iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** II **Month of publication:** February 2020

DOI: http://doi.org/10.22214/ijraset.2020.2082

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 8 Issue II Feb 2020- Available at www.ijraset.com

Identification of Diseases in Dairy Cow Based on Image Texture Feature and Suggestion of Therapeutical Measures

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Abstract: ***In every part of India, where farming is done, Cow plays a vital role in agricultural practices. Diseases in cow have a severe impact in its health and life. It is necessary to develop methods and measures in order to increase the accuracy in diagnosis of multi type diseases. It is a difficult task to diagnosis the cow disease manually. It requires expertise for diagnosis the cow disease, and this consumes excessive processing time. Hence, image processing techniques is introduced for the detection of cow disease. These detection techniques will be helpful in identify three types of diseases namely lumpy skin diseases, blackleg diseases and hoof and mouth disease in dairy cow. The signs of these diseases were appeared on the skin. Hence the skin images of cow were considered for recognition. These techniques will also suggest the therapeutically measures for identified diseases.***
Keywords: ANN classifier, CLAHE, Disease detection, Fuzzy C Means, GLCM, image processing, Median filter.

I. INTRODUCTION

Veterinary science is generally concerned with the prevention, diagnosis, control, and treatment of diseases which affects the health of domestic and wild animals. By implementing image processing technique in veterinary science, more accuracy is obtained in disease detection.

The Cows are considered to be a sacred animal in Hindu religion. There is no ambiguity that the cow is a very helpful and delicate animal. Everything is lucrative to us which are recognized with a cow. There are still a lot of cows that are not taken care of. They are left to roam around on the roads through which they may get many diseases. The disease in cow drastically reduces its growth. Therefore, it is necessary to find the ways and means to combat diseases. Detection of cow's disease and its severity has always been challenging. Earlier naked eye observation (visual analysis) was the only available technique to analyze the disease severity. This requires continuous monitoring of the farm for the correct estimation of disease by expert in this field. As the visual analysis requires constant human observations, the process (visual analysis) tends to be very costly, cumbersome and time-consuming for large areas of farms. In order to overcome this problem a new advanced technology has been used, so that early and accurate estimation of diseases is done and remedial measure can be applied at the right time. Image processing techniques are proven to be one of the accurate and economic practices for measuring the parameters related to various cow's disease. This paper illustrates three types of diseases in dairy cow namely lumpy skin diseases, blackleg diseases and hoof and mouth disease in dairy cow.

Lumpy Skin Disease is a disease affecting cow which causes fever, depression, skin nodules and oedema, enlarged lymph nodes, also nodules on the mucous membranes, nasal and ocular discharges, milk drop, swellings in the leg and lameness. The firm nodules are up to 5 cm in diameter in the skin. These can be found on all over the body, but particularly on the head, neck, udder, scrotum and perineum. The disease has considerable economic impact due to production losses (e.g. milk drop, reduced quality of skins), movement and trade restrictions imposed on the affected areas.

Fig. 1 Lumpy skin disease

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
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Blackleg Diseases an infectious bacterial disease that affects the cow's leg which is caused by a gram-positive bacteria species called Clostridium Chauvoei. The affected leg will begin to feel hot to touch and will begin to swell slightly and also black patches will be found on and around the affected area. This will lead to the animal becoming lame and struggling to walk on it. Blackleg can, unfortunately, occur at any time of the year, though most cases occur during the warmer summer months. The nature of the blackleg disease means that treatment is extremely difficult, while the effectiveness of vaccines has been disputed. Usually, the cow will only survive for a short period after the first signs of the disease are noticed, with many dying within 12 hours.

Fig. 2 Blackleg disease

Hoof and mouth disease is an infectious and sometimes viral disease that that affects cloven-hoofed animals, including domestic and wild bovids. Initial signs are dullness, inappetance, decreased milk production, and fever, followed by an increased salivation, lameness, and serous nasal discharge. As the blisters increase in size and number, soreness of the hooves leads to treading and kicking, and lesions become readily apparent. Vesicles may appear on the lips, gums, dental pad, tongue, nares, muzzle, inter digital spaces, and teats. These rupture in time and leave eroded areas.

Fig. 3 Hoof and mouth diseases

II. LITERATURE SURVEY

Shaveta Malik et al [1], proposed a method for identifying EUS (Epizootic Ulcerative syndrome) disease in fish. The images are collected from the various sources. Region of interest is used to extract the features in the fish image. Various classification techniques such as neural network and K-Nearest Neighbour is used to classify EUS infected fish and Non-EUS infected fish.

Shweta.S. Kothawale et al [3], proposed a method for identifying a disease in grape leaf using Support vector machine recognization methods. In this system is has two types of dataset namely trained data and testing dataset. The features extracted from the training leaves dataset are compared with the features extracted from testing leaves dataset. Based on the matched features, the images are classified by the SVM.

O. N. Pandey et al [2], proposed a framework for identifying brain tumour using image processing techniques. The input for this framework is taken from the patient MRI scan image. Threshold segmentation and watershed segmentation is used to locate the objects and the boundaries in images. By observing the differences in brightness and darkness in MRI image, brain tumour can be detected.

Di Cui et al. [21], proposed the image processing techniques for detecting rust on plant leaf multispectral images and detect its growth amount of diseases. The images are collected from the greenhouse of research institute. The explained method uses the concept of evaluating the centroid of each image for further processing.

Rittika Raichaudhuri et al. [22] proposed the framework for identifying wheat leaf Diseases. In this robotized framework is utilized to identify the leaf infections. The k mean methods and vigilant channels are used for image preparation and segmentation handling. The design acknowledgment is done through PCA or GLCM and classification of diseases through SVM or ANN.

Naresh Khuriwal al. [23] proposed a method for earlier detection of breast cancer using image processing. In this deep learning techniques is applied on MIASDatabase.200 images from MIAS database are preprocessed by using preprocessing algorithm such as, Colour based segmentation, Watershed Segmentation and Adaptive Mean Filters.12 features are extracted from the image for diagnosis of breast cancer and it provides classification accuracy of 98%.

Abdulrahman Alhawaimil [23] proposed a method for identifying a brain stroke using image processing techniques. Matlab image processing software is used to analyze brain stroke image captured from the magnetic resonance imaging (MRI).In this brain stroke area is calculated from the MRI brain stroke images. This calculation makes the doctors to know more about stroke size.

III. PROPOSED SYSTEM

The proposed system aims at developing real time system for cow disease diagnosis and giving Therapeutical Measures for cow disease. The proposed system is explained with the help of flow chart given below in Fig. 4:

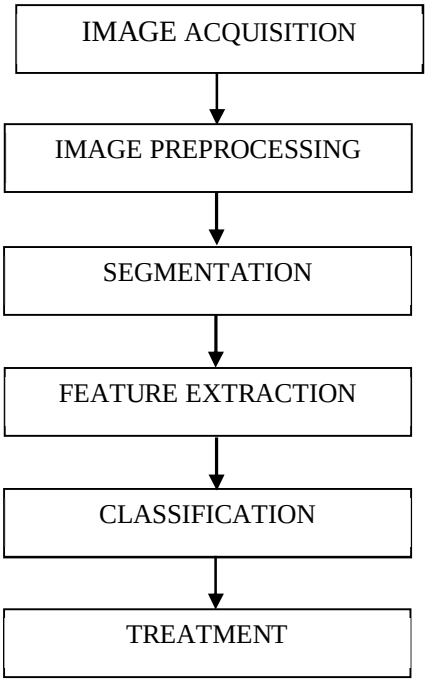

Fig. 4 Flowchart for proposed system

A. Image Acquisition

The first stage of image processing is image acquisition. The sample image of the diseases is collected from mobile camera with different resolution. The collected images include healthy animal and the animal affected by the different diseases like lumpy skin diseases, blackleg diseases and hoof and mouth disease which is used to train the system.

B. Image Preprocessing

The collected images are in RGB form. It is then converted into gray scale intensity image using grayscale conversion techniques. Then the images are resized to 400x400 px by using resizing techniques for getting accurate result.The captured image may be in obscure state. The obscure image is enhanced by Contrast limited adaptive histogram equalization (CLAHE) technique [4] for improve the image quality. In these techniques, the input image is portioned into equally sized rectangular tiles and the lightness value is redistributed across each portion.

The gray scale image has salt and pepper noise. Median filter [5] is used to remove the noise in the image. In this, the pixel matrix of an image is constructed. Salt and pepper noise in the image is identified by the 0px and 255px respectively. The window pattern slides over entry by entry, across the entire signals. The middle value of the window is decided by the median value of the window. Median value of all entries decides the middle value of the windows.

C. Image Segmentation

Segmentation is done to obtain the area of interest.ie to partition the infected portion. Improved Fcm technique [6] is used to segment the image. The concept of improved FCM algorithm is based on data compression where dimensionality of input is highly reduced. It includes two steps, namely, quantization and aggregation. The quantization is performed by masking the reduces 'm' bits of feature value. In aggregation, the feature vectors which will share common intensity value are grouped together. Improved FCM algorithm composed of the following steps:

1) Initialize matrix U=[uij], $U^{(0)}$

2) At k-step: calculate the center vectors C(k)=[c_i] with U(k)

$$c = \frac{\sum_{j=1}^{n} \mu_{ij}^{m} y_j}{\sum_{j=1}^{n} \mu_{ij}^{m}}$$

3) Update the value of U(k) , U(k+1)

$$\mu_{ij} = \frac{1}{\sum_{k=1}^{c} \left(\frac{d_{ij}}{d_{ij}}\right)^{\frac{2}{(m-1)}}}$$

4) If || U(k+1) - U(k)||< Σ then STOP; otherwise return to step 2.

D. Feature Extraction

Gray level co-occurrence matrix (GLCM) [8]is one of the widely used texture analysis algorithm because of its easy implemented. GLCM contains information about position of pixels having similar values of gray level [16]. GLCM extract structural information about texture pattern and it is analyzed at different scale and orientation. This made GLCM more effective. It provides tabulation on how frequently diverse combinations of pixel intensity values occur in an image. A co occurrence matrix is specified as

Pd = ||{((a1,b1),(a2,b2)) : I(a1,b1) = r, I(a2,b2) = s}||

Where Pd is the matrix which measures spatial dependency between two gray levels, r and s represent the displacement and d is their distance.From the GLCM the texture feature calculated are contrast, correlation, energy, entropy, mean, variance and standard deviation.

1) *Contrast:* The contrast is the measure of intensity value of a pixel and its neighbour pixel over the image. In visual perception, contrast is obtained by difference in colour and brightness of the object and with other objects within same field of view.

$$\sum_{i=0}^{G-1} \sum_{J=0}^{G-1} (i-j)^2 p(i,j)$$

2) *Correlation:* The correlation measures the linear dependency between gray levels of neighbouring pixels.

$$\sum_{i=0}^{G-1} \sum_{j=0}^{G-1} \frac{ijp(i,j) - \mu_{x\gamma_y}}{\sigma_x \sigma_y}$$

3) *Entropy:* Entropy is the measure of randomness and it is used to characterize texture of the input images. Its value will be high when all elements of the concurrence matrix are same.

$$\sum_{i=0}^{G-1} \sum_{j=0}^{G-1} p(i,j) \log_2 [p(i,j)]$$

4) *Homogeneity:* Inverse Difference Moment or homogeneity is a measure of image textures.Its feature obtains the measure of closeness of distribution of GLCM elements to GLCM diagonal. It has range of value so it can determine whether the image is a textured or non-textured image.

$$\sum_{i=0}^{G-1} \sum_{j=0}^{G-1} \frac{p(i,j)}{1 + (i-j)^2}$$

5) *Energy:* It can be defined as measure of extent of pixel pair repetitions. It measures the image uniformity. When pixels values are very similar, energy value will be large.

$$\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}[p(i,j)]^2$$

Where μ represent the mean of Pd and ∂ are the S.D (standard deviations). The statistical features compute dare provided as input vectors to the classifier.

E. Classification

Artificial neural network [9] is used for classification of diseases.

There are three classes of disease identified in the cow namely lumpy skin diseases, blackleg diseases and hoof and mouth.

The texture features of the cow image act as inputs to the neural network and the cow disease will be the target to be identified. Given an input, which composed of five texture features, the neural network is expected to recognize the correct cow disease. This is done by providing the previously recorded inputs to the neural network and then it is tuned to produce desired output. This process is called as neural network training. Algorithm for classification using ANN

1) Preparing the data

The texture features like correlation, homogeneity, contrast, entropy, energy are obtained by using GLCM method. And then the values of features are stored in the.CSV (comma separated by values) form files.

Creating training sets:

The whole images are to be taken to extract the texture features and then stored to CSV file.

Creating testing sets:

a) The testing images of cow are taken as same as the training images.

b) The precaution should take while taking the testing images. The testing image should not be as same training image.

2) Pre-process the image into the specific form that it can be used by the neural network. In MATLAB, the neural network object toolbox expects features along rows and samples along columns. Hence, our dataset have features along columns and samples along rows. Hence the matrices are transposed.

3) Building neural network classifier: The next step is to creating a neural networks (cascade forward neural network) so it can learn to classify the classes. Since, the neural network starts with the random initial weights, their results will differ every time its run. A 1-hidden layer in cascade feed forward network is shaped with 28 neurons in hidden layer.

4) While creating training set, the testing set is also created. The training data set is used to train network. Training process continues as long as network continues improving on its validation set. The test set will provides the completely independent measurement of network accuracy.

5) Testing the classifier: The trained network can be tested with the testing set. This will give us an idea of how well the neural network will work when applied in the real world.

6) Classification accuracy is computed using the confusion matrix. The network response is compared with the desired target response to construct the classification matrix which will give a comprehensive picture of classifiers performance.

F. Diagnosis and Treatment

Classification diagnoses the cow disease using Artificial neural network. Once the classifier diagnoses the disease, the system will give the therapeutical measures for those identified disease.

IV. CONCLUSION AND FUTURE SCOPE

This paper gives a description of various diseases diagnosis models for cow by using image processing techniques .From this researcher can get an idea to build the various diagnosis system in veterinary science. These methodologies will diagnosis only a few numbers of diseases in cow.

In future the present methodologies will be expanded by developing a model for diagnosis all types of diseases in cow. And also, the common model will be developed for diagnosis of all types of disease in various animals.

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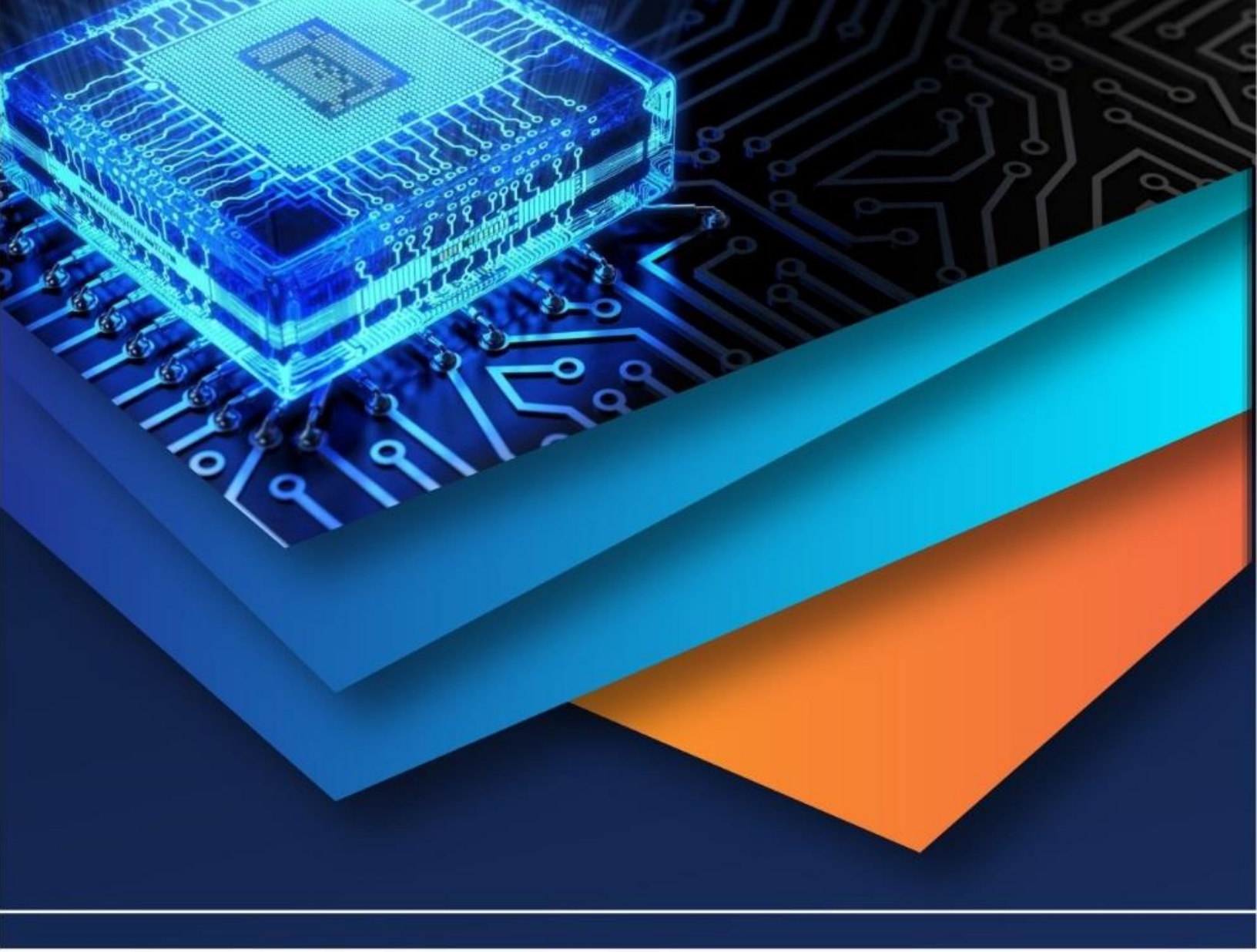

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