Teat and Udder Disease Detection on Cattle using Machine Learning

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***Abstract* - In high milk yielding cattle udder and teat diseases are common. Due to this the farmers are facing more problem in production and quality of milk. In agriculture, research of automatic cow disease is essential in monitoring large population of cows, and If symptoms appear on the udder or teat, the disease should be automatically detected immediately. There is a need for automatic system where the Cow Teat and Udder diseases are detected, the effect of disease on milk yield and what medicines should be used for its cure. The aim of this work is to solve the problem of detecting and preventing diseases of different breed of cows. To determine the optimal architecture for deep learning, several models are considered. As a source of the training data, the cow teat and udder images of cow in villages are used. For this approach automatic classifier Convolutional Neural Networks (CNN) model will be used for training the model based on learning with some training samples. The developed model is then considered for classification using Support Vector Machine (SVM) deployed as a web Application which can detect 3 types of diseases among cows viz. Mastitis, Udder score and Frozen teats also classifying healthy cows among the datasets. Validation Accuracy Results show that the system can show the accuracy 93.50 % and Training Accuracy is approximately 97.87%**

Keywords: Animal Health, Cow Teat and Udder disease, Image Processing, CNN, SVM Classification.

I. INTRODUCTION

Protein and calcium are the important dietary nutrients which are abundant in dairy products. Livestock Health are the prime concern for all veterans and animal husbandry departments in state agencies. Cows have become a huge source of energy and are an important part of the global warming solution. Several cow diseases have the potential to bring disastrous economic, social, and ecological consequences.

Teat-end categorization in rural areas is simply done by specialists using naked eye observation to identify and classify teat-ends. As previously said, naked eye observation necessitates a huge team of experts as well as continuous cow monitoring, which is quite expensive when done for numerous cows. Due to which consulting experts are even cost high and time-consuming too.
We have all seen how the farmers as well as all the people get infected due to distortion of cows due to various diseases. This problem not only affects the farmer's income but it also affects the healthy cows if the disease affected is contagious. The estimated loss due to Cow Teat and Udder disease is 12-14 crore in India which is a huge amount of money.

This proposed work will be very helpful to farmers in rural areas and also will help them in saving their cattle rearing from diseases as farmers invest huge amount on their Cows because it is the main source or backbone of farmers to yield crops and also for milk yield. Also we have tried to implement this project in a regional language so as to make things more understandable for farmers.

This proposed work considers teat and udder images with sufficient quality, process the images to analyze the teat ends based on udder width and height to detect the type of disease with better accuracy result.

One of the most important needs of this proposed work is the ease of detection of the disease by the farmers in a very simple manner as farmers cannot predict the disease just by looking at the Cow. This system will also help farmers identify the disease at the early stage to cure the disease and stop further spread of the disease as if one Cow Teat and Udder is Infected there is a chance that disease might spread on many Cows in the farm if it is contagious. The main goal of this proposed work is to identify the most common diseases seen in Cow Teat and Udder. Mastitis, Udder score and Frozen teats are the three types of cow disease employed in this research. The user can upload a Cow image, and if the Cow has a disease, the name of the disease, with the accuracy will be presented on the user's screen after pressing the process image button. If there is no disease in the Cow Teat and Udder after uploading the image, a message reading "Healthy cow" will be displayed. The image is segmented using the CNN algorithm, and Classification made through SVM.
To make an efficient use of Machine Learning Algorithms which reduces time and cost for Farmer to detect the cow disease, with almost 94% accuracy on each type of disease.

II. LITERATURE REVIEW

There are different algorithms and methodologies for identifying the disease on cow. There are many

different organizations and many researchers who havestudied and have done work on this topic using different algorithms. Some of them are summarized below.

Tania Bobbo [1], Bovine mastitis is the most important economic and health issue for dairy farms, according to a study. They employed trained machine learning algorithms to forecast the udder health status of cows, with the goal of improving the surveillance system and assisting farmers in predicting cows with high somatic cell counts on the next test day.

Pranay Bharti [2], The goal of this study was to see if there was a link between the shape of the udder, the shape of the nipple, the length of the nipple, and the diameter of the udder in jersey hybrid cattle raised in hot and humid climates. They used visual inspection and evaluation to examine the udder shape of 24 nursing Jersey hybrid cows whose shape was tested.

J. Besier [3], They have provided an outline of the scientific information that has been accumulated over the last 5 decades since most industrialised countries have fully adopted mechanised milking. The dairy industry is vital in development.

M. Sathiyabarathi [4], They concentrate on mastitis in this article. Mastitis is the most common and most common dairy cow disease, and it is also the most expensive. Infrared thermography was utilised (IRT). It's a quick and easy approach to expose people to radiation in the field, and it uses IRT as a diagnostic tool to examine normal and physiological states.

Naeem Abdul Ghafoor [5], We used a dataset of 6600 cows with sensory characteristics and mastitis prevalence in this study. They employed a supervised machine learning method to find the most efficient factors for predicting the risk of mastitis in cattle.

Clair L. Firth [6], The Austrian research population had a low number of dairy cows, and they were treated with antibiotics at rarely set daily amounts, according to the findings. Beta-lactam antibiotics, particularly penicillins, as well as 3rd and 4th generation cephalosporins, were the most often used antibiotics in the treatment of mastitis.

Hooman Derakhshani [7],This study adds to our understanding of the composition and structure of bacterial communities seen in various bovine MG environments. We specifically identified the sorts of hubs and possible formation taxa linked to MG inflammatory status and/or future clinical mastitis incidence. Further research into the MG microbial flora in vitro and in vivo could provide information on the many processes by which the symbiotic microbial flora interacts with mammitis pathogens and maintains breast homeostasis.

John I [8], In cattle fed Lactobacillus-based LACT products or iodine-based PC products, somatic cell counts followed a similar pattern. Teat score maxima of 1, 4, and 5 were lower in the LACT group. Lactobacillus-based products tended to mean somatic cell counts during three treatment periods and were less likely to increase papillary terminal values than iodine-PC-treated cows.

Ina Pampariene [9], In plainly healthy patients, IRT can detect alterations that have not yet created clinical signs. The IRT results of healthy dairy cows and cows with asymptomatic mammary inflammation, which assessed the skin surface temperature of the papillary sphincter muscles, were highly similar to the CMT results of bovine mammary gland inflammation.

Arun Mourya [10], The prevalence of asymptomatic mastitis was 31.55 percent in cattle and 20.18 percent on a quarterly basis in and around Jabalpur, Madhya Pradesh. Based on SCC, MCMT, and milk pH, the highest prevalence was found at age 57 (38.50%), fourth birth (44.12%), early lactation (56.25%)) and mating (35.06%).

III. METHODOLOGY

Collecting Cow photos for categorization, creating, training, and validating the model for illness detection using enhanced SVM are all parts of the procedure. Feasibility of the use of deep learning classification of teat-end condition in Holstein cattle is one of the similar technique from existing literature we came across. The purpose of this work is to demonstrate the feasibility of the use of a deep learning neural network for classification of teat-end condition in digital images. In the proposed system deep learning concept is used as same as in the base paper mentioned above also elaborate with classifying 3 types of diseases along with classifying healthy teat-end condition among the dataset. The first step is the farmer will upload the image of the Cow on the website. After uploading the image, farmers can click on the process Image button and wait for the result. For this CNN algorithm, the VGG 16 module is used to train the model and the cow Village datasets along with datasets collected through online is used for model training. In the proposed work for training the model to recognize the pattern and to get the accurate results CNN(Convolutional neural network) has been used in that VGG-16 is a type of CNN model which is best computer vision models to date.VGG-16 model is a popular and easy to built for training purpose.

Firstly import the dataset and normalize the data to make it suitable for the VGG16 model to understand then the each data is divided into pixels and pixel values will be given ranges from 0-255 then the pixel values will be pooled together to create a model file for further classification. The process is depicted in the below diagram(Fig 1).

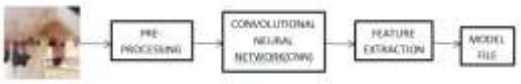


Fig 1: Process Structure

Here we have used CNN (Convolutional Neural Network) to train the model where it is the actual portion of dataset to discover and learn patterns. It is the very important and most of the datasets are used to train the model to get the most accurate results. VGG-16 can be used for classification but in the proposed system we used it to train the model with the 5 layers like input layer, 2 hidden layers, pooling layer and lastly the output layer which provides the model file with the pattern to easily classify the test data with accurate result using SVM also it's a very good classifier with efficient accuracy with the minimal data. SVM draws a decision boundary or hyper-plane between 2 classes to classify the type of disease also in future work it can be used for regression.

CNN stages includes:

Input layer for uploading the data or image of cow.
1st hidden layer where image divided into pixel.
2nd hidden layer to provide pixel values(0-255).
Pooling layer where every pixel values will be combined or pooled together.
Output layer create a model file as a reference for the test data.

Image Datasets

A total of roughly 100 images of cows were obtained from an internet source and Village farm. These photographs were divided randomly for training and testing the prediction model, with some images obtained manually through the high resolution camera as shown in Fig 2.

Fig 2: Examples of datasets collected.

Image Loading/ Preprocessing

The prediction model requires a large amount of training data in order to deliver improved outcomes. In order to increase the model's performance, image augmentation is frequently required to create the best prediction model with limited training data. Image augmentation enhances the set of images in the given datasets and reduces over-fitting by adding a few distorted photos to the training data. The processed picture is diverged, meaning the G, R, and B, grayscale, values are all subtracted from the mean value.

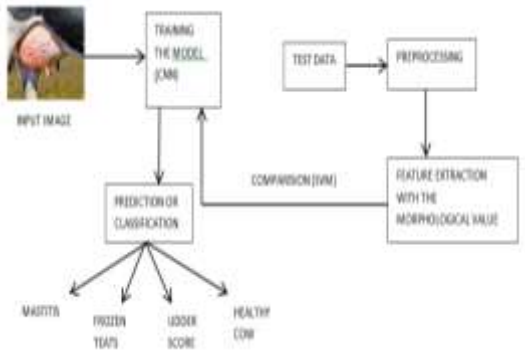


Fig 3: Proposed System Architecture

Training Datasets

Preparing the datasets was the first stage in processing the existing datasets. CNN were used during this step as image data input, which eventually formed a model that assessed performance. Method of segmentation is used in preprocessing technique to extract information such as color, shape, width, and length of the cow's udder and teat.

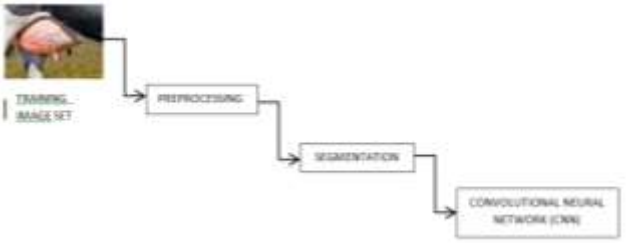


Fig 4: Classifier Model

Test Datasets

Test data will be further move to preprocessing stage where it is a very important step in image data because there will be background noise, unwanted data and focusing mainly on cow teat and udder part as a input file to detect the disease with accurate and efficient manner.

IV. RESULTS AND DISCUSSION

Fig 5: Grayscale Image

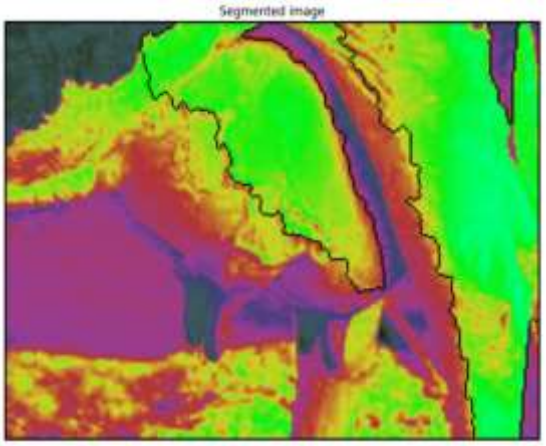
In Fig 5, shows the Cow image in grayscale; this step is critical for subsequent processing. Because there are millions of hues in the world, the resources and time necessary to process each one will be considerable. The RGB image will be converted to grayscale to solve this difficulty and acquire the appropriate output rapidly.

Fig 6: Thresholding Image

Figure 6, shows the thresholding image, i.e. the gray scale binarization form. For categorization, features will be taken from the image.

Fig 7: Segmented Image

Image segmentation is a crucial topic in image processing Because it allows us to interpret the content of a picture, image segmentation is a significant topic in image processing and computer vision. The teat and udder image in the above image has been segmented to extract information such as color, shape, width, and length of the cow's udder and teat.



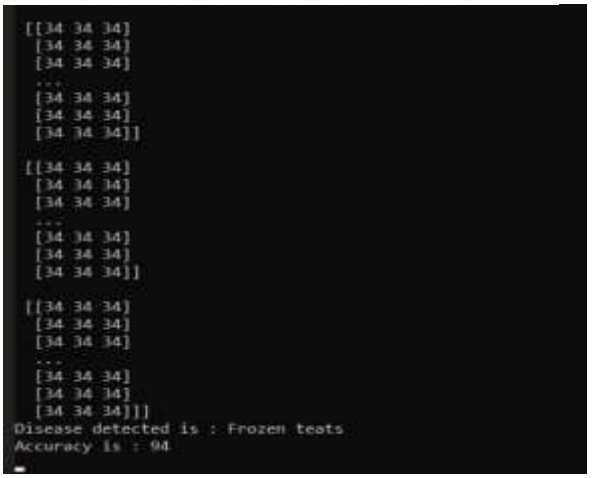


Fig 8(a)

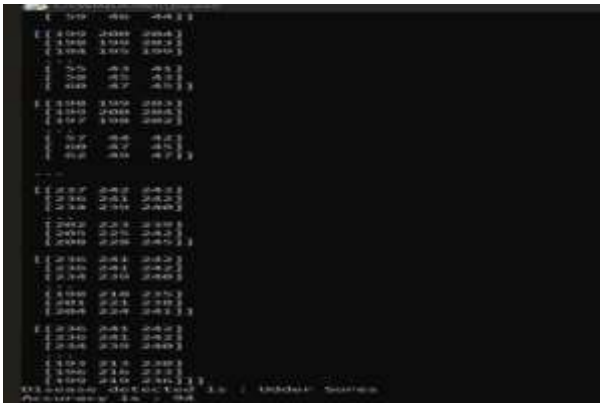


Fig 8(b)

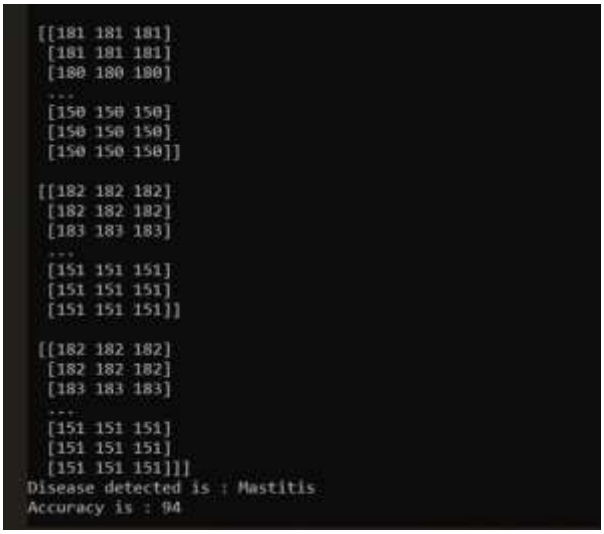


Fig 8(c)

Fig 8: Classification(Detection of Disease)

Figure 8 shows the disease detected in different conditions and the disease classification accuracy for a classifier like SVM is 94 percent for all three diseases – Frozen teats, Udder Stone and Mastitis. Matrix value compared with the training and test datasets are displayed.

The system also detects the Healthy cow with the same accuracy 94% as shown in the below figure 9.

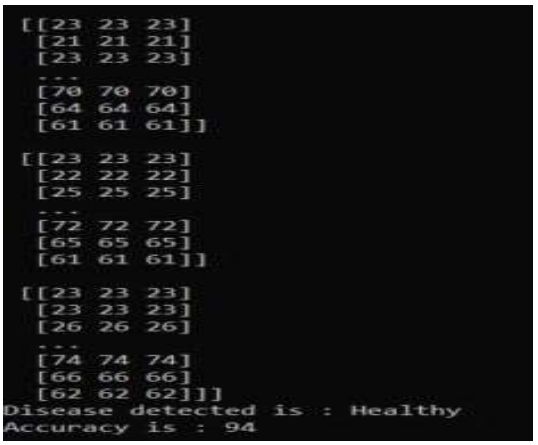


Fig 9: Healthy Cow

V. CONCLUSION

The purpose of this research is to develop a reliable and user-friendly illness classification system for cattle. A pre-trained Convolutional Neural Network was fine-tuned before being placed online. The end result was an app for detecting cattle diseases. This service is completely free and simple to use, requiring only a smartphone and an internet connection. Overall, this research is conclusive in demonstrating how CNN may be used to help small-holder farmers fight cow disease. Diversifying training datasets and testing similar web apps in real-world scenarios should be priorities in the future. The fight against cow illness will continue without such advancements. As a result, the proposed work was completed successfully.

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