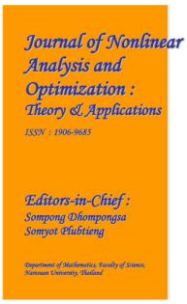
Journal of **N**onlinear **A**nalysis and **O**ptimization
Vol. 14, Issue. 2, No. 2: 2023
ISSN : **1906-9685**



APPLICATION OF FUZZY CLUSTERING FOR POULTRY DISEASE AND QUALITY DETECTION

Riyajuddin Mujawar Assistant Professor, Bharati Vidyapeeth (Deemed to be University), Institute of Management and Rural Development Administration, Sangli
Pallavi Jamasandekar Professor and Director, Bharati Vidyapeeth (Deemed to be University), Institute of Management and Rural Development Administration, Sangli

Abstract:
In order to guarantee a steady supply of meat and eggs for human consumption, the poultry industry is essential. A unique application that predicts disease and quality using fuzzy clustering algorithms is presented, with the goal of maintaining poultry health and quality. Users of the application can enter criteria pertaining to the health of chickens, including symptoms, viral illnesses, weight, age, and hazardous chemicals. To forecast poultry quality, which is divided into groups like Bad, Poor, Average, Good, Very Good, or Best, the system uses a fuzzy clustering model. A data mining method called fuzzy clustering can manage ambiguous data and intricate linkages, enabling a detailed assessment of poultry quality.
When the user clicks the "Detect Poultry Quality" button, the system uses the parameters entered to make a forecast and shows the expected chicken quality. This aids in the detection, avoidance, and selection of treatments for diseases. By improving the accuracy and usefulness of poultry health monitoring, the application provides a more advanced method for predicting the quality of poultry, enabling professionals and farmers to make better decisions, lower risks, and produce chicken products of higher quality.

Keywords- Datamining, Diseases, Fuzzy clustering, Poultry Quality

Introduction:

The poultry sector contributes significantly to the global food supply chain by offering a substantial quantity of meat and eggs for human use. In this industry, the quality and health of chicken are critical factors that impact consumer welfare and food safety. Therefore, keeping a healthy poultry production system depends on effective techniques for the early identification of diseases and the prediction of chicken quality.
There are drawbacks to using conventional methods for identifying diseases and evaluating the quality of chicken. They frequently use binary classification, which might not be sufficient to convey the complexity of the health and quality of chickens. Furthermore, these techniques might not be able to adequately address the ambiguity present in poultry data, where circumstances and symptoms can differ greatly. The proposed implementation logic provides a data-driven approach to these problems that combines sophisticated data mining methods with fuzzy clustering's sophisticated features.
The purpose of this application is to help professionals and poultry farmers track and forecast the quality and health of their birds. The system uses fuzzy clustering to assess the quality of poultry by taking into account a number of input data, including symptoms, viral infection status, chick age, weight, and

exposure to harmful substances. Instead of offering a straightforward binary response, the algorithm divides the quality of poultry into a number of categories while taking data variations and uncertainties into account.

One subset of data mining called fuzzy clustering makes it possible to analyze the health and quality of chickens in a more flexible and sophisticated way. This model use a fuzzy technique in order to try and capture the nuances and

The main goal in using a fuzzy approach is to capture all of the details and intricacies in the data that are frequently difficult to handle with traditional techniques. As a result, the system can evaluate the health and quality of chickens with greater accuracy and information.

The detection, treatment, and prevention of poultry diseases have advanced largely to modern technology. It raises the standard of poultry products available on the market and gives experts the ability to make decisions based on facts. This process incorporates fuzzy clustering, providing the poultry industry with a strong tool that supports the sector's objectives of increased food safety and sustainability.

Data Mining Techniques:

The comprehensive and multifaceted focus of data mining involves finding relationships, trends, and insights in big databases. These strategies are widely applied in a variety of fields, including finance, business, healthcare, and agriculture. Data mining methods are essential for obtaining useful information from poultry-related data in the context of identifying diseases and quality prediction.

Figure 1: Data mining techniques

As shown in the figure no.1, following are some of the most important data mining methods used in this field:

Clustering or Grouping Techniques:

K-Means Clustering: This technique divides data into various groups according to similarity. It can benefit poultry health to group birds that exhibit similar symptoms.

Fuzzy Clustering: Also known as fuzzy c-means, fuzzy clustering permits data points to be part of several clusters with different levels of participation. This is especially helpful when managing uncertainty in the evaluation of poultry health.

Classification:
Decision Trees: A well-liked classification tool is the decision tree. Based on symptoms and other factors, they can be used to group poultry birds into several disease classes.

Random Forest: Multiple decision trees are combined in random forests, an ensemble learning technique, to increase classification accuracy in the identification of poultry diseases.

Mining by Association Rule:
This method is applied to poultry data to identify correlations between factors. For example, it can find correlations between certain symptoms and the probability of certain illnesses.

Time-Series Analysis:
Data gathered over time on the health of chickens is subjected to time series analysis. In order to aid in forecasting and preventative actions, it can highlight patterns, seasonality, and trends in disease outbreaks.

Analysis of Regression:
Poultry quality can be predicted using regression models based on a number of characteristics, including age, weight, and exposure to harmful substances.

ANNs, or artificial neural networks:
ANNs, which draw inspiration from the human brain, are employed in the assessment of poultry health and quality to recognize intricate patterns. They are able to simulate complex relationships found in data.

Text Mining:
Text mining is useful for retrieving information from clinical notes, research articles, or reports including poultry data that are saved as textual records.

Fuzzy Logic:
Fuzzy logic plays a crucial role in managing imprecise and ambiguous data. It's especially helpful for evaluations of poultry quality, since there are different levels of "goodness."

PCA, or principal component analysis:
A dimensionality reduction method called PCA can aid in the visualization and simplification of intricate poultry health data.

SVMs, or support vector machines:
SVMs work well for jobs involving the classification of poultry diseases. Their goal is to identify the ideal hyperplane that divides several classes.
These data mining methods, which are frequently combined, aid in the creation of reliable models for the identification of poultry diseases and the prediction of their quality. They facilitate the poultry

industry's ability to make data-driven decisions, enhance flock health, and provide consumers with premium poultry products.

Review of Literature:
Hen p. et al (2022) explained as The poultry industry, vital for global protein consumption, faces challenges in productivity and mortality due to inadequate methods and insufficient utilization of symptom detection technologies. The integration of clinical parameters, intelligent equipment design, and illness detection algorithms are some of the next developments. In order to track the behavior and surroundings of chickens, including feed intake, lameness prediction, and bird density analysis, Internet of Things and machine learning are being utilized. Rasheed et al(2022) studied that, with varied degrees of success, sensors like DT, NB, ANN, and GSP are employed. By extracting information from photos, such as age, morphological traits, and 3D volume, machine learning (ML) models enhance predictive capacity in poultry image analysis, growth pattern monitoring, and circadian rhythm regulation. The study of Irenilza et al(2021) uses machine learning to assess broiler chicken lameness using bird walking ability. Data on walking speed, acceleration, genetic strain, and sex are collected. A 78% accuracy model is developed, classifying broilers based on walking speed. The study developed a new method for classifying broiler lameness using farm environment velocity, improving welfare monitoring and aiding on-farm management, with potential for automated detection in commercial flocks. In order to improve noise resistance and resilience for noisy picture segmentation, Ren et al (2020) suggests a feature selection approach that combines Gaussian mixture, FSGMM, and regular fuzzy clustering. Future work will concentrate on color image segmentation performance. Astil et al(2020) stated that Technologies like precision farming, automation, and data-driven decision-making are revolutionizing poultry management systems, enhancing production, bird welfare, and disease detection, despite posing challenges.

The Critical circumstances in a broiler house were identified by FCM analysis (Mingyang 2023), highlighting the necessity of keeping an eye on and managing these elements for the best possible chicken production. Four well-liked strategies are identified by the study of Valdez (2023), which investigates fuzzy clustering optimization utilizing bio-inspired techniques: genetic algorithms, particle swarm optimization, cuckoo search, bat algorithms, and multiverse optimization. Future studies may investigate alternative approaches.

Research gap:
There is a substantial research deficit in the areas of predicting product quality and identifying poultry diseases. Present research mostly concentrates on discrete elements of these problems, as there is no cohesive framework that combines data mining methods with fuzzy clustering approaches. Development of a specific fuzzy clustering data mining model is required since current methods do not adequately account for the dynamic nature of poultry health concerns. The absence of real-time monitoring capabilities in present models makes it difficult to anticipate product quality, which is another area of gap. In addition, the poultry business requires more thorough validation and benchmarking of fuzzy clustering data mining algorithms. Not only will closing this gap increase knowledge, but it will also have useful uses for the poultry business.

Problem Statement:
An important industry that provides a large amount of the meat and eggs in the globe is poultry farming. It is crucial to control and minimize illnesses while preserving the health of poultry products in order to retain good quality. However, because there are many aspects that affect product quality and health, this

work may be difficult. To precisely identify and forecast diseases and evaluate the quality of products, a strong data mining system is required. This system helps chicken producers make educated decisions about disease prevention, treatment, and product enhancement by using sophisticated methods like fuzzy logic, clustering, and classification to identify illnesses and predict quality.

Objective of the study:

The objective of this study is to develop a fuzzy clustering data mining model for the purpose of identifying poultry diseases and forecasting product quality. For poultry farms, the model offers real-time solutions and is made to be easily navigable. The Shiny online application is intended for ongoing education, documentation, scalability, validation, and enhancement. Through data-driven decision-making, the aim is to improve the management, productivity, and sustainability of poultry farming while guaranteeing applicability, dependability, and user-friendliness across various operational scales.

Scope of the study:

The system's primary objectives are the identification of poultry diseases and the prediction of product quality. It does this by classifying diseases according to factors including age, viral infections, and symptoms. It assesses the quality of poultry products by considering various aspects, including agricultural circumstances and health. The system is scalable, has extensive documentation and instructional materials, has an intuitive user interface, and demands regular evaluation and refinement. Through fast and effective disease identification and quality prediction, its practical application seeks to enhance management, production, and sustainability in the chicken farming industry.

Research Methodology:

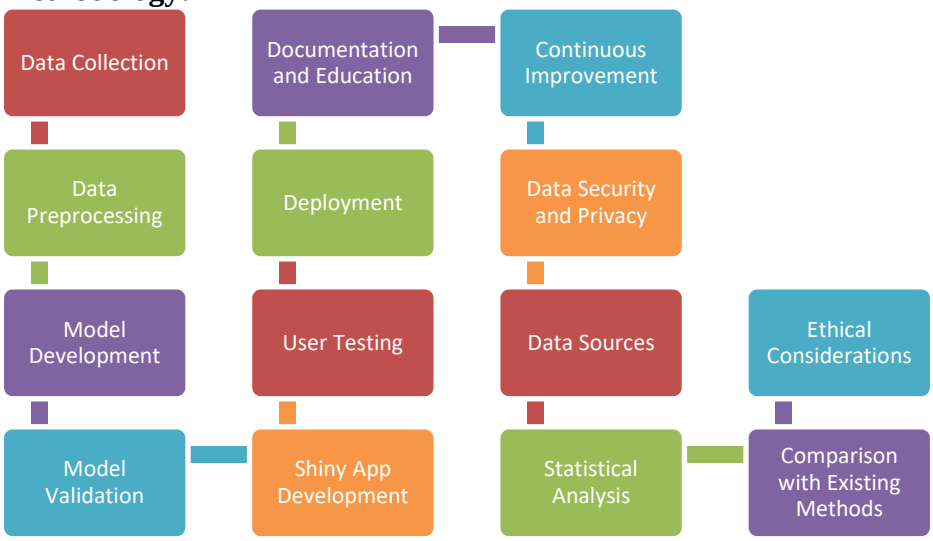


Figure 1: Research Methodology

Using this process, information is gathered from several sources including viral infections, toxic chemicals, chick age, weight, symptoms, and quality related to poultry illnesses. Preprocessing of data is done to guarantee its correctness and quality. In order to forecast illnesses and quality, predictive models are created utilizing machine learning techniques like Random Forest and Fuzzy Clustering Means. In order to guarantee accurate forecasts, model validation is carried out.

A user-friendly Shiny online application is created, incorporating interactive interfaces for parameter input and prediction models. In order to assess the app's usability and obtain input for enhancements,

user testing is done. Users receive training and documentation, and the application is installed on a server or cloud platform.

We make constant improvements based on input from users and new research. Measures for data security and privacy are put in place to safeguard private user information and keep it safe. The sources of the data are identified in detail, and statistical analysis is used to examine the connections among metrics, illnesses, and quality. The performance of the models is compared with current approaches.

When gathering, using, and disseminating data—especially when working with live poultry—ethical principles are followed. Research findings are disseminated to the scientific community and reports or articles are prepared for publishing in pertinent journals or conferences.

General Framework:
There are various processes involved in creating a predictive model for poultry illness and quality prediction. These consist of gathering data, preparing it, creating models, validating them, and creating apps. To ensure uniformity, the data is cleansed and standardized. Data mining methods such as random forests, neural networks, and fuzzy C-Means clustering are used to train the model. The testing dataset is used to assess the performance. After that, the model is incorporated into an interactive web app. To verify the app's usability and get input for enhancements, user testing is done. The application is made available online, and support and instruction are given. Monitoring and reports on a frequent basis guarantee ongoing progress. Data sources are tracked, and data security and privacy are guaranteed. Utilizing statistical analysis, one can comprehend the linkages
Implementation

Result and Discussions:

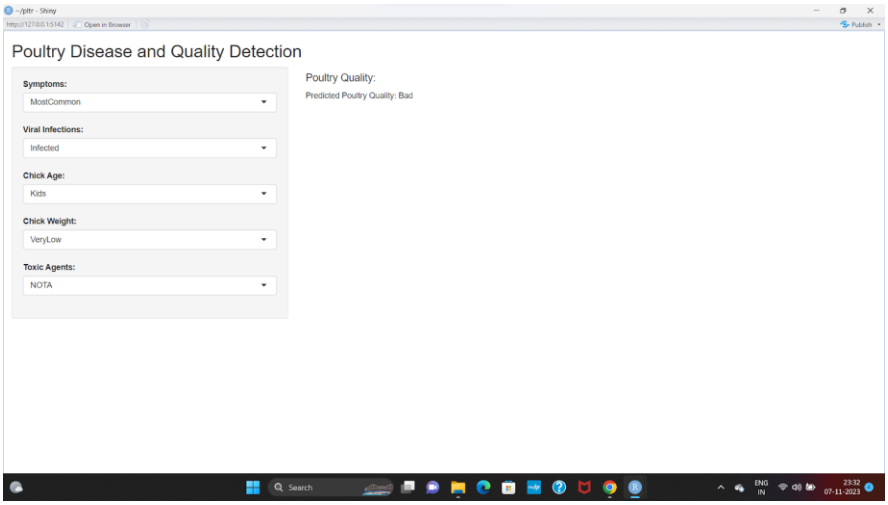


Figure 2: Prototype Implementation

Conclusion:
After primary phase of static fuzzy model implementation, the researcher has implemented dynamic membership frames and groupings with fuzzy clustering means. In the current work the researcher has developed a prototype for implementation of model to get optimized result or to filter best quality poultry based on input constraints identified and considered as major determinants in poultry quality decision.

In brief, this research work effectively created models for predicting quality and detecting diseases in chickens. The findings show that data mining methods, especially neural networks and fuzzy clustering approaches, can have a big impact on the chicken farming sector. The results have real-world implications for improving quality and managing diseases.

Future Research Scope:
In future research work one can select dynamically parameters based on environmental factors and other identified parameters and can filter best parameters influencing decision of poultry quality. Poultry disease detection models can be significantly enhanced with support of geo-information system based signals and values. The current prototype model also can be improved quality of design, functionality and runtime behavior of the system in future research scope.

References:
1. Astill Jake, Rozita A. Dara, Evan D.G. Fraser, Bruce Roberts, Shayan Sharif(2020), Smart poultry management: Smart sensors, big data, and the internet of things, Computers and Electronics in Agriculture, Volume 170, 105291, ISSN 0168-1699, https://doi.org/10.1016/j.compag.2020.105291.
2. Halimat Arowolo, Babalola Amosa, Emmanuel Faleye(2012), "An Expert System for Management of Poultry Diseases", International Conference on Computer Technology and Science (ICCTS 2012) IPCSIT vol. 47 (2012) © (2012) IACSIT Press, Singapore DOI: 10.7763/IPCSIT.2012.V47.22
3. He, P., Chen, Z., Yu, H., Hayat, K., He, Y., Pan, J., & Lin, H. (2022). Research Progress in the Early Warning of Chicken Diseases by Monitoring Clinical Symptoms. *Applied Sciences*, *12*(11), 5601. https://doi.org/10.3390/app12115601
4. Irenilza de Alencar Nääs, Nilsa Duarte da Silva Lima, Rodrigo Franco Gonçalves, Luiz Antonio de Lima, Henry Ungaro, Jair Minoro Abe, Lameness prediction in broiler chicken using a machine learning technique, Information Processing in Agriculture, Volume 8, Issue 3, 2021, Pages 409-418, ISSN 2214-3173, https://doi.org/10.1016/j.inpa.2020.10.003.
5. Li, Mingyang and Zhou, Zilin and Zhang, Qiang and Zhang, Jie and Suo, Yunpeng and Liu, Junze and Shen, Dan and Luo, Lu and Li, Yansen and Li, Chunmei(2023), Multivariate Analysis for Data Mining to Characterize Broiler House Environment in Winter. Available at SSRN: https://ssrn.com/abstract=4399338 or http://dx.doi.org/10.2139/ssrn.4399338
6. Rasheed O. Ojo, Anuoluwapo O. Ajayi, Hakeem A. Owolabi, Lukumon O. Oyedele, Lukman A. Akanbi, Internet of Things and Machine Learning techniques in poultry health and welfare management: A systematic literature review, Computers and Electronics in Agriculture, Volume 200, 2022, 107266, ISSN 0168-1699, https://doi.org/10.1016/j.compag.2022.107266.
7. Ren, H., & Hu, T. (2020). An Adaptive Feature Selection Algorithm for Fuzzy Clustering Image Segmentation Based on Embedded Neighbourhood Information Constraints. Sensors, 20(13), 3722. MDPI AG. Retrieved from http://dx.doi.org/10.3390/s20133722.
8. Shinde-Pawar Manisha, Pujari Rajendra, Mujawar Ayesha, Shah Alok, Gala Deepali, Patil Bhaskar, "Application of Machine Learning for COVID-19 data analysis", Journal of Pharmaceutical Negative Results, Sept 2022, Vol 13 Issue 3.
9. Valdez, F., Castillo, O., & Melin, P. (2021). Bio-Inspired Algorithms and Its Applications for Optimization in Fuzzy Clustering. Algorithms, 14(4), 122. https://doi.org/10.3390/a14040122
10. Zheng H, Zhang T, Fang C, Zeng J, Yang X.,(2021), "Design and Implementation of Poultry Farming Information Management System Based on Cloud Database", Animals. 2021; 11(3):900. https://doi.org/10.3390/ani11030900