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Automation in Poultry Farm Using AI-ML IOT

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ABSTRACT: Poultry health monitoring using Internet of Things (IoT) platform employing Artificial Intelligence (AI) techniques is presented. For monitoring the poultry farm and bird health, the IoT devices employing different types of sensors video/image processing and classification capabilities, along with vocalization (sound) based Poultry livestock analysis is being studied. Availability of growingly inexpensive computational resources, IoT devices, and standard algorithms, has made a strong case to employ modern day technology to continuously monitor the large farms with millions of birds and improve the overall productivity. As eggs and poultry are biggest source of protein intake, the advance technological solutions for poultry farm management should be employed on priority basis.

KEYWORDS: Poultry Farming, Random Forest (RF), Chicken age detection, Health Monitoring

I. INTRODUCTION

The poultry industry is crucial for providing high-protein, low-fat food globally, particularly chicken and eggs. As consumer concerns about meat safety rise, ensuring the well-being of poultry becomes essential for producing healthier products. Chickens are prone to diseases that can spread rapidly within flocks, leading to economic losses. Early detection of illnesses through behavioral monitoring can mitigate these risks. Recent technological advancements enable continuous monitoring of chicken health using sound analysis and image processing, allowing for the identification of abnormal behaviors and early disease detection. Machine learning models, particularly supervised learning techniques, are employed to predict health outcomes based on labeled data, enhancing the accuracy of disease detection. This research aims to develop an IoT-based prediction service to categorize layer chickens effectively. By leveraging artificial intelligence, the study focuses on determining the day-age of chickens, which is vital for predicting illness susceptibility and optimizing their nutritional intake during critical growth phases. The ultimate goal is to improve the quality of poultry products and animal welfare, benefiting both the industry and consumers. This whole scenario creates a need to employ modern technology solutions. Different sensors, cameras, and microphones can be used for poultry health monitoring and management, thereby reducing the risks to human health, as by employing technology human interference in livestock monitoring can be reduced to minimal. Also, the efficiency of the overall system and timely detection of any disease/disorder or behavioral problem in poultry will be improved.

II. MOTIVATION AND OBJECTIVES

Quality Control in Poultry Production: The poultry industry faces increasing demands for high-quality chicken meat and eggs. The study aims to enhance the quality control processes within the poultry sector to ensure a steady supply of healthy products, addressing growing concerns about poultry quality globally .[2]

Health Monitoring: There is a significant need for continuous monitoring of the health and well-being of laying hens. The study evaluates the current state of sensor technology and its potential to provide real-time health assessments, which is crucial for improving animal welfare and productivity[1]

Utilization of Advanced Technologies: The integration of Artificial Intelligence (AI) and the Internet of Things (IoT) is a key objective. By employing AI techniques, particularly the LSTM-RF model, the study seeks to improve the accuracy of identifying and predicting the health status of chickens, thereby facilitating better management practices in poultry farming.

Data-Driven Decision Making: The research emphasizes the importance of data collection and analysis in making informed decisions regarding poultry management. By utilizing advanced data augmentation techniques and machine learning models, the study aims to enhance the predictive capabilities related to chicken health and productivity.

Enhancing Animal Welfare: Another objective is to improve the living conditions of hens based on their preferences and behaviors, which can lead to better animal welfare outcomes. The study highlights the importance of understanding day-age and its implications for managing the health and productivity of laying hens.

III. LITERATURE SURVEY

- 1) "Smart Farming Technologies for Sustainable Agricultural Development" by V. Mucherino G. Lendaris- IoT-enabled systems continuously measure bird weight, detecting growth deviations. ML models predict growth trends, optimizing feeding strategies. Improved resource efficiency and production forecasting.
- 2) "Artificial Intelligence in Agriculture" by K. Beullens D. Baier- AI tracks bird movement and behavior in real-time, identifying abnormalities. ML recognizes patterns of stress or illness through behavior analysis[3]
- 3) "Precision Agriculture for Livestock Production" by J. W. Oltjen E. Kebreab- AI-powered systems detect unusual bird behavior (e.g., reduced movement, abnormal feeding). ML predicts disease outbreaks before visible symptoms appear, allowing early intervention.[4]
- 4) "Smart Agriculture: Technology and Applications" by G. Kolios T. Kosmanos- Real-time monitoring of temperature, humidity, and air quality. AI optimizes ventilation and temperature based on real-time data. Reduced disease risk and better bird health outcomes[6].

IV. METHODOLOGY

IoT-based automatic poultry farm emphasizes image data collection, data augmentation, model selection, and validation for proper poultry health monitoring and disease prediction.

Image dataset of the chickens from various day-ages has been collected at high resolution. This is to ensure diversity so that the character related to health and growth can be captured.

All the techniques applied for data augmentation are Mixup, Cutout, and CutMix. These techniques helped increase the diversity of datasets and augmented robustness for the image samples through modification; thereby improving generalizability in the models.

Hybrid Model-LSTM-RF: A hybrid model combining LSTM networks with RF algorithms was developed. The LSTM extracted relevant temporal features from an image and passed further to predict health outcomes in Random Forest models. Here, the outcomes of the deep learning capability for feature extraction were combined with the ensemble learning for robust prediction ability.

Validation and Performance Metrics: The model has been validated on the data set segments using the Stratified K-fold cross-validation technique. Model performance was evaluated with the help of metrics like accuracy, precision, recall, and F1-score; notably, the LSTM- RF hybrid model showed high accuracy, 95 %.

System Architecture:

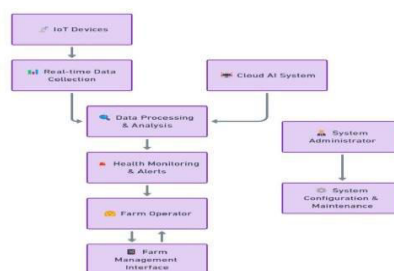


Fig.1. System Architecture

This system architecture diagram shows IoT devices collecting real-time data, which is processed and analyzed with support from a cloud AI system. Health monitoring and alerts inform farm operators through a management interface. System administrators handle configuration and maintenance to ensure smooth operations, enabling efficient farm management and proactive responses to potential issues.

V. VIDEO/IMAGE FOR POULTRY FARM ANALYSIS

The machine learning technology using poultry big data with camera sensing technology can be utilized to sense the suspected disease symptoms. A similar system has been used in . Camera-based technologies such as object recognition and abnormal motion detection algorithm for chickens can be used to study areas related to chicken health, nutrition, stress level, behavior, environment, and diseases. A few image examination procedures have been concentrated to screen domesticated animals, including image investigation, optical stream, and infrared imaging in and. Optical stream imaging method that can measure changes in radiance in a sequence of an image, infection with *Campylobacter* in chickens can be detected in . *Campylobacter* severely affects the welfare of the birds as solid provoking conditions can lead to looseness of the bowel, poor litter quality, and decayed strolling capacity in infected domesticated animals like chickens and hens. In, for the predict health and welfare continuously, the combination of Optical flow and Bayesian regression has been used. Also, Optical Flow is used to predict plumage damage and management and/or environmental risk factors in laying hens as described by the authors in and. This model shows a better prediction of feather damage and excellent identification of high prevalent damaged f locks. Disease immunity development in the livestock is another important factor. Infrared Thermal Imaging can used to prevent heat stress which is of vital importance to poultry welfare, especially because it would go a deep way in influencing the bird's immunity, health, and bring about major mortalities. The measured data can be utilized in maintaining the ambient temperature of the poultry farm. Superficial body temperature can be picked through the use of Infrared thermal imaging (IRTI) technology. This is a non- invasive technique wherein different body temperature is represented in the form of different colors which can be used to detect fever indicating the onset of disease . Several studies are indicating a strong relationship between surface temperatures measured by IRTI to that of chicken core body temperature. Many researchers believe that much more information about bird's condition can be recorded using facial surface temperature than the ambient temperature and, thus, has great prospects to be implemented at a commercial level to monitor thermal stress level. A dead chicken is identifiable by image technology. An SVM based automatic detection algorithm has been utilized to detect a dead chicken .

VI. SOUND-BASED ANALYSIS OF CHICKENS IN THE POULTRY INDUSTRY

The distinctive features of birds' calls provide insight into the biological meaning of birds. In particular, for social interactions, birds have been shown to depend on acoustic communications while also depending on signaling alarms with particular sounds. The sensing of certain sounds also provides an indication of stress ful conditions, and these sounds may develop into an intriguing approach for assessing welfare indicators in birds, helping them in increasing the productivity of leveraged sector poultry. Chicken sounds can expose a great deal of information about their health and happiness. The chicken produces sounds like clucks, chortles, and caws that might divulge its happiness. Dogmas indicate the presence of certain diseases in chickens. Respiratory diseases pose a significant challenge to health in meat production. Rales and sneezing sounds indicate an increase in symptoms associated with respiratory infections in the chickens. The shrill screams may indicate predators and convey distress. In conjunction with time of day, there are noise levels in poultry; chickens are noisier in the morning and much more quiet in the evening. So, any deviation in behavior may be construed as an abnormality for notification of the poultry supervisor. There is a need to deploy sound recognition technology and sound-discriminating algorithms ensuring the scientific precision to recognize chicken sounds from calling in prediction and delivery of information on chicken diseases, behaviors, weights, age, happiness, and welfare.

VII. CONCLUSION

The IoT-based automated poultry farm project aims to enhance animal welfare and productivity through continuous monitoring and advanced AI techniques like LSTM-RF. This approach can lead to improved egg quality and quantity, addressing market demands . Future work should focus on expanding sensor technology, engaging stakeholders for better implementation, and ensuring scalability to adapt to various farming environments . Overall, the project has the potential to revolutionize poultry farming practices, ensuring sustainability and improving product quality.

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