

Livestock Farming System for Bovine Health Monitoring using Machine Learning and IoT

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Abstract — This research presents a machine learning-based system for bovine health monitoring. The system analyzes parameters such as temperature, humidity, activity, and heart rate to predict cattle health. Random Forest is used as the primary model, and K-Means clustering is applied for pattern analysis. The system includes a web dashboard, graphical visualization, chatbot assistance, and SMS alert mechanism. It is designed to support future IoT integration.

Keywords: Machine Learning, Precision Livestock Farming, Bovine Health Monitoring, Random Forest, K-Means Clustering, IoT Integration, Flask Web Application, Predictive Analytics, Smart Agriculture

I. INTRODUCTION

Livestock farming is a critical component of the agricultural economy, especially in developing countries where dairy production is a major source of income. Ensuring the health and productivity of cattle is essential for sustainable farming.

Traditional methods of monitoring livestock health are based on visual inspection and manual observation, which are often inefficient and prone to human error. Early detection of diseases is difficult using these methods, leading to increased mortality rates and financial losses.

With advancements in Artificial Intelligence (AI) and Machine Learning (ML), automated monitoring systems have become increasingly viable. These technologies allow for the analysis of multiple health parameters simultaneously and provide accurate predictions in real time.

The objective of this project is to develop a Precision Livestock Farming System that leverages machine learning techniques to predict bovine health conditions. The system is designed to be user-friendly, efficient, and scalable, with the potential for future IoT integration for real-time data acquisition.

II. LITERATURE REVIEW

Several research studies have explored the application of technology in livestock monitoring systems. IoT-based solutions have been widely used to collect real-time data from animals using wearable sensors. However, many of these

systems lack efficient data analysis and predictive capabilities.

Previous approaches using statistical models have limitations in handling nonlinear and complex relationships between multiple parameters. Machine learning algorithms such as Random Forest, Decision Trees, and Neural Networks have shown better performance in classification tasks due to their ability to learn from data patterns.

Despite these advancements, there is still a gap in developing a fully integrated system that combines prediction, visualization, alert mechanisms, and user interaction. This project addresses these limitations by developing a complete system that integrates machine learning with a web-based interface and alert system.

III. METHODOLOGY

The proposed system is developed using a dataset stored in CSV format containing key parameters such as temperature, humidity, activity level, and heart rate. Data preprocessing techniques are applied to ensure data quality and remove inconsistencies.

The dataset is divided into training and testing sets using stratified sampling to maintain class balance. Multiple machine learning algorithms including Random Forest, Logistic Regression, and Decision Tree are implemented and evaluated based on accuracy and confusion matrix.

Random Forest is selected as the final model due to its high accuracy, robustness, and ability to handle complex feature interactions. K-Means clustering is applied to group similar data points and analyze behavioral patterns within the dataset.

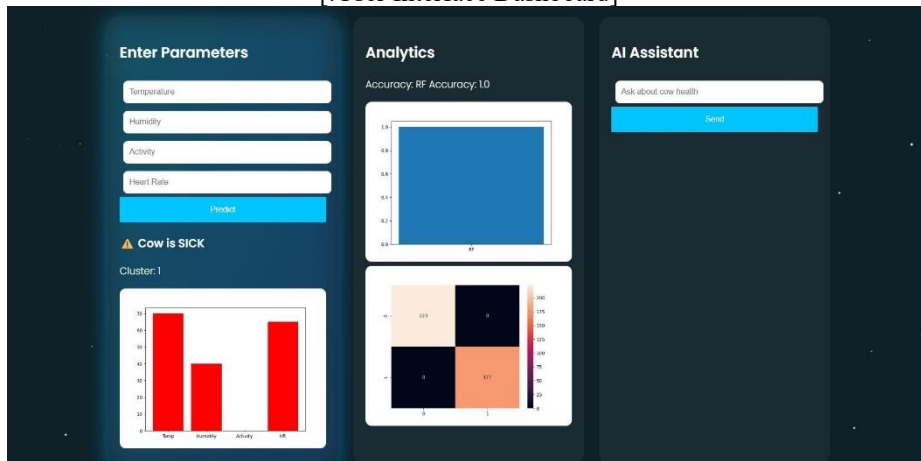
The trained model is integrated into a Flask-based web application, allowing users to input parameters through an interactive interface and receive real-time predictions.

IV. SYSTEM IMPLEMENTATION

The system is implemented using Python programming language and Flask web framework. The user interface is designed to provide a seamless and interactive experience.

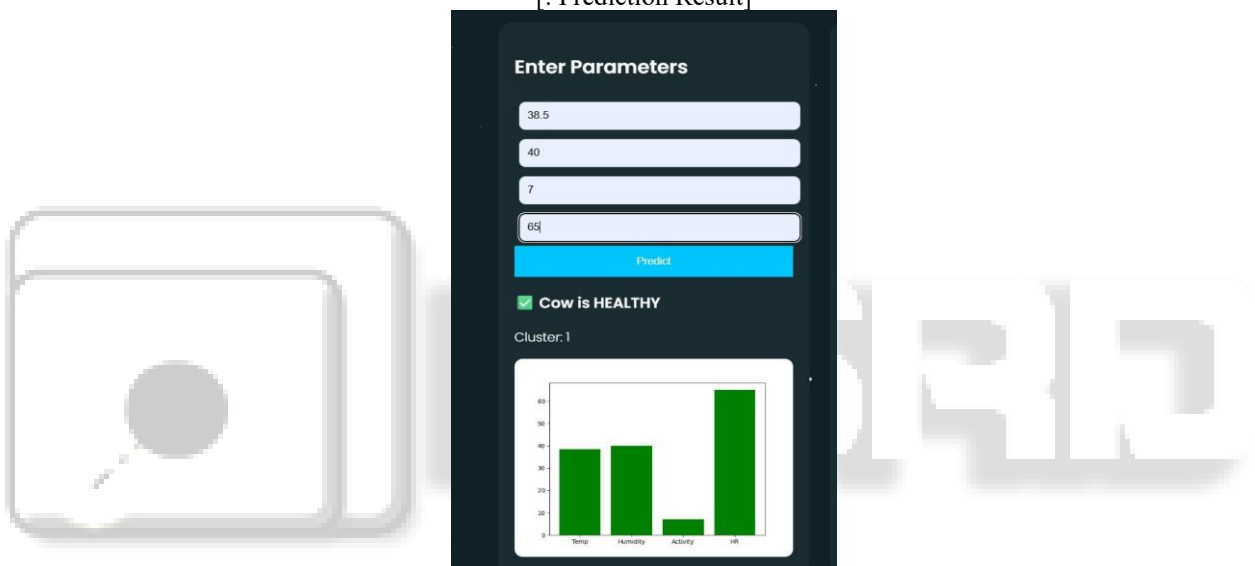
The user enters the input parameters such as temperature, humidity, activity level, and heart rate through the web interface.

[User Interface Dashboard]



Once the input is submitted, the machine learning model processes the data and generates a prediction indicating whether the cow is healthy or sick.

[Prediction Result]



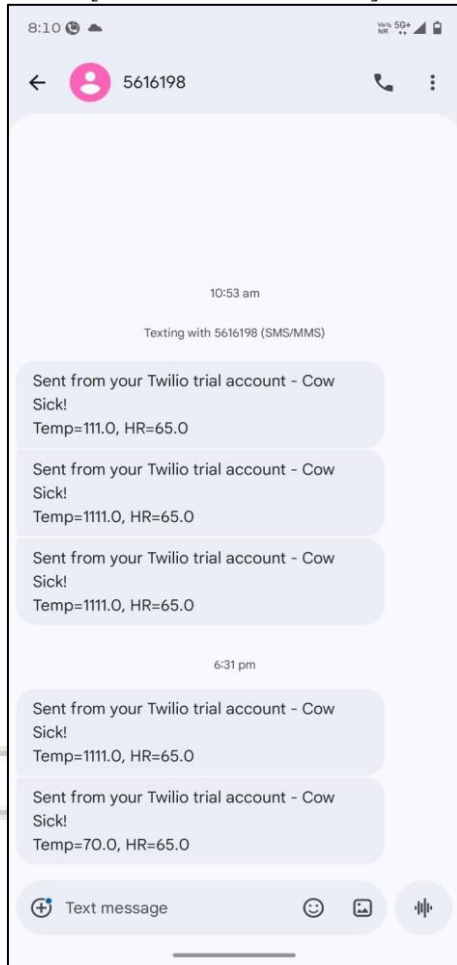
The system also generates a graphical representation of the input parameters to provide better visualization.

[GRAPH VISUALIZATION]



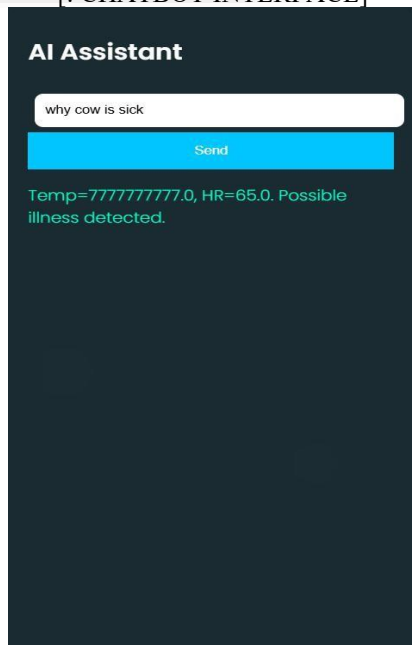
An SMS alert system is integrated using Twilio API to notify the user in case of critical health conditions.

[: SMS ALERT SYSTEM]



Additionally, a chatbot interface is implemented to assist users with basic health-related queries and provide guidance.

[: CHATBOT INTERFACE]



V. RESULTS & ANALYSIS

The performance of the machine learning model is evaluated using accuracy metrics and confusion matrix. The Random Forest model achieved high accuracy compared to other models.

The system successfully classifies cattle as healthy or sick based on the input parameters. Graphical outputs help in understanding the variation of parameters and their impact on prediction results.

The integration of SMS alerts and chatbot enhances the usability and practical application of the system.

VI. CONCLUSION

This research presents a comprehensive Precision Livestock Farming System for monitoring bovine health using machine learning techniques. The system provides accurate predictions and reduces dependency on manual monitoring.

The integration of machine learning, web technologies, and alert systems makes the solution efficient and user-friendly. Future enhancements include real-time IoT sensor integration and advanced deep learning models for improved prediction accuracy.

VII. REFERENCES

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