper is finding and categorizing the disease in paddy leaf with the help of image processing. 2- Dimensional computerized pictures are those electronic pictures that have been generated on the basis of the computer. They are mainly generated out of two-dimensional forms like 2-Dimensional geometric form, word, and electronic pictures, and using methods exclusive to them. It becomes possible to refer word to a field of computer science that includes certain methods, or it can refer to the forms it selves. These types of digital pictures are mostly used. These are initially built on conventional printing and drawing technology, such as scientific drawing, advertising, typography, cartography, and so on. In such implementations, a two-dimensional image/graphic is more than just a reflection of a real-world object; it is an individual artifact with added textual meaning. 2D models are considered for the reason that these models have additional strict control of pictures/graphics in comparison to three Dimensional computerized pictures. The approach of three Dimensional computerized pictures is very much analogous to camera work in comparison to style. In this article, we implemented scaling using BILINEAR Interpolation in order to compress images with minimal loss in image quality. This paper has presented CNN based advance approach to detect and classify paddy leaf disease. Advance mechanism has make use of approach that is considering image compression, edge detection and CNN in order to perform detection of disease rapidly with more accuracy.

Keywords: Paddy leaf, image processing**,** 2D, 3D, digital image, rotation, scaling, CNN

[1]INTRODUCTION

Agriculture is found a significant source of income for humans in a number of countries [1]. Farmers cultivated food plants based on the environmental condition of the land as well as the specifications. Farmers, on the other hand, face several challenges such as a lack of water, natural hazards, plant pests, and so on [2]. Several problems have been eliminated as a result of technical facilities that have been implemented in order to limit disease transmission. There is no need to seek expertise because such a mechanism has the potential to increase food production [3]. The diagnosis of plant disease [4] becomes an essential subject of study in the area of agriculture. It has been discovered that the most difficult task is identifying and classifying plant diseases. The detection of plant diseases [5] is critical in order to prevent declines in agricultural product quantity and yields. Plant disease identification research considers diseases to be patterns found on plants [6]. Plant diseases are difficult to track as they are created by hand. Since doing the manual processing time requires a significant amount of effort and experience, plant disease identification as well as image processing mechanisms have been used [7]. Data retrieval entails recognizing diseases by retrieving images. Images are segmented and pre-processed. Finally, the characteristics are extracted in order to classify them [8]. Such methods may be used to improve the appearance of contaminated plants' exteriors [9]. It has been discovered that in many species, the leaves are a major source of disease. Sheath rot, brown blot, leaf blast, bacterial blight, and leaf smut have all been identified as common diseases in rice plants [10]. The symptoms of plant diseases differ depending on the plant. According to observations, plant diseases come in a range of colours, sizes, and shapes. There are several diseases associated with various characteristics of plant leaves. Some plant diseases are pink, while others are brown, according to researchers [11]. Many cancers have similar forms but different shades. However, others are the same hue but different shapes. After segmentation, a normal portion of disease-related characteristics can be retrieved [12]. Manual diagnosis of those diseases which are connected with plants has been usually done by scientists by inspecting them with their naked eye which takes more time and is more costly in case of farms which are wider in length and breadth [13]. This process is not easy. From time to time error comes in to existence at the time of determining disease nature

[14]. Rice yield has decreased in recent years due to a lack of knowledge about appropriate management for correcting rice plant leaf diseases [15]. Four most prevalent rice plant diseases are being studied. These diseases are known in the form of brown spot, leaf explosion, bacterial disease, and covering decay.

[2] IMAGE PROCESSING

Two-dimensional computer graphics, which is built on vector graphics devices, first appeared in the 1950s. In the intervening decades, these were increasingly supplanted with the help of those instruments which are formed on the basis of raster. In this field the procedure related to PostScript language and X Window System become game changers. Numerical forms become famous in the form of vector pictures, electronic image/graphics, become famous in the form of raster pictures, and text to be typeset are all represented with the help of material, style and colour, location, height, orientation, arithmetical operators and situation. It becomes possible to use 2Dimensional arithmetical changes like rotation, conversion, and resizing for the modification and manipulation of components. In object oriented pictures, a graphic is represented indirectly by an object endowed with a self-rendering process, which is a technique that assigns colours to image/graphic pixels using an arbitrary algorithm. In object-oriented programming paradigms, complex models can be constructed by merging simpler objects.

2.1 Image Scaling

It exists in the form of method in which a graphical picture is resized in computer graphics. The process of resizing is not easy. It needs balance in the middle of performance, smoothness, and sharpness. When using bitmap pictures, the picture element that creates the picture, becames more apparent with the increment and decrement of picture size. The picture looks "soft" once the picture element is averaged, or jagged. The trade-off in the company of vector pictures may be in computing power in support of re-rendering pictures. It becomes visible in the form of slow re-rendering in the company of still picture, or slower frame rate & frame skipping inside computerized animation.

2.2 Loosy & Lossless Image Compression

Lossy or without loss compression of pictures is available. Without loss encoding becomes ideal in support of historical functions. It is generally used for health photography, scientific illustration, clip art, and comic books. In situations where the Lossy compression methods are used at short bit rates they add compression artefacts. Lossy techniques become useful at the time of normal photography like portraits, where minimal reliability loss is tolerable for the achievement of important reduction in bit rate. In a visual manner without loss compression is lossy compression that causes marginal variations.

Techniques in support of without loss picture compression become:

- Run-length encoding – used as the default choice in PCX and as one of several options in BMP, TGA, and TIFF.
- DPCM and Predictive Coding
- Entropy encoding
- Flexible dictionary methods like LZW – used in GIF and TIFF
- Reduction utilized inside PNG, MNG, and TIFF
- Chain codes

Compression without loss

It exist in the form method in which the compressed information is completely recovered out of original information. In comparison to this, , on the other hand, lossy encoding exist in the form of method in which only a picture related to original information is recovered, It will typically increases the rate of compression . Therefore, the size of files is reduced.

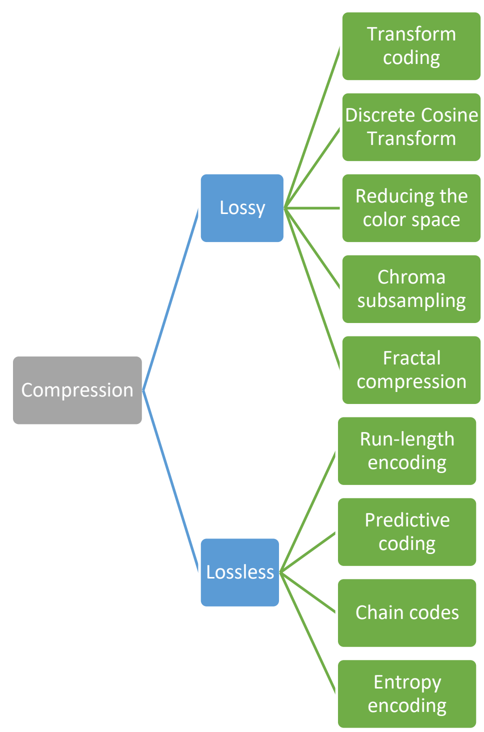

Fig 1 Lossy and lossless image compression

2.3 Edge detection

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Edge detection is process of extracting the outlines or border from image is termed as edge detection. To reduce image content during of feature selection there would be need of edge detection. Edge detection eliminates the useless content of image to allow rapid feature selection. The edge detection mechanism has been applied before feature selection in order to reduce the time consumption. Moreover the used of compression mechanism would reduce the size of image. There have been four type of edge detection

1. **Prewitt:** The Prewitt operator has been utilised in image processing. It is one of the edge detection algorithms. This has been considered as discrete differentiation operator. It calculates an approximation of gradient of image intensity function. On every point in the image, output of Prewitt operator might be corresponding gradient vector. Result might be norm of vector sometime.
2. **Robert:** Roberts Cross operator implements simple, quick to calculate, 2-D spatial gradient measurement over graphical contents. It highlights the regions of high spatial frequency that are corresponding to the edges. Input to operator is a grayscale in its most common usage.
3. **Sobel:** The Sobel operator is termed as Sobel–Feldman operator. It is also known as Sobel filter that has been utilized in graphical processing as well as computer vision. It is well known edge detection algorithms. It develops graphical content that are emphasizing the edges.
4. **Canny :** Canny edge detection is a method for extracting valuable structural information from various objects of vision and for significantly reducing the quantity of data to be processed. It has been used extensively in many computer vision systems. Canny has found that the edge detection requirements are relatively similar for various vision systems. In a variety of situations, an edge detection solution can therefore be used to address these requirements. The basic edge detection criteria include:
   1. Detect the edge at a low error rate, which means that as many edges as possible in the image are accurately detected.
   2. The edge point the operator detected should be located on the edge centre accurately.
   3. Only once should a given edge in the picture be marked, and noise need not make false edges, where possible.

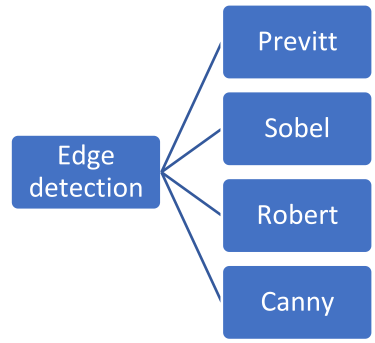

Fig 2 Edge detection

[2]LITERATURE REVIEW

In this article, we will use the image processing toolbox in MATLAB to compress images without sacrificing image quality. To do this, we must first investigate image processing science.

There have been studies to identify and diagnose paddy leaf diseases. Some studies make use of an integrated Deep Neural Network with the Jaya algorithm [1]. Existing research focuses on rice quality improvement [2]. With the help of picture quality analysis it becomes possible to conduct automatic plant diseases identification in vvarious varieties of crop [3]. Some researchers proposed integrated disease management for rice kernel smut [4]. Researchers have suggested many AI-based expert systems [5, 10] and nanotechnology-based systems [6]. Image analysis has been widely used to identify and analyse rice plant diseases [7, 9, 12]. Deep neural networks [13, 14] are now built into image processing-based mechanisms to identify and recognise plant diseases, providing a precise and efficient solution. The experimental findings were analysed and correlated with ANN, DAE, and DNN in that study. For blast impacted, these approaches obtained a high precision of 98.9 percent. In the case of bacterial plague, it was 95.78 percent, and in the case of sheath rot, it was 92 percent. Furthermore, in the case of brown spots, accuracy was found to be 94%. The average leaf picture accuracy was 90.57 percent. Some scholars, however, have used support vector machines [16].

Sangeet Saha, Chandrajit Pal, Rourab Paul, and others have a brief journey through hardware innovations for image processing[17] and their applications in cryptography.

The role of embedded applications in image and video processing, networking, and cryptography has grown in the current research period. Improved pictorial knowledge for improved human vision, such as deblurring and de-noising, is a revived research focus in many fields such as satellite imaging, medical imaging, and so on. We would like to focus on the importance of computer vision as one of the areas where hardware-implemented algorithms outperform software-implemented algorithms. Image Processing Techniques: A Comparative Study and Implementation[18] Sukhjinder Singh, R.k Bansal, and Savina Bansal use MATLAB.

Media improvement helps to improve image accuracy for improved rendering. This paper discusses three image improvement methods: GHE, LHE, and DSIHE, both of which increase the optical clarity of images. In this article, we apply and test the above-mentioned techniques on objective and subjective image quality parameters (such as PSNR, NAE, SC, AE, and MOS) to assess the quality of grayscale enhanced images. A comparative analysis is also being conducted. Histogram Equalization (HE) methods (such as GHE & LHE) aim to adjust the mean brightness of an image to the middle level of the gray-level spectrum when dealing with gray-level images, reducing their applicability for contrast enhancement in consumer electronics. DSIHE methods seem to address this downside because they aim to retain both brightness and contrast enhancement, though at the expense of the naturalness of the input image.

Dibyendu Ghoshal in the company of others conducted research on graphics edge detection with the help of gradients.

It is a paper which presents a report on picture edge/border detection with the help of gradients. Edge/border detection becomes the fundamental operations in the treatment of pictures and its analysis. Edges/borders shape the outline of an object and thus serve in the form of boundary in the middle of object and surroundings. Accurate detection of edge/borders is critical for analysing simple image properties such as field, perimeter, and form. MATLAB 7.0 was required as a software tool.

Mie Sato et_al, (2000) tested a region growing method on the basis of magnitude of gradient in support of perfect separation [20].

“They express that undesirable partial-volume –effect which lies on boundary between a high intensity region & a low intensity region, makes unerring boundary determination a difficult task. A new approach to segmentation is required for removing adverse effect on boundary, which is unwanted especially from point of view of volume rendering. A gradient is useful for enhancing boundary because it emphasizes on difference among voxel values”. Through the analysis of magnitude of gradient, it becomes possible to see sufficient dissimilarities. It becomes necessary to display this dissimilarities on the border area because these dissimilarities played an important role in improving the perfectness of the seperation process. Researches in relation to border zone seperation are being conducted.

Stoyan Donchev. (2000) used a flexible maximum gradient approach to segment areas and features in greyscale images[21].

“One of the most critical procedures of image processing is image segmentation, which is the isolation of an object from its surroundings". There are currently two basic types of segmentations realised in connection with strength and its gradient, as well as two basic types of segments areas and boundaries, respectively. "Field" is a word which typically refers to topologically joined regions of a picture with a relatively uniform allocation of strength, where as "border" is a word which typically describes those areas in which strength varies in a very dramatic way, or zones whose value of intensity gradient is high. It becomes possible to place borders in the middle of object and its context. It is also possible to place border in the middle of different areas of identical object. Out of these two separation methods one is used for the purpose of picture treatment in most cases. This is the reason due to which an innovative flexible threshold gradient approach has been submitted here. It is an approach which considers picture in the form of single indivisible entity in the company of areas and boundaries. The analysis of this structure yields the effects of a segmented image.” The system is proposed for use in a variety of contexts, including analysis of 3-dimensional scenes with random illuminating source spot, coding of image homogenising regions, analysis of printed documents with inconsistent backgrounds and low content, decreasing the amount of strength levels and eliminating material redundancy, and so on.

Nikos Aspragathos and Phillip Azariadis (2001) Geometric[22] entity representation and transformation in computer graphics with the help of binary unit vectors and line amendment.

In order to define and transform 3D mathematical units in computerized pictures, a representational paradigm is presented in this article. The structure which has been presented here is built on the basis of binary unit vectors, and subsequent changes are performed with the help of binary rectangular matrices. Solidity emerges in the form of primary strong point of such type of representation, because other helpful mathematical properties of a demonstrated surface, like contiguous or usual vector, are embedded inside the real demonstrational paradigm itself.

Conversion, alterations, and view modifications are represented in natural manner with the help of screw displacement principle, where as resizing has been achieved when the moment vector of all the binary line is used. In addition to this, a transform operator assessment is proposed on the basis of binary unit quaternions for the determination of that optimal formula which can be used at the time of computational method implementation in support of computerized animation. In the end, empirical distinction in the middle of paradigm which has been submitted here and standard flexible paradigm is provided inside the computerized animation in order to demonstrate their process benefits.

[4] PROBLEM STATEMENT

In the case of paddy leaf, disease classification and prediction are difficult. The problem with paddy leaf disease identification is poor picture quality. Many of these approaches, especially LZW and its variants, be used in publicly available and copyrighted tools. Several methods are copyrighted in the US and other nations. Their use legally necessitates licencing from the copyright owner. Because of patents on specific types of LZW compression, and in particular licencing activities by patent holder Unisys that many developers consider violent, It is suggested by several publicly available advocates that people do not use GIF for squeezing immobile pictures files for PNG, because it incorporates those contract methods which is based on LZ77 in the company of range of domain specified forecasting filters. On the other hand, LZW license was expired in the June month of year two thousand and three.

The work of number of lossless compression methods which are utilized in favour of text is practically fine in support of indexed pictures. On the other hand, remaining methods fails to work in support of usual text, but still helpful in support of those bitmaps pictures which are mainly uncomplicated. It is also useful in support of those strategies which make use of picture specified qualities (like the ordinary occurrence of adjacent two dimensional domains of analogous tones, and the fact that coloured pictures generally hold a limited range of colours out of those representable in the colour space). It is already assumed in the past that contraction of sound without loss emerges as a much specialised field. It becomes possible for methods which contracts sound without loss to take help of the wave like structure of the data's repeated patterns, simply by means of "autoregressive models" for anticipating "next value ". It encode inconsistency in the middle of predicted and authentic data. The variation in the middle of predictable and authentic data is known in the form of error. In situations where these errors are small, dissimilarity values such as zero, plus one , one,. on sample values is very normal. It becomes possible to manipulate them once they are programmed in some external bits.

When only the gaps present in the middle of 2 copies of a file or, in video compression of consecutive pictures within a series is compacted it is considered valuable . It is known in the form of delta encoding. It came out of a Greek letter. It signifies a distinction in arithmetic. This concept is usually utilized where all variants become important except for compression and decompression. Although the error compressing technique in the above lossless audio squezzing system may be demonstrated in the form of delta encoding from the approximated to unusual sound wave, the approximated version of the sound wave is meaningless in any other sense.

The issue with exiting researches is that they did not work on the quality of image while classifying the paddy leaf. Moreover there is need to improve the performance during classification and prediction. Research is supposed to implement scaling using BILINEAR Interpolation in order to compress images with minimal loss in image quality. Moreover in order to improve the performance there is need to introduce the edge detection mechanism that would eliminate the use less portion from paddy leaf image. Only useful portion would be considered. This would reduce the image processing time and lead to high performance during classification and prediction process.

Table 1 Comparison chart for previous researches

Author / Year	Objective	Methodology	Limitation
Ramesh, S., & Vydeki, D. (2020) [1]	In order to recognize and classify the disease of paddy leaf	Best DNN in the company of Jaya method	Process of traning is time consuming
X.E. Pant azi, D. M oshou, A. A. Tamou ridou (2019) [3]	For automatic identification of those leaf disease which are present in the various variety of crops	Examination of picture quality and multi-grade classification devices.	There is need to increase the accuracy
Astonkar, R. Shwet a, V.K. S handilya (2018). [7]	recognition and examination of those Diseases which destroy crops	Picture treatment	The process of detection need to more efficient and reliable.
Singh, B. Kumar, S. S. Ganapa thysubra manian, A. Singh (2018). [8]	Deep learning in support of plant stress phenotyping: trends in addition to upcoming perception	Image processing	Need to improve performance and reliability

[4] ADVANCED PADDY LEAF CLASSIFICATION

Advanced research are focusing on study of existing pattern detection and techniques. During research work review the loopholes of traditional techniques used in pattern detection has been made. Research proposes a methodology for mask detection using edge based CNN (convolution neural network) algorithm. Proposed work is supposed to implement the proposed methodology using MATLAB. Comparison of proposed methodology and algorithm with the traditional algorithm has been made. The proposed work is supposed to be more efficient as compared to traditional techniques.

Process Flow of Proposed Methodology

1) The image base of data set captured by camera would be created. The graphical content captured from camera is pre-processed using image resize function.
2) Apply tradition CNN classifier in order to check the space and time consumption after getting the image dataset. The time and space variable is stored in order to compare it with upcoming time and space variable in case of edge detection mechanism.
3) Apply the edge detection mechanism on the image set. The edge detector would eliminate the useless portion of image. The edge detection deduces the file size as well as the feature extraction time.
4) Apply the proposed CNN classifier in order to check the space and time consumption. The CNN classified is supposed to have rich features. The trained CNN classifier is enough to train the image set. The decisions are made according to trained image set.
5) Compare the performance and space consumption of traditional and proposed work.

Table 2: Comparison Chart for Traditional and Advanced Research

Feature	**Traditional Research**	**Advanced Research**
Detection time	Comparatively high	Comparatively low
Space	More storage space is required	Comparatively less space required
Accuracy	Relatively less accuracy	Relatively high accuracy
Edge Detection mechanism	Not applied	Canny edge detection is applied
Neural Network	Not applied	Convolution Neural Network
Flexibility	Lack of flexibility	High flexibility as it could be applied in another application
Scalability	Limited scalability	Work could be implemented at huge scale
Performance	Relatively low	Relatively high
Mechanism	DNN	CNN

[5] EXPERIMENTAL RESULTS

A. Acquisition of images

Acquisition of images is procedure of getting image that is used in research. Rice plant leaves images are captured by using high resolution digital camera from farm field. In order to perform recognition of diseases, all captured images are required to be shifted to computer. This is the location where action process of implementation takes place. Dataset is prepared with 650 images that are consisting 95 normal images and 125 bacterial blight images. Data set is having 170 blast images along with 110 sheath rot images. Moreover dataset has 150 brown spot images.

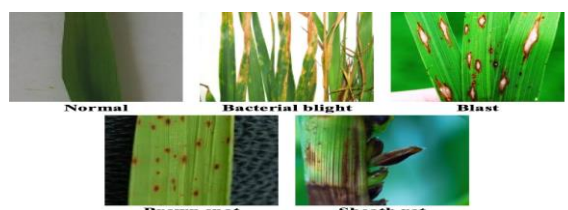

Fig 3 Sample images of normal and diseased leaves

B. Pre-processing

In order to reduce need of memory and computation of power, the size of images in dataset is changed. The cropping operation is performed on image to set dimension of 300×450 pixels during pre-processing phase. During preprocessing significant operation is to remove image background by applying hue values based fusion with edge detection mechanism. Image in RGB model is converted into HSV at initial stage. From the HSV model S value is considered for process as it overs the whiteness. Considering threshold value to 90, image is modified to binary image. Then this binary image is fused with original RGB image in order to create a mask. Threshold value is chosen considering many trials. Fusion process is helps in removing background by assigning pixel values to 0. Pixel value 0 is showing black color in the RGB model. Following figure is showing preprocessing steps.

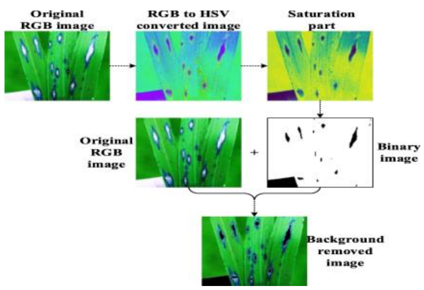

Fig 4. Pre-processing steps for background elimination

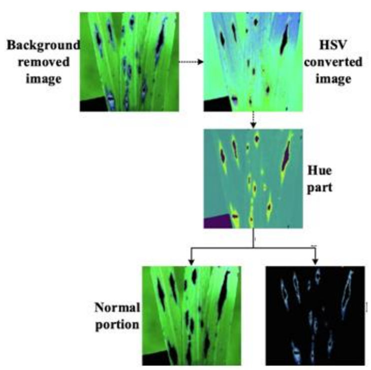

Fig 5 Edge detection from the hue part

C. Extracting features

In this work texture and color features are extracted. The color features includes extraction of mean and standard deviation values whereas the texture features include the GLCM features. Finally edge detection mechanism is applied to improve the accuracy during detection.

1) Color features

1. Initial R, G and B components have been fetched for diseased portion. Mean value and standard deviation have been evaluated.
2. In case of HSV model, H, S and V components are considered. Then mean value has been calculated.
3. In case of LAB color model, L, A and B components are taken in account. Then mean value is calculated.

The mean and standard deviation are calculated by using the formulas given below.

$$M_y = \frac{1}{n}\sum_{x=1}^{n} P_{yx} \quad \ldots\ldots(1)$$

$$S_y = \sqrt{\frac{1}{n}\sum_{x=1}^{n}\left(P_{yx} - M_y\right)^2} \quad \ldots\ldots(2)$$

Here n is showing total number of pixels. P_{yx} is meant for pixel values.

2) Texture Features

Considering spatial relationship among pairs of gray value intensity pixels, the GLCM is getting texture of image. From GLCM the specified displacements homogeneity, correlation, energy and contrast can be found. Formulas for such characteristics have been shown as.

$$H_y = \sum_{x-0}^{n} \frac{P_{yx}}{1+(y-x)^2} \quad \ldots\ldots(3)$$

$$Ct_y = \sum_{x=0}^{n} P_{yx}(y-x)^2 \quad \ldots\ldots(4)$$

$$Cn_y = \sum_{x-0}^{n} P_{yx}\frac{(y-M)(x-M)}{S_y} \quad \ldots\ldots(5)$$

$$E_y = \sum_{x=0}^{n}\left(P_{yx}\right)^2 \quad \ldots\ldots(6)$$

where, H_y shows homogeneity, Ct_y is meant for contrast, Cn_y indicates correlation, E_y shows energy, n is considered for total number of pixels, P_{yx} is presenting pixel values, M_y is showing mean and S_y is showing standard deviation.

D. CNN based classification

The framework of CNN contains three layers i.e. input layer, output layer and hidden layers. The proposed architecture of CNN is shown in following figure

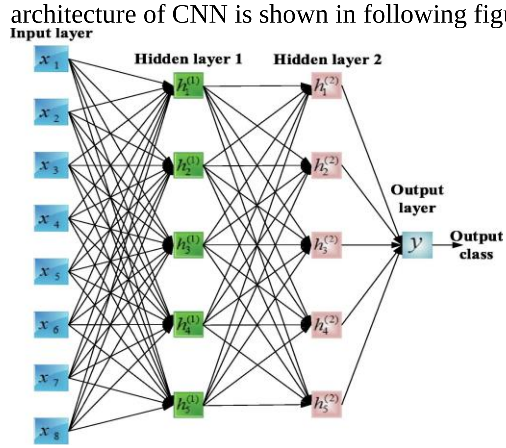

Fig 6 Architecture of conventional Neural Network with hidden layers

The simulation part is providing the comparative analysis of accuracy in case of previous and proposed work. Considering overall accuracy in case of previous and proposed model following table has been produced. It has been observed that the overall accuracy is more in case proposed model where CNN has been used with canny edge detection mechanism as compare previous model. In proposed model overall accuracy is 97.692% but in case of previous research it was 93.077%

Table 3 Comparison of overall accuracy

	Previous research	Proposed research
Overall accuracy	93.077%	97.692%

Considering precision accuracy in case of previous and proposed model following table has been produced. It has been observed that the precision accuracy is more in case proposed model where CNN has been used with canny edge detection mechanism as compare previous model.

Table 4 Comparison of Precision accuracy

Class	Previous research	Advanced research
Blast	96.67%	100%
Bacterial blight	92.58%	100%
Brown spot	92.59%	96.296%
Sheath Rot	88%	95.833%
Normal	95%	95.238%

[6] SCOPE OF RESEARCH

Research work has focused on CNN based advance approach to detect and classify paddy leaf disease from images. Advance mechanism has make use of approach that is considering image compression, edge detection and CNN in order to perform detection of disease rapidly with more accuracy.

Most efficient methods for automatically structuring, indexing, and retrieving image information have been investigated in research. This work would investigate various image compression approaches, including loosy image compression methods and lossless image compression methods. Image transmitting during networking is ideally suited for the application of an algorithm based on Huffman Coding to compress the image with the least amount of loss of image quality. Implementing the algorithm in MATLAB to compress an image during preserving image consistency has reduced the probability of file retransmission. Calculations of the Peak Signal to Noise Ratio and Mean Square Root Error confirm the algorithm's accuracy. Use of CNN model made in advance research provides overall accuracy and precision value.

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