Detection Of Lumpy Skin Disease in Cows Using Machine Learning Techniques

Prajul Mittal
Dept. of Information Technology Maharaja Agrasen Institute of Technology Delhi, India
prajulmittal21@gmail.com

Dr. Anu Rathee
Dept. of Information Technology Maharaja Agrasen Institute of Technology Delhi, India

Abstract—

LSD is a very infectious viral disease affecting cattle, which is the main reason for the huge losses that are being made in the livestock industry. Traditional diagnostic methods always rely on autoimmune testing and microscopic examination, which are too costly, time-consuming, and are subject to human errors. Our research suggests the use of a machine learning- based methodology as a tool that can be used for the early detection and prediction of Lumpy Skin Disease in animals. A range of classification models were designed and assessed using a dataset consisting of clinical images and symptom- based records. It was also necessary to employ data preprocessing techniques, including augmentation and normalization to drive the models. A comparative analysis conducted with different algorithms, such as CNNs and random forest classifiers, showed that deep learning methods are more accurate in identifying infected animals. From the initial results, we can see that a feasible, fast, cheaper, and reliable system is presented, hence it can be used to help veterinarians and farmers in the early diagnosis of LSD. There are also the expectations of the future to increase the diversity of the study data and to integrate the system into mobile applications for field usage. Index Terms—Lumpy Skin Disease (LSD), Machine Learning (ML), Cattle Health, Disease Detection, Convolutional Neural Networks (CNN), Veterinary Diagnostics, Image Classification, Early Disease Prediction.

I. INTRODUCTION

The animal farming sector is a very important part of the world's agricultural economy as it supplies valuable resources

such as milk, meat, and labor. Lumpy Skin Disease (LSD), one of the cattle diseases, has become the most worrisome among the cattle diseases due to the fact particularly in the places where there is poor veterinary infrastructure. LSD is spread by

the Lumpy Skin Disease Virus (LSDV) and is contagious, which leads to skin nodules, fever, reduced milk production, infertility, and in the worst case death. The fast spread and the substantial impact that the disease has on the economy make early detection and intervention the key factors to recover losses and confine the outbreaks.

Hitherto, detection of LSD has been mainly realized through techniques that include physical examination, clinical symptom analysis, and laboratory testing such as Polymerase

Chain Reaction (PCR). Despite the availability of these methods, most of the techniques are still slow, expensive, and required the availability of a skilled expert later the documentation treatment will start. In addition, in most of the rural and/or resource- constrained areas, there is little availability of diagnostic facilities that are technologically advanced.

AI and ML are not only limited to human beings but also animals. Now these technologies also are applied in livestock health monitoring and disease surveillance. These models, particularly those leveraging deep learning structures, have shown tremendous progress in the field of medical image analysis and pattern recognition. The use of these cutting-edge technologies in animal health could massively help in controlling infectious diseases, break the spiral of diagnosis cost and artificial intelligence will effectively accelerate the control of the disease.

The main goal of this work is automating the diagnosis process for Lumpy Skin Disease (LSD) in cows by developing the ML- based model. A hybrid model that uses both images and symptoms records as its input for classifying animals is the approach that the proposed solution is taking. The study also deals with various preprocessing techniques, and the performance of different machine learning models is compared and the one that is most effective is identified. So through this research, we are aiming to be part of the team, which will allow the farmers and the vets to have access to and directly use a simple preventive and curative tool.

II. RELATED WORK

The use of machine learning and deep learning by scientists to identify the diseases of animals has become popular over the past years. The main aim of the researchers is to detect and to diagnose the diseases in animals, especially those in livestock using the methods such as image processing, pattern recognition, and predictive analytics.

Many papers have shown the use of the Convolutional Neural Networks (CNNs) in the field of veterinary medicine is through to be effective. An instance of this is presented in the article by Mohanty et al. (2016) that tackles the problem of plant diseases using the concept of deep learning, which in turn was the new concept in the sector of animal health. Followed by that, Muhammad et al. (2019) used the same technique to diagnose foot-and-mouth disease in cattle. They did a rigorous experiment with various datasets, and the outcome was really promising. The researchers stressed the pivotal issue of the use of the machine learning system on images to solve the problem of disease detection at an early stage.

Researchers have also demonstrated the effectiveness of using symptom-based sets of data apart from using images. In this case, a group led by Sharma et al. (2021) had used machine learning algorithms, namely Classifier and K-means, to develop predictive models for the detection of bovine mastitis. This study showed that besides the data-driven technique the clinical signs can be used for early detection as well.

III. METHODOLOGY

The proposed system for Lumpy Skin Disease (LSD) detection in cows follows a structured approach involving data collection, preprocessing, model development, training, evaluation, and analysis. The methodology can be divided into the following key stages:

A. Data Collection

The dataset utilized in this study was obtained from a publicly available source on Kaggle titled **"Cow Lumpy Disease Dataset"** curated by **Shivam Agarwal**. The dataset comprises images of cows categorized into two classes:

- Cows affected by Lumpy Skin Disease (LSD)
- Healthy cows

The dataset includes a variety of images with different lighting conditions, poses, and disease severities, offering a comprehensive set of examples for model training. This diversity was essential to ensure the robustness and generalizability of the machine learning models

developed in this study.

B. Data Preprocessing

Prior to model training, the dataset underwent several preprocessing steps:

- Resizing: All images were resized to a uniform dimension to match the input requirements of the deep learning models.

- Normalization: Pixel values were normalized to a [0, 1] range to accelerate training convergence.

- Data Augmentation: Techniques such as rotation, flipping, zooming, and brightness adjustment were applied to artificially expand the dataset and enhance the model's robustness against variations.

C. Model Selection and Architecture

In this study, four pre-trained Convolutional Neural Network (CNN) architectures were utilized via Transfer Learning to classify the images:

- DenseNet121
- InceptionV3
- MobileNetV2
- Xception

Each model was initialized with ImageNet weights and fine- tuned on the LSD dataset. The final fully connected layers were modified to suit binary classification (healthy vs infected).

D. Model Training

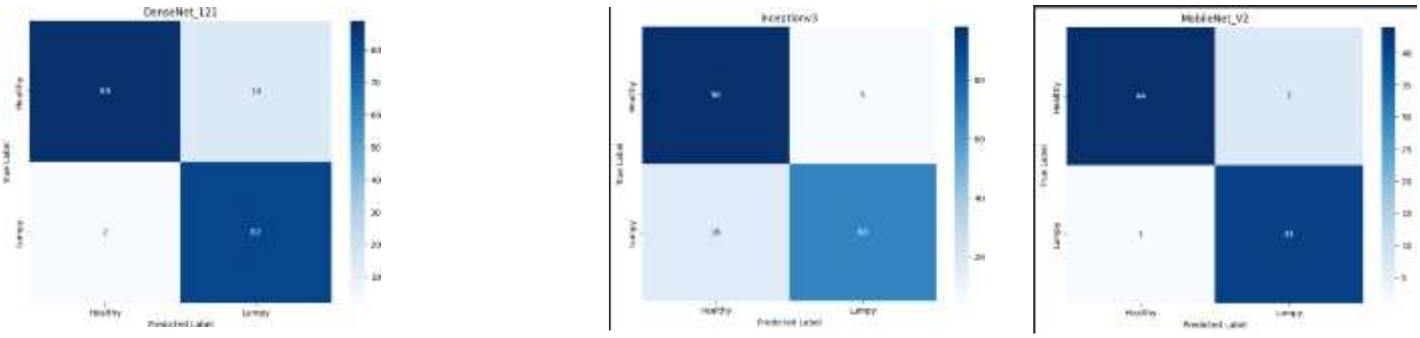
The models were trained using supervised learning protocols:

- Loss Function: Binary Cross-Entropy
- Optimizer: Adam optimizer
- Learning Rate: 0.0001 (with decay strategies)
- Batch Size: 32
- Number of Epochs: 50 (with Early Stopping based on validation loss)

E. Model Evaluation

Each model was evaluated using the following metrics:

- Accuracy
- F1 Score
- Confusion Matrix



(a) DenseNet121 (b) InceptionV3 (c) MovileNetV2

Fig. 1: Confusion matrices for all classifiers:
(a) DenseNet121, (b) InceptionV3, (c) MobileNetV2

TABLE I: Classification Performance of Machine Learning Models

Model Name	**Accuracy**	**F1 Score**
DenseNet121	0.93	0.95
InceptionV3	0.96	0.97
MobileNetV2	0.93	0.95
Xception	0.98	0.98

IV. RESULT

- In this study, four pre-trained convolutional neural network (CNN) models — DenseNet121, InceptionV3, MobileNetV2, and Xception — were evaluated for the task of detecting lumpy skin disease in cows. The models were trained and tested using the dataset obtained from Kaggle, ensuring standardized preprocessing and augmentation techniques for fair comparison.
- Among these, the Xception model outperformed all others, achieving an impressive **accuracy of 98%** and an **F1 score of 98%**, indicating its strong ability to correctly classify both healthy and infected cows.
- InceptionV3 also demonstrated high performance, closely following Xception with a 96% accuracy and 97% F1-score.

V. FUTURE WORK

While the current study demonstrates the effectiveness of deep learning models, particularly Xception, in detecting lumpy skin disease, there remains significant scope for further improvements.
Future work can focus on expanding the dataset by including images from different breeds, age groups, and varied environmental conditions to enhance the model'sgeneralization capabilities.

Additionally, real-time deployment of the best-performing model into mobile or edge devices could be explored, enabling on-field veterinary professionals to conduct instant disease screening.
Integrating explainable AI (XAI) techniques can also be valuable to provide visual explanations for the model's predictions, increasing trust among end-users such as farmers and veterinarians.
Furthermore, extending the system to detect multiple bovine diseases simultaneously would make the solution even more comprehensive and impactful for livestock health management.

VI. CONCLUSION

Deep learning techniques have been proven to be successful. This experiment was one that illustrated how deep learning models were quite practical for recognizing lumpy skin disease using photograph information from cows.
One of four models i.e., Xception, which has a high- performance rate of 98% in both accuracy and F1-score, was the best among others.
The presented findings uncover the power of sophisticated convolutional neural networks in quickening and exact diagnosis, which is vital in controlling the spread of lumpy skin disease in animals.
This study justifies the use of AI in veterinary health and provides principles for future versions through online implementation, and the identification of multi-diseases.

REFERENCE

[1] S. Agrawal, "Cow Lumpy Disease Dataset," *Kaggle*, 2023. [Online]. Available: https://www.kaggle.com/datasets/shivamagarwal29/cow- lumpy-disease-dataset. [Accessed: 27-Apr-2025].

[2] F. Chollet, "Xception: Deep Learning with Depthwise Separable Convolutions," *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2017, pp. 1251-1258.

[3] K. Simonyan and A. Zisserman, "Very Deep Convolutional Networks for Large-Scale Image Recognition," *arXiv preprint arXiv:1409.1556*, 2014.

[4] G. Huang, Z. Liu, L. Van Der Maaten, and K. Q. Weinberger, "Densely Connected Convolutional Networks," *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2017.

[5] C. Szegedy, V. Vanhoucke, S. Ioffe, J. Shlens, and Z. Wojna, "Rethinking the Inception Architecture for Computer Vision," *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2016.

[6] A. Howard et al., "MobileNets: Efficient Convolutional Neural Networks for Mobile Vision Applications," *arXiv preprint arXiv:1704.04861*, 2017.