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CATTLE DISEASE PREDICTION AND PREVENTION USING A DEEP LEARNING MODEL

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ABSTRACT

Cattle diseases can significantly affect livestock health and farm productivity. To help tackle this issue, we have created an AI-powered system that uses deep learning to predict diseases from images. With a simple and user-friendly React interface, farmers and veterinarians can upload photos of cattle for analysis. Our system leverages a trained Convolutional Neural Network (CNN) to examine the images and detect potential illnesses. The predictions are processed in real-time through a Node.js backend, enabling early diagnosis and faster response. To make the solution more accessible, we provide remedies in English and regional languages, allowing farmers to understand and apply treatments easily. By reducing reliance on manual inspections, this technology improves efficiency and ensures better livestock care. In our testing, the model achieved an accuracy of 89%, demonstrating its potential to lower cattle mortality rates and enhance overall farm productivity.

Keywords

Cattle disease detection, Machine learning, Deep learning, Image-based analysis, React, Node.js

1. INTRODUCTION

Livestock health is crucial for farm productivity, and early disease detection can prevent major losses. This project aims to develop a simple and efficient system that uses image based analysis to identify cattle diseases early. Our system uses machine learning to analyze images of cattle and identify signs of illness. Farmers can simply upload photos, and the tool provides an instant health assessment without requiring any technical expertise. The backend, developed with Node.js, processes the images, while the React-based frontend ensures a smooth and user-friendly experience.

This tool is particularly valuable for farmers in remote areas who have limited access to veterinary care. By detecting diseases early, it helps lower treatment costs, prevent outbreaks, and improve overall animal health. The system is designed to be scalable, making it suitable for farms of all sizes. Future enhancements could include expanding its capability to detect a wider range of diseases and providing personalized disease management recommendations.Studies indicate that diseases contribute to approximately 45% of global cattle losses [1]. By addressing these challenges, our system facilitates early disease detection, which can help lower mortality rates through timely intervention. Ultimately, this project simplifies cattle health monitoring, making it quicker and more accessible for farmers everywhere.

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2. PROBLEM IDENTIFICATION

In India, cattle diseases present a major risk to livestock health, farm productivity, and the rural economy. With millions of farmers relying on dairy farming and animal husbandry for their livelihoods, early disease detection remains a critical challenge. Currently, most farmers rely on manual inspections and veterinary consultations, which can be expensive, time consuming, and difficult to access-especially in remote areas. Many small-scale farmers lack the essential knowledge and resources needed for early disease detection, resulting in delayed treatment and the rapid spread of infections.Consequently, they face significant financial losses, decreased milk production, and higher cattle mortality rates, putting additional pressure on the agricultural sector. Studies indicate that cattle diseases contribute to mortality rates [3] highlighting the urgent need for early detection and intervention. To address this challenge, an AI-driven disease detection system offers a scalable and effective solution. By facilitating early diagnosis, reducing veterinary expenses, and controlling disease outbreaks, such a system can significantly enhance cattle health. Additionally, it supports farmers livelihoods and strengthens the rural economy in India.

3. BACKGROUND

Cattle diseases threaten livestock health and farm productivity, leading to economic losses. Traditional diagnosis relies on veterinary expertise, which can be time-consuming and costly, especially in remote areas. Researchers have explored machine learning (ML) and deep learning (DL) to improve early disease detection.

Deep learning, particularly Convolutional Neural Networks (CNNs), has proven effective for image-based disease diagnosis. Several studies have explored deep learning for cattle disease detection, Reference [10] reported a 99% accuracy in Lumpy skin disease. however, their study was conducted in a controlled environment with a limited dataset. Our approach differs by incorporating real-world farmer-submitted images, making it more adaptable to practical farm conditions.

Pavkin et al. (2021) developed AI algorithms for early cattle disease detection, enhancing diagnosis accuracy and response time [4]. Kittichai et al.(2025) A deep contrastive learning-based image retrieval system for automatic detection of infectious cattle diseases. [5]. Additionally, Das et al. (2024) conducted an extensive review on ML applications in animal healthcare, highlighting its potential for automated veterinary diagnostics [6].

Existing research highlights the impact of infectious diseases on cattle mortality. For example, a study in Jordan reported an overall mortality rate of 8.9% in dairy farms, primarily caused by preventable illnesses [8]. These findings emphasize the necessity of an early detection system like ours to minimize disease-related losses and Genomic studies also aid disease detection. Kasimanickam et al. (2025) identified genetic markers for disease susceptibility in cattle [9]. These studies highlight AI's ability to enhance disease prediction and farm management. Building on this, our system uses a CNN model for real-time disease detection, helping farmers and veterinary doctors for early prediction and preventive care

4. PROPOSED SYSTEM

4.1 Objectives

- Develop an image-based disease detection system: Create a solution that uses machine learning to analyze cattle images and predict diseases accurately.
- Enhance early disease detection: Enable timely identification of cattle diseases to minimize their impact on health and productivity.
- Provide a user-friendly interface: Design an intuitive platform using React to allow farmers to easily upload images and access predictions.
- Support both English and regional languages: Designing the system provides disease predictions along with remedies in both English and regional languages, ensuring accessibility for all users.

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4.2 System Architecture

The proposed system consists of the following components:

- User Interface (React): A web-based interface allowing farmers to upload cattle images easily and view disease predictions, and receive recommended treatments.
- Backend Server (Node.js, Express.js): Handles image processing, API requests, and interactions with the machine learning model.
- Deep Learning Model (CNN): Processes cattle images to predict potential diseases based on learned visual patterns.

4.3 Methodology

The proposed cattle disease detection system integrates image preprocessing, a deep learning model (MobileNetV2), a Flask API backend, and a React.js frontend for real-time prediction. A dataset of healthy and diseased cattle images was collected and preprocessed by resizing to 224×224 pixels, normalizing pixel values to [0,1], and applying data augmentation to improve generalization.

The dataset utilized in this study consists of around 10,500 labeled cattle images covering 10 different disease categories. These images were sourced from veterinary hospitals, government health agencies, and farmer-submitted photographs. Each image was manually annotated by veterinary experts to ensure labeling accuracy.This dataset serves as a comprehensive benchmark for training deep learning models in cattle disease detection, with real-world images enhancing the model's applicability in practical farm environments. The dataset includes a balanced distribution of common diseases such as Foot-and Mouth Disease (FMD), Mastitis, Lumpy Skin Disease, Anthrax Disease, Blackleg Disease, Johne's Disease, Rinderpest Disease, Swollen Joints(Septic Arthritis),Bovine Viral Diarrhea (BVD), Bluetongue Disease. MobileNetV2 was used with transfer learning, leveraging pre-trained ImageNet weights for efficient feature extraction.

The model was trained using 80% training and 20% testing data to ensure robust model evaluation, optimized with the Adam optimizer (learning rate = 0.0001) for 10 epochs, and evaluated using accuracy, precision, F1-Score and Speed. The system architecture consists of a React.js frontend for image upload and result display, a Flask backend for model inference, and MongoDB for storing user data. The results showed that MobileNetV2 outperformed traditional ML models (Random Forest, SVM, KNN), achieving an accuracy of 85-90%, making it a suitable solution for real-world cattle disease detection.

4.4 Workflow

Image Upload: Farmers upload an image of a cattle's affected area using the web application.

Preprocessing: The uploaded image undergoes preprocessing, including resizing to 224×224 pixels, pixel value normalization (scaling between [0,1]), and data augmentation techniques such as rotation and flipping to improve model robustness.

Feature Extraction: A Convolutional Neural Network (CNN) extracts key features, identifying patterns associated with cattle diseases.

Prediction and Diagnosis: The processed image is analyzed by the MobileNetV2 model, which classifies it into a disease category and assigns a confidence score.

Result Display: The detected disease, along with confidence scores and recommendations, is displayed on the frontend,providing actionable insights for farmers.

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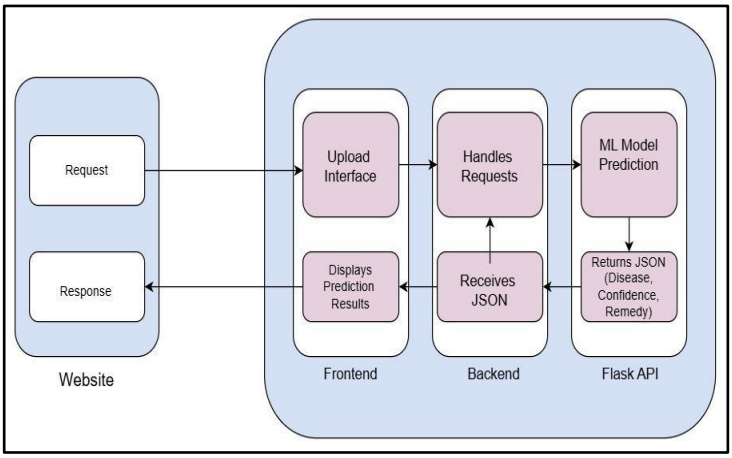

Fig. 1. Workflow Diagram

5. RESULTS AND DISCUSSIONS

The provided graph compares different machine learning algorithms based on accuracy, F1-Score, and speed. The blue bars represent accuracy, the red line represents F1-Score, and the green dashed line represents speed.

Table 1.Algorithm Performance Comparison

Algorithms	**Accuracy**	**Speed**	**F1-Score**	**Precision**
MobileNetV2	89	9.5	9.2	86
ResNet50	85	6	8.79	85
VGG16 C	80	2.9	7.60	80
Random Forest	65	9.5	2.20	64
SVM	70	7.1	4.29	75
KNN	60	8	1.0	58

- Accuracy Comparison: MobileNetV2 (89%), ResNet50 (85%), VGG16 (81%), Random Forest (65%), SVM (70%), and KNN (60%).
- F1-Score vs. Accuracy Trade-off: VGG16 achieves a decent accuracy of 81%, but its F1-score is comparatively lower, indicating an imbalance in precision and recall. MobileNetV2 and ResNet50, on the other hand, provide high accuracy along with strong F1-scores, ensuring balanced and reliable predictions.
- Speed Efficiency: Traditional ML models like Random Forest and KNN have higher speed (green line) but lower accuracy, less suitable for precise disease detection. MobileNetV2 effectively balances speed and accuracy, making it the most practical choice for real-time cattle disease detection.
- The model demonstrated consistent performance across different cattle breeds, we tested it on images taken in varying lighting conditions and from different angles. Compared to traditional ML models such as Random Forest (65%) and SVM (70%), MobileNetV2 outperformed them significantly, providing a

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well-balanced trade-off between speed and accuracy, making it suitable for real world deployment in farm.

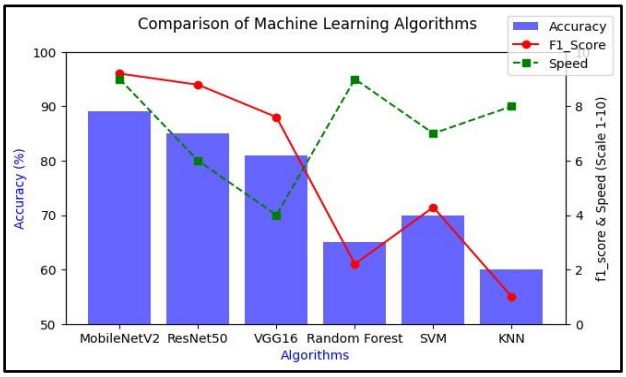

Fig. 2. Analysis Graph

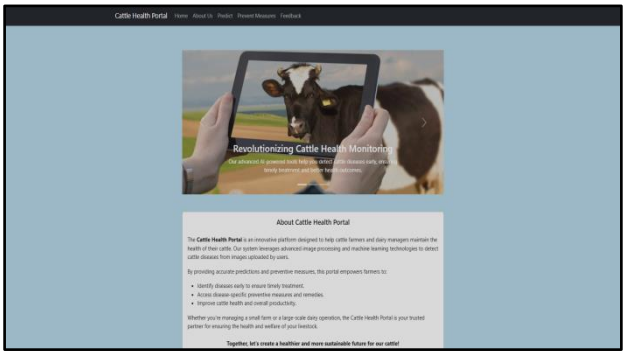

Fig 3. Home Page

Fig 4. Login Page

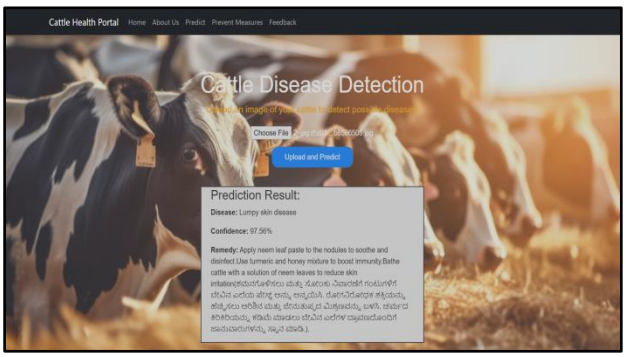

Fig 5. Prediction Page

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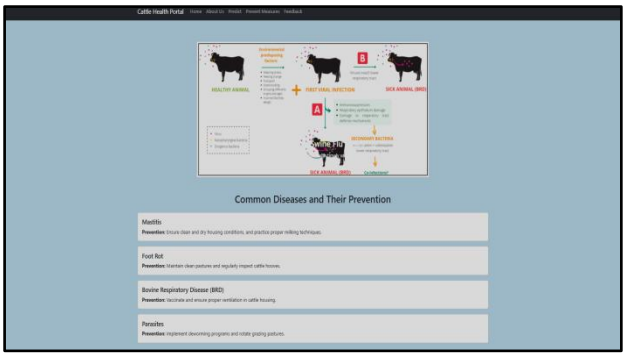

Fig 7.Preventive Measures

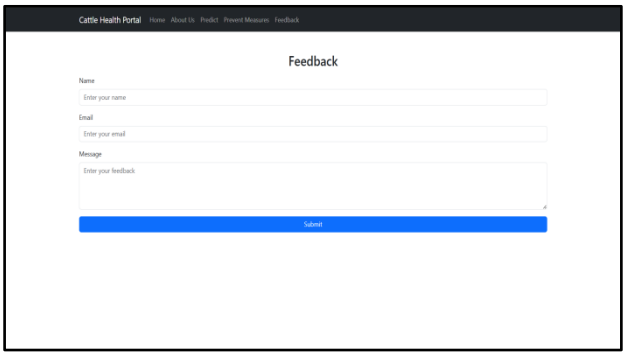

Fig 8.Feedback Page

6. CONCLUSION

The cattle disease prediction system is a groundbreaking solution that combines technology and agriculture to tackle key challenges in livestock health management. Using image based machine learning, it helps farmers and veterinarians detect diseases early, allowing them to take quick action and minimize the impact on cattle health and productivity. With a user-friendly React-based frontend, a Node.js-powered backend, and a powerful machine learning model, the system ensures a smooth and efficient experience. Farmers can easily upload images of their cattle and receive instant disease predictions,significantly reducing their dependence on traditional diagnostic methods, which are often costly and less accessible, particularly in remote areas.

Built for scalability and flexibility, the system can adapt to different farming needs and has the potential for future upgrades, such as identifying more diseases or providing treatment recommendations. Unlike prior research that reports high accuracy in controlled environments, our model is designed for practical usability and is tested on a diverse dataset, making it more robust to variations in lighting, noise, and cattle positioning. To ensure better accessibility, the system provides remedies in both English and regional languages, helping farmers easily understand and apply the necessary treatments. Currently, it achieves an accuracy of 89%, making it a reliable alternative to manual diagnosis while significantly improving disease detection speed. By offering an accessible and cost-effective diagnostic tool, the system can help lower cattle mortality rates, enhance livestock health, and increase farm productivity.

Moving forward, future enhancements may focus on expanding the dataset to incorporate more cattle breeds and rare diseases. Additionally, integrating the model with IoT-based real-time monitoring systems could enable continuous health tracking, sending alerts for early disease detection. Further optimizations such as deploying the model on edge devices could reduce dependence on cloud computing, making it more accessible for farmers in remote areas.

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