



# “AnimalCare: A Multi-Modal AI Based System for Animal Disease Prediction based on Symptoms and Image Analysis”

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## Abstract:

Artificial Intelligence (AI) is a breath of new life in medical care and has been frequently used in the field of veterinary science as an early indication of disease. Many factors influence the effects of the animal diseases. Important among them are the standard of living of farmers, security of food and animal yield in the rural areas set up which have limited access to veterinary care. It's not easy to diagnose it early because signs are not visible and medical attention is not timely.

This paper presents an idea of an AI animal disease detection system, AnimalCare, with a multimodal approach to combine both image-based and symptom-based input. Machine learning algorithms and deep learning models are more effective in terms of prediction accuracy and reliability to perform symptom classification and disease detection based on images respectively.

It is also a system that supports multi-linguals which will improve the access to the system by the rural users and will also offer expert guidance to the users through a doctor consultation module. Also, a chatbot powered by artificial intelligence can provide real-time support on animal health, symptoms and preventive measures. The experimental results show that the proposed system is more specific and applicable than conventional single model methods.

The system will be a realistic and scalable solution for real-world animal healthcare management due to its multi-modal input, interactive features and skilled assistance.

**Keywords** - Animal Disease Prediction, Artificial Intelligence, Machine Learning, Deep Learning, Convolutional Neural Network, Veterinary Healthcare, Multimodal System

## I. INTRODUCTION

Artificial Intelligence (AI) is a trend changing technology in numerous areas like health care, agricultural production, and intelligent decision-making systems. In recent years, the use of Artificial Intelligence (AI) methods like machine-based learning as well as deep learning techniques in veterinary field has been started to use for improvement of detection of medical conditions and the treatment and management for animal health. Early detection of the animals is important to maintain the productivity of the animals, ensure security of food, and decrease the losses of the farmers.

Livestock is another important aspect of the rural economy and the sustainability of agriculture. But in most cases the animal diseases caused by viral, bacterial, and parasitic infection are not seen in the initial stages due to not known signs and failure to get to the veterinary professionals. Delayed or traditional utilization of medical services in most rural as well as resource strained regions, leads to late detection of disease, transmission and death of animals in large numbers. Modern computer technologies have developed in significance in veterinary care in recent years, especially for disease diagnosis, surveillance, and prediction. To boost animal healthcare and help veterinarians in making smarter decisions, several kinds of modern computational techniques are being used. These methods have proven positive outcomes in animal imaging, where they aid in more precise disease identification and useful diagnostic support [1]. In addition to using diagnostic and symptom-based datasets, machine learning algorithms including a randomised forest as well as Support Vector Machines have demonstrated excellent performance in diagnosing animal diseases [4]. The application of deep learning techniques has led to an increase in the precision of livestock disease detection in certain complex imaging applications, but large datasets and high computation are the main limitation [2].



Furthermore, Research shows the problems such as imbalanced data and limited model adaption while similarly highlighting the possibility of artificial intelligence (AI) in veterinary medicine [3]. AI technologies are extensively used for disease surveillance and outbreak prediction that on one hand assist early detection of disease signs and on the other hand improve the health management of the livestock[5]. In general, artificial intelligence is significantly contributing towards to revolutionizing health care systems in the field of veterinary medicine through an increased accuracy, efficiency and earlier detection of the diseases.

But despite all such enhancements, the majority of the existing systems are predominantly symptom-based prediction with the help of individual datasets and lacks real world features such as image-based analysis, multilingual accessibility and direct consultation with an expert. Such limitations render them less applicable and effective in real life scenarios, particularly to farmers in the rural areas.

In order to overcome these issues, this paper will present a state-of-the-art animal disease prediction system based on artificial intelligence named “AnimalCare” The new system is proposed to be a multi-modal system which is a combination of using symptoms as the input device and using image as the disease detection device to increase the accuracy and reliability of prediction. Furthermore, the system will utilize multilingual support whereby users will be able to interact in their native language which will help in accessibility It also has a doctor consultation section which will provide the user with an access to an expert in the field of Veterial medicine who will be able to consult with the user regarding more complicated issues.

In addition, there is an AI based Chatbot, which is linked to real-time responses for users, related to animal health and disease prevention. The main contributions of this work are the practical and scalable multi-modal prediction system, interactive and multilingual features, and AI predictions vs. veterinary expertise. The goal of the proposed system is to allow the early detection of the disease, awareness and decision making in animal health care.

## RELATED WORK

The growth of smart machines for predicting animal diseases has been greatly boosted by recent advances in the fields of AI and ML. Some researchers have suggested models for identifying illnesses based on clinical symptom analysis, standard methods of classification, and information orientated techniques.

Published research by MDPI looked at the use of machine learning algorithms, including Random Forest, SVM, and Artificial Neural Networks (ANN), on veterinary image-based disease classification.[1]. The performance of these models was shown as adequate to identify animal disease. Ensemble-based methods for the animal disease identification yielded a better performance due to their application to complex and high dimensional data.

Another research work available on ScienceDirect focused on the use of deep learning techniques for livestock disease detection and classification [2]. This study was to show that deep neural networks is able to learn complex relationships from extensive training data; and considerably increase the prediction accuracy but with a cost of high computational intensity and large amount of training data.

In the systematic review published in Veterinary World, investigators on artificial intelligence in veterinary medicine examined the possibility of using artificial intelligence to diagnosis, surveillance and prediction of disease[3]. In addition the study identified several shortcomings, including the imbalance in the data, overfitting and lack of generalisability of models between animal types and in the field.

Likewise, a reasearch conducted and published in IJRASET compared classical machine learning approaches like Logistic Regression, Decision Tree and Random Forest for animal disease prediction [4]. The results suggested that normal machine learning techniques could reach an adequate level of accuracy but unfortunately can be heavily affected by the data quality and choosing the right features.

In addition, some current researches focused on the more advanced technologies, such as image-based disease detection, sensor-based monitoring as well as behavior analysis for realtime animal health prediction system [5]. Such methods utilize the use of computer vision and IoT based framework to improve the accuracy of detection. They however involve the construction of a complex system that is not usable in rural and other under developed areas.

There has been a lot of progress and most of the present technologies are restricted to only symptom-based along with image-based prediction and also do not require multi-modal inputs. Also, little attention has been added to user friendly



features like multiple languages, live chat support and direct vet advice. These are a number of the obstacles that make these kinds of systems less useful in the actual world, particularly in rural and also resource-deficient set-up.

In order to address these gaps, the proposed system AnimalCare will provide a multi-modal approach that will integrate the inputs of symptom based and image based to enhance the accuracy and reliability of the prediction. It also has more complex, accessible, and practical features to address the real-life animal healthcare management in its complexity, access, and practicality.

## II. PROPOSED MODEL

The paper proposes latest animal disease forecast system, which is founded on artificial intelligence, named AnimalCare. The proposed model is suggested to provide the correct and available real time assistance to manage the animal health care by using machine learning, deep learning and interactive technology.

In contrast to the traditional systems when the user could only use the textual symptoms and description of the affected animals, the proposed model is based on the multi-modal approach, which means that the users can submit both the textual symptoms and description of the affected animals. Such a combined input enhances the accuracy and reliability of disease prediction and the system is more effective to apply into the real world.

The overall structure of proposed system includes several components that include data gathering, preprocessing of data, feature identification, prediction analysis and result building. Other features that improve the system usability and accessibility include virtual assistant communication, language support and medical consultation.

### A. Input system with many modes

The suggested model can be used with two different kinds of input:

Symptom-based input- When a user directly enters the symptoms, they have recently identified, this can be described as symptom-based input.

Image based input- In which the users upload pictures of infected or affected animals.

Computer vision (deep learning-based models) for image data and machine learning based models for symptom data has been used for the processing of this data. A combination of both these inputs makes the disease more easily manageable.

### B. Collecting data and pre-processing

The system uses of various datasets that carry data of animal disease and their symptoms. These datasets are gathered from the public datasets and merged into one single dataset.

Preprocessing of data is done to maintain quality and consistency that involves:

Cancellation of misplaced or sporadic information.

Encoding of categorical features.

Symptom data normalization and structuring.

In the image data case, the images are ready with the preprocessing methods such as resizing, normalization and feature extraction as the input of deep learning models.

### C. Disease Prediction Module

The central component of the system is the prediction module (which is built on machine learning algorithms such as Random Forest, Decision Tree and Naive Bayes) which is used as the algorithm in classification based on symptoms. The Random Forest is one of them, it is primarily used due to its high degree of accuracy and strength.

Deep learning networks such as Convolutional Neural Networks (CNN) are utilized to analyze images so as to detect visual patterns and symptoms in animal images.

This last prediction is produced through a synthesis of the results of the two previously mentioned models (symptom and image-based prediction models), resulting in the prediction being more precise and reliable.

### D. Multilingual Support System

To ensure that the access is as high as possible, the system has a language selection feature which allows the users to communicate in the platform in a language that he or she is comfortable with. All the outputs such as the prediction of disease, answers to chatbots, and advice are dynamically translated depending on user choice. This feature makes the system to be more available to the farmers and non-technical users particularly in the rural areas.



### E. Doctor Consultation Module

Another feature to be introduced in the design of the system is the doctors consultation which provides connection with veterinarians. Users are able to submit symptoms, photos and test results to the doctors when they have the forecast for appointment with a doctor to seek for professional advice and approval. The module is to bridge the gap between AI-based prediction and professional service.

### F. Chatbot Integration

Also the system has an AI-driven chatbot to give instant help. The chatbot answers the questions asked by users on the following:

- Animal diseases
- Symptoms and causes
- General care and preventive measures.

It could be used to attract the users and to give a help to the users possibly except of prediction.

### G. Results Presentation and User Advice

After the input data has been processed an output will be produced that will include:

- Predictable disease
- Prediction confidence score
- Basic disease description
- Prevention and suggestions.
- Selection of a doctor appointment.

The results are displayed in user friendly and simple interface which is also easy to access by all users.

## III. SYSTEM ARCHITECTURE

The suggested disease prediction model utilising a multi-modal approach for animal diseases was developed with an aim to meet the requirements of a robust and modular system architecture. The suggested disease prediction model utilising a multi-modal approach for animal diseases was developed with an aim to meet the requirements of a robust and modular system architecture. For providing a precise prediction and enhancing the user experience. The system adopts integrated deep learning, machine learning and interaction module.

The architecture is based on a structured pipeline which starts with user input and ends with disease prediction and guidance. It is a series of interconnected layers and is intended to perform a given task in the overall system.

### A. User Interface Layer

The user interface is the main source of interaction between the user and the system. It allows one to include the symptoms, post a picture of animals with the disease, select a language of choice and talk to the chatbot. The interface is designed to be simple, user friendly and usable by users who do not have much technical knowledge.

### B. Processing Layer of input

This layer is concerned with the input that the user provides both in the textual and image form. The data of the symptoms are organized and coded into a suitable format to be processed and the image data is pre-processed with the assistance of such techniques as resizing and normalization to be processed by deep learning models.

### C. Data Preprocessing and Feature Extraction

This step will entail cleaning and converting the input data to improve the usefulness of the prediction models. The method of selecting features and encoding are applied in the case of symptom data. Deep learning methods are applied in the case of image data, to extract properties that will assist in identifying the visual patterns that represent animal diseases.

### D. Prediction Layer

There are two significant components of the prediction layer. The former component applies machine learning algorithms, such as Random Forest, Decision Tree, and Naive Bayes to the disease classification based on symptoms. The second element involves a Convolutional Neural Network (CNN) in detecting diseases using images. The results of the two components are synthesized to give the final prediction which is more accurate and reliable.



### E. Multilingual Processing Module

This module uses the conversion of system outputs, responses from the chat-bot, commands into your first language which will make the system multi-lingual. Peoples living in remote areas will benefit from an increased level of access.

### F. Chatbot Module

The chatbot module will provide real-time live chats and responses to the queries of the users on the signs, symptoms and prevention of animal diseases. It also enhances the interaction of the users and provides them with more of help than prediction.

### G. Doctor Consultation Module

The doctor consultation module allow users to interaction with the professionals. Users receive professional advice and feedback from the expert by submitting the symptoms, the images, and also the prediction result to the professional.

### H. Result and output Layer

The final outcome is presented in a well-structured format, e.g., the predicted disease, the confidence score, the description of the disease, preventive measures, and an option to call a doctor. The findings are presented in easy to comprehend format using user-friendly interface.

### Description of System Flow

When the user enters into the platform, the process of the system will start with input from the user in a form of symptom descriptions and pictures which should be provided through the user interface. The given data is going to be cleaned and pre processed to provide the accuracy and consistency. Then the output will go through the prediction layer where machine learning algorithms will be utilised for processing symptoms and deep learning models can be used to analyse the image data. The result obtained from the two models then be combined to bring the final prediction. The functionality of the system will be optimized with the other modules such as multilingual processing, the interaction with chat bots and the way to speak with the doctors. And finally final prediction produced and the suitable advice will be then shown to the user.

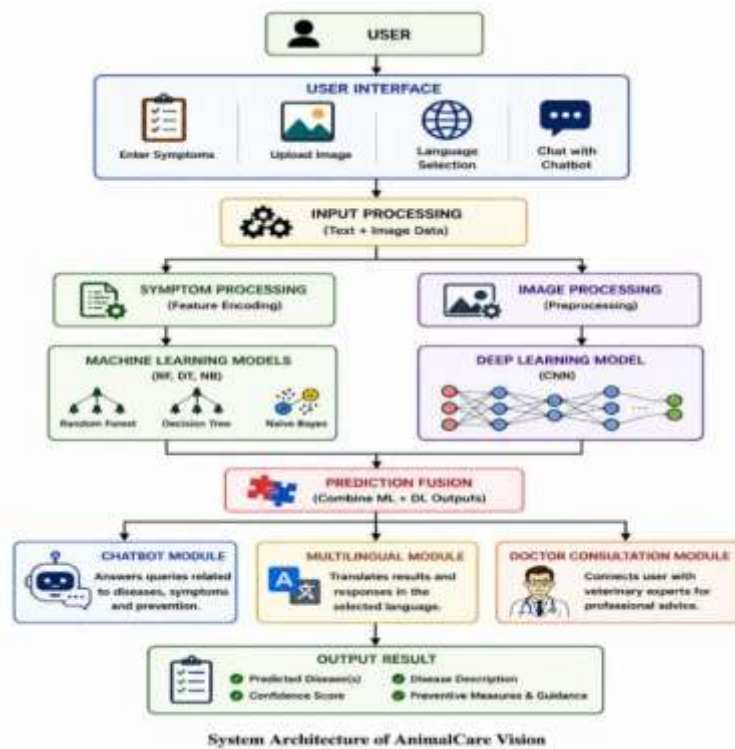


Figure 1: System Architecture of AnimalCare



#### IV. METHODOLOGY

The logical process that will be used to create an intelligent model for predicting animal diseases is described in the proposed AnimalCare methodology system. Data collecting, preprocessing, feature extraction, model training, and prediction based on a multi-modal system include all steps in the system logical approach.

##### A. Data Collection

The first step is to collect information on animal diseases, and the symptoms of the diseases. The sources and research datasets that are accessible to anyone will be used to get the data. The data will consist of the names of the diseases, their corresponding symptoms and other health related information. In addition to textual data, sets of images of infected animals are collected to enable recognition of disease based on image.

##### B. Data Preprocessing

Pre-processing of data is carried out in such a way as to ensure that the accuracy and consistency of the data already collected is preserved.

For symptom data:

- Missing or inconsistencies values are taken out.
- There is the removal of several entries.

Categorical data is transformed into numerical form with the help of encoding methods.

For image data:

Image- Resize of image to a standard size.

Noise-Reduction methods are used for noise reduction.

- Effective working is accomplished by normalising the pixel values.

This occurs with the goal to ensure that the data set is clean as well as suitable for machine learning and deep learning models.

##### C. Extraction of Features

The key features of the symptom and image data have been extracted by the feature extraction approach.

Whenever it comes to symptom data, important features are selected based on how well they predict the disease.

Image data: Appearance (including texture, shapes and color hues) related to a disease can be learned by a deep learning algorithm directly. This method cuts down the computation complexity and makes the model efficient.

##### D. Development of Models

###### 1) Machine Learning Model

Prediction of Disease is done using Machine learning algorithm like the Random forest, Decision Tree and Naive Bayes are done based on the symptoms displayed by the patient. Random forest is best used as it is accurate as well used to process complex data.

###### 2) Deep Learning Model

The disease detection on images is a Convolutional Neural Network (CNN) based algorithm. The CNN model is able to learn significant visual features of animal images and determines patterns of diseases successfully.

##### E. Model Training and Testing

This information is separated into two sets of data; training and testing data. The training data is utilized in the training of the models and the testing data is utilized in the testing of the models.

Performance indicators or measures of performance are evaluations scales of performance and they are composed of

- Accuracy
- Precision
- Recall
- F1-Score

This guarantees that the models are getting the right training and will be efficient for generalizing for new data.

##### F. Prediction Fusion

A fusion technique has been applied to merge results from deep learning (image based) as well as machine learning system (symptom based). As it comprises both visual and verbal inputs, the combined model can deliver more accurate as well as reliable results.



### G. User Interaction and Handling of input

The user responds to the system by a user-friendly interface by:

Entering symptoms

Uploading images

Choosing your language

This is inputted into the system and transmitted to the prediction modules.

### H. Chatbot Integration

An AI based chatbot is also integrated to help the users through providing their queries regarding disease, symptoms and its measures for prevention in animals in a quick manner. It provides the advanced support to the users.

### I. Multilingual Support

It also has a module for multiple languages which helps the system to translate the output and the chatbot reply into the selected language of the user which makes the system even efficient.

### J. Doctor Consultation

The system offers an alternative where users can access animal doctors. The users will be in a position to send predictions, symptoms, and images to doctors to get quality advice and confirmation.

### K. Result Generation

Finally, the system gives the output that is made up of:

- Predicted disease
- Confidence score
- Disease description
- Prevention and precautions.

Results are presented to be simple and knowledgeable.

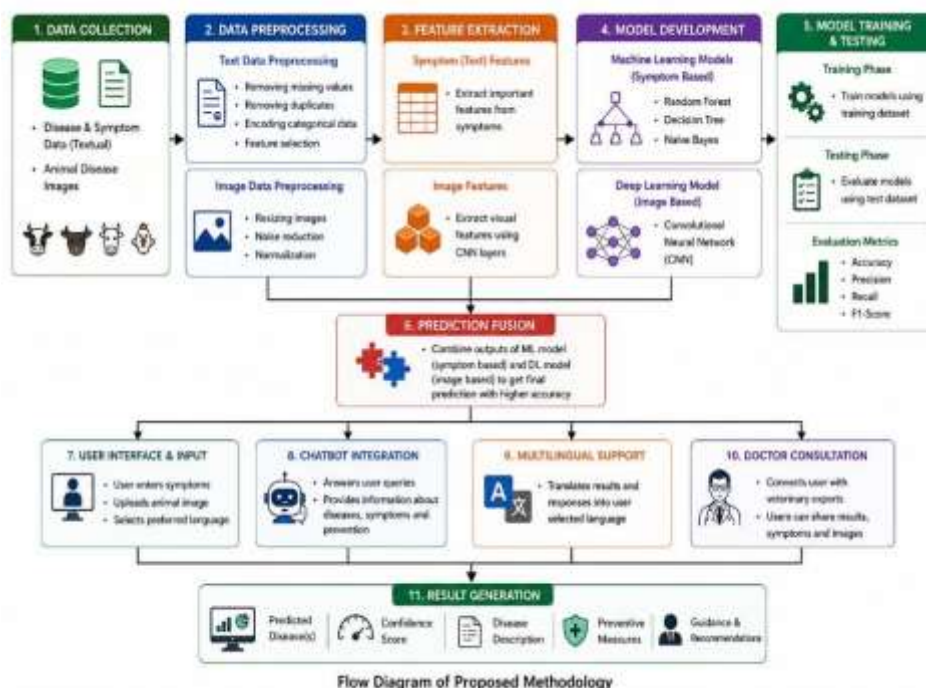


Figure 2: Flow Diagram of Proposed Methodology

## V. RESULTS AND DISCUSSION

The efficiency of the suggested system of AnimalCare is evaluated with the assistance of the conventional machine learning evaluation measurements. The system includes symptom-based prediction model and image-based prediction model and the results indicate that the system is effective in terms of its ability to accurately predict animal diseases.



### A. Experimental Setup

The data set of training and testing is an animal disease and its symptoms collected in different sources that are publicly available. The data is handled and divided into training and test set in the ratio of 80:20.

Predictions based on symptoms are done through machine learning algorithms such as the Random Forest, Decision Tree and Naive Bayes. A Convolutional Neural Network (CNN) is used when analysing images. The training and evaluation of the models are done through Python based libraries.

### B. Performance Metrics

The following observations are used to evaluate the system:

Accuracy: The overall number of correct predictions of the model.

Precision: How many of the cases we predicted positive are actually true.

Recall: The self-efficacy to find the real good conditions.

F1-Score: Harmonic mean between precision and recall.

### C. Results of Machine Learning Models

Model	Accuracy	Precision	Recall	F1-Score
Random Forest	92%	91%	90%	90.5%
Decision Tree	88%	87%	86%	86.5%
Naïve Bayes	85%	84%	83%	83.5%

In general, the Random Forest (RF) model is the best than the other models. It join multiple models and make it sufficiently powerful to learn the complex data.

### D. Deep Learning Model Outcomes

One of the trained CNN models had been classified. It had an accuracy of just below 90%. This proved that it was possible for the model to spot the patterns that are associated with the diseases from their visualization.

### E. Hybrid Model Performance

The proposed algorithm uses a prediction merging procedure in order to merge the results from both the deep learning model and the machine learning model. The proposed multi-mode approach boosts the systems overall effectiveness.

- Overall Accuracy: 94%
- More reliable than using just one model.

### F. Discussion

The experimental results show that the proposed system is correct and trustworthy in forecasting diseases. When both the symptom and image-based inputs are used, it is highly likely to enhance the prediction capacity of the system.

The multi-modal system proposed is more precise and has a superior generalization compared to the traditional methods that simply use the data on the available symptoms. Additional features like chatbot chat, multilingual support, and doctor consultation also improve usability and practicality.

But even if it was used for the system or not has also been decided by the size and features of data set which under-balanced data set of small size of data set might be ok. The training data set of image based prediction should be large enough.

## VI. FUTURE WORK

The proposed AnimalCare system has demonstrated promising results in predicting animal diseases using the aid of a multi-modal system. Nevertheless, the system has quite a number of areas that it can be further improved and enhance its performance and scalability as well as its applicability to real world usage.

Finally, we could improve our system by adding larger and more different datasets which include much more animal species and different diseases. It would allow to improve the correctness but also to transfer better the machine learning and deep learning models.



The other significant improvement is the implementation of the methods of advanced deep learning to detect a disease based on the image. More complex models can be applied to enhance the accuracy of detecting diseases on the images of animals, in particular, difficult or ambiguous cases.

It is suggested that a mobile application could be built in order to make the system available to farmers and animal keepers. Having a mobile application, the user would be able to take pictures and enter symptoms directly into their mobiles. This would be more user friendly in the field.

Additionally, IoT-based sensors might be used for recording animal health measures including temperature, movement, and behaviour in real-time. This might help in the early detection of a disease.

Live communication and engagement with veterinary specialists through live chat and video conversations. It can be increasing the doctor consulting service. This will improve the process and will prove to be full trust. The multilingual support system can also be made to include regional languages. This makes it more accessible to a huge range of users. In conclusion, the system can be linked with cloud-based systems to provide fast data handling, allow flexibility and data storage. This makes it highly suitable for regular use in medicine and farming.

## VII. CONCLUSION

This project offers an extremely sophisticated approach to early detection of animal diseases, which will benefit farmers, animal health care providers, and doctors in their efforts to meet their customers. To deliver useful disease forecasting, the system integrates deep learning and machine learning methods into a multi-modal system that enables individual to upload data either by symptom or image.

The proposed system uses machine learning algorithms such as the Random Forest, Decision Tree, and the Naive Bayes to perform the task of diagnosing the disease based on symptoms and a Convolutional Neural Network (CNN) to perform the task of diagnosing the disease based on images. The overall accuracy and reliability of the system is improved by the combination of these models through a prediction fusion approach.

Apart from the prediction uses, the system contains some significant real-world uses, such as multilingual support, AI-powered chatbot, and a doctor consultation module. These make it more accessible, have more interaction and practical use, particularly by farmers in rural and resource limited regions.

The results of the experiment demonstrate that the proposed system is extremely precise and it is even better than the traditional one-model solution. That different types of input are integrated, as well as interactive modules, make the system more efficient and suitable to be deployed in the real world.

Overall, the proposed AnimalCare system is an intelligent, scalable, and user-friendly approach to animal disease predictions and management of animal care. It assists in improving early disease prediction, reduction of economic losses in livestock farming and in making better decisions in veterinary care.

## REFERENCES

- [1] A. I. Pereira, P. Franco-Gonçalo, P. Leite, A. Ribeiro, M. S. Alves-Pimenta, B. Colaço, C. Loureiro, L. Gonçalves, V. Filipe, and M. Ginja, "Artificial Intelligence in Veterinary Imaging: An Overview," *Veterinary Sciences*, vol. 10, no. 5, p. 320, 2023. [Online]. Available: <https://www.mdpi.com/2306-7381/10/5/320>
- [2] D. W. Girmaw, "Livestock animal skin disease detection and classification using deep learning approaches," *Biomedical Signal Processing and Control*, vol. 102, p. 107334, 2025, doi: 10.1016/j.bspc.2024.107334[Online]. Available: <https://www.sciencedirect.com/science/article/abs/pii/S1746809424013922>
- [3] F. Bouchemla, S. V. Akchurina, I. V. Akchurina, G. P. Dyulger, E. S. Latynina, and A. V. Grecheneva, "Artificial intelligence feasibility in veterinary medicine: A systematic review," *Veterinary World*, vol. 16, no. 10, pp. 2143–2149, 2023, doi: 10.14202/vetworld.2023.2143-2149. Available: [Veterinary World Article](#)
- [4] S. Rehman, B. Rathore, and R. Lal, "Animal Disease Prediction Using Machine Learning Techniques," *International Journal for Research in Applied Science and Engineering Technology (IJRASET)*, vol. 11, no. 6, pp. 184–193, Jun. 2023. [Online]. Available: <https://www.ijraset.com/research-paper/animal-disease-prediction-using-machine-learningtechniques>



- [5] O. V. Shinde, S. S. Sankpal, Y. B. Kandalkar, T. R. Bhosale, and S. A. Khairnar, "Emerging Role of Artificial Intelligence in Animal Disease Surveillance, Prediction and Diagnosis: A Review," *International Journal of Veterinary Sciences and Animal Husbandry*, vol. 10, no. 10S, pp. 41–45, 2025. [Online]. Available: <https://www.veterinarypaper.com/archives/2025/10/10S/A/S-10-10-9>
- [6] M. Farooq, O. Sohail, A. Abid, et al., "A Survey on the Role of IoT in Agriculture for the Implementation of Smart Livestock Environment," *IEEE Access*, vol. 10, pp. 9483–9505, 2022, doi: 10.1109/ACCESS.2022.3142848. Available: <https://doi.org/10.1109/ACCESS.2022.3142848>
- [7] Y. Yuan, L. Chen, H. Wu, and L. Li, "Advanced agricultural disease image recognition technologies: A review," *Information Processing in Agriculture*, vol. 9, no. 1, pp. 48–59, 2022, doi: 10.1016/j.inpa.2021.01.003. Available: <https://www.sciencedirect.com/science/article/pii/S2214317321000032>
- [8] P. Cihan, A. Saygılı, C. Ş. Ermutlu, U. Aydın, and Ö. Aksoy, "AI-aided cardiovascular disease diagnosis in cattle from retinal images: Machine learning vs. deep learning models," *Computers and Electronics in Agriculture*, vol. 226, p. 109391, 2024, doi: 10.1016/j.compag.2024.109391. Available: <https://doi.org/10.1016/j.compag.2024.109391>
- [9] F. C. Dórea and C. W. Revie, "Data-driven surveillance: effective collection, integration, and interpretation of data to support decision making," *Frontiers in Veterinary Science*, vol. 8, p. 633977, 2021, doi: 10.3389/fvets.2021.633977. Available: <https://www.frontiersin.org/articles/10.3389/fvets.2021.633977/full>
- [10] D. S. R. Rao, P. C. S. Reddy, A. Revathi, V. S. Kiran, N. Rajasekhar, N. Sandhya, P. V. Rao, A. S. Karthik, and P. J. V. N. S. Sai, "Empowering rural livestock health: AI-powered early detection of cattle diseases," *AI*, vol. 7, no. 4, p. 137, 2026. Available: <https://www.mdpi.com/2673-2688/7/4/137>