PREDICTING LUMPY SKIN DISEASE IN CATTLES THROUGH MACHINE LEARNING

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***Abstract*—Lumpy Skin Disease (LSD) is a concerning and contagious viral disease affecting cattle, distinguished by symptoms like fever, reduced milk production, and infertility, leading to major financial repercussions. To predict LSD infection in cattle with high precision, we aim to deploy machine learning. To achieve an F1 score of 98% and make them the most effective in detecting infected cattle, approximately ten classifiers will be trained on disease data with Random Forest and Light Gradient Boosted Machine (LGBM). For evaluating an accurate prediction of LSD occurring due to environmental conditions, we will feed these features (raw images of cattle) into machine learning models. A machine learning model called the Convolutional Neural Network (CNN) and ANN will be used for predicting LSD in cattle through their visual data that is images. This model will provide a robust framework for predicting Lumpy Skin disease in cattle using machine learning.**

Keywords: Lumpy Skin Disease (LSD), Random Forest, Light Gradient Boosted Machine, Artificial Neural Network (ANN), Forecasting, Disease Prediction.

I. INTRODUCTION

Lumpy Skin Disease is caused by the Lumpy Skin Disease Virus (LSDV), a member of the Capripoxvirus genus. It primarily affects cattle, leading to symptoms such as fever, swelling of lymph nodes, skin nodules, infertility, and significant reductions in milk production. LSD has severe economic implications, including decreased productivity, increased veterinary costs, and trade restrictions. Outbreaks can lead to economic losses estimated in millions, affecting farmers and the agricultural economy. The primary objective of this research is to develop a machine learning model that accurately predicts the occurrence of LSD in cattle based on available data. The study also aims to forecast potential outbreaks to facilitate timely intervention. Machine learning techniques allow for the analysis of large and complex datasets, improving the ability to identify patterns that traditional statistical methods might miss. These models can adapt and improve over time as more data becomes available, enhancing prediction accuracy. Convolutional Neural Networks (CNNs) are a specialized form of artificial intelligence (AI) model, particularly well-suited for image classification and object detection tasks. By processing images through multiple layers, CNNs can detect and learn distinctive features such as shapes, patterns, textures, and even complex, hierarchical relationships within the visual data. These unique capabilities make CNNs ideal for applications where subtle visual distinctions are key to accurate categorization or diagnosis, such as in medical imaging, facial recognition, and, as in this case, veterinary disease identification. In this study, a CNN model has been employed to analyze cattle skin images to classify them into two categories: infected with Lumpy Skin Disease (LSD) and non-infected. LSD, a viral disease affecting cattle, leads to significant skin lesions, which the CNN can detect early on by learning to recognize specific patterns associated with these lesions. The ability of CNNs to automatically learn and detect these visual patterns enables the model to identify signs of LSD with high accuracy, often earlier than traditional methods. This early detection is crucial for initiating timely treatment and containment measures. In this study, a CNN model has been employed to analyze cattle skin images to classify them into two categories: infected with Lumpy Skin Disease (LSD) and non-infected. LSD, a viral disease affecting cattle, leads to significant skin lesions, which the CNN can detect early on by learning to recognize specific patterns associated with these lesions. The ability of CNNs to automatically learn and detect these visual patterns enables the model to identify signs of LSD with high accuracy, often earlier than traditional methods. This early detection is crucial for initiating timely treatment and containment measures

II. LITERATURE SURVEY

Lumpy Skin Disease (LSD) has emerged as a significant infectious disease in cattle, causing substantial economic impacts in affected regions. Recent advancements in machine learning and deep learning offer promising avenues for improving the diagnosis, detection, and analysis of LSD outbreaks. This section reviews existing studies employing diverse machine learning methodologies for LSD detection and prediction, with a focus on CNN architectures, support vector machines, ensemble learning approaches, and explainable models. Velugoti et al. (2023) proposed a Convolutional Neural Network (CNN) model leveraging DenseNet169 architecture for detecting LSD based on image data. The authors initialized the model with pre-trained weights and used an input shape of (256, 256, 3) to fit their dataset, demonstrating the effectiveness of dense layers

in extracting high-dimensional features relevant to disease detection. DenseNet's ability to mitigate vanishing gradient issues made it a suitable choice for this application, highlighting the utility of deep learning architectures in handling complex image-based data.

Existing Studies on Stress Detection and Sleep

Meanwhile, ensemble models and explainable algorithms enhance predictive accuracy and interpretability, offering comprehensive solutions for disease management. Building on these studies, our research aims to develop a robust and efficient model for detecting LSD in cattle, leveraging the strengths of these methodologies and contributing to the broader body of work on AI-driven animal health diagnostics.

A. Machine Learning in Stress Prediction

Machine Learning (ML) techniques have become a cornerstone in LSD prediction, offering the potential to predict the disease efficiently.[5]. Various machine learning models such as Random Forest, CNN, ANN, Support Vector Machines (SVM) have beenutilized for successful prediction. [6]. These models have shown impressive accuracy rates in detecting stress levels. Forinstance, a Random Forest classifier achieved an F1 score of 90 and above.

B. Gaps in Literature

Despite progress in using machine learning for Lumpy Skin Disease (LSD) detection, several gaps remain. Current models often rely on specific architectures (e.g., DenseNet169, SVM) and single data types, missing opportunities for advanced deep learning and multimodal integration (e.g., combining physiological, environmental, and image data) that could boost accuracy. There is also a need for real-time, low-resource models suited for rural deployment, as well as explainable CNN models to enhance trust and usability. Temporal analysis and transfer learning are underexplored, limiting proactive management and adaptability across regions. Addressing these gaps could improve LSD detection's robustness, accuracy, and applicability in diverse settings.attributes and utilizing the Random Forest classifier to predict stress with higher accuracy. This approach has the potential to enhance stress prediction models and provide a more holistic view of the relationship between stress and sleep.

III. PROJECT UNDERTAKEN

A. Problem Definition

Develop a machine learning based model that accurately predicts Lumpy Skin Disease (LSD) outbreaks using visual data with the help of Convolutional Neural Networks (CNN) and Artifical Neural Networks (ANN), for better identification of disease by raw images of cattle.