IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 7, April 2024

Live Stock Shelter Management System using IoT and ML

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Abstract: *In India, domestic animals are vital contributors to the country's economy, serving as a significant source of income for farmers and fulfilling various work and service roles. Keeping these animals safe and healthy in their shelters is really important because they mean a lot to farmers. Livestock farming faces big challenges, especially when it's raining, because bad weather can make the animals sick and less productive, causing problems like hoof issues.This project proposes an affordable shelter solution for Indian livestock, integrating IoT and machine learning to monitor environmental conditions. Sensors track temperature, humidity, gas levels, and soil moisture, with data analysed using the Arduino IDE and K means algorithm. Through predictive analysis, the system detects potential abnormalities like high temperatures, excessive humidity, elevated soil moisture, or the presence of harmful gases within the shelter. The predictive analysis also identifies specific stress conditions, such as heat stress from high temperatures, cold stress because, the temperature drops below the lower critical temperature, hoof diseases caused by increased soil moisture, and respiratory issues from harmful gas presence. Timely notifications are sent to user upon identifying such irregularities, enabling prompt interventions to mitigate health risks and improve herd welfare and productivity.*

Keywords: IoT, ML, Arduino, k means

I. INTRODUCTION

Cattle often experience health issues in their early stages because farmers lack awareness about preventing and detecting these problems immediately. This ignorance can be costly and harmful to the health and productivity of the animals. Therefore, it's essential to have predictive data before diagnoses. Livestock refers to domesticated animals raised on farms for various purposes such as producing wool, leather, milk, and meat. These animals, including cattle, sheep, cow and goats play a significant role in the economy. However, farmers often encounter challenges related to the health and well-being of their livestock. Monitoring the activities and health status of livestock is crucial to prevent significant losses. Traditionally, farmers have relied on manual methods to monitor their livestock, which can be unreliable and prone to human error, especially on large farms. As the number of cattle on farms continues to increase steadily, it becomes increasingly challenging to monitor the cattle shelter. Cattle, in particular, are susceptible to health issues, especially in their early stages, which can negatively impact their productivity and overall well-being. Unfortunately, many farmers lack the necessary knowledge and awareness to identify and address these problems promptly. This lack of awareness can lead to significant financial losses and harm the health of the animals. In response to these challenges, modern technology offers innovative solutions to enhance cattle shelter management. By utilizing advancements in sensor technology, and machine learning, cattle owners can now monitor key environmental parameters.

II. INTERNET OF THING (IoT):

The Internet of Things (IoT) is a network of interconnected devices, including household appliances, wearables, industrial machinery, medical devices, and environmental sensors, that collect and exchange data over the internet using sensors, software, and other technologies.IoT aims to create a vast ecosystem for physical objects to communicate, share data, and make intelligent decisions without human intervention, but raises concerns about data privacy, security,

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and interoperability standards. As IoT continues to evolve, addressing these challenges will be crucial to realizing its full potential while ensuring the integrity and security of connected systems and data.In the case of the livestock shelter monitoring system, IoT enables the integration of various sensors, such as temperature, humidity, gas, and soil moisture sensors, into a unified network. These sensors continuously gather data on environmental conditions within the shelter. Through IoT connectivity, this data is transmitted wirelessly to a central hub or server for processing and analysis. This connectivity also enables remote access to real-time information about the shelter's conditions from anywhere with an internet connection.

II. LITERATURE REVIEW

There are numerous livestock shelter management system using IoT and machine learning project that are already available. [1] Kumari and Yadav's 2018 paper presents an IoT-based smart animal health monitoring system using Raspberry Pi. The system collects real-time data from sensors like temperature and pulse rate, processed by an Arduino Uno microcontroller and Wi-Fi module. [2] This paper presents an IoT-based system for monitoring dairy cow health, combining hardware devices, cloud, and end-user application, proving effective in real-life scenarios for animal welfare and estrus cycle. [3] Seema Kumaria and Dr. Sumit Kumar Yadavb's paper explores the use of Raspberry Pi3 as a core controller for collecting and processing data on animal health status. [4] Bernard Ijesunor Akhigbe and Kamran Munir's paper explores IoT's ecosystem, architecture, and technicalities in LsM, revealing data as the primary contributor.[5] Daniel Riordan & Joseph Walsh's paper proposes a system for automatic identification of animal health events, enhancing herd health and yield, while reducing inspection and long-term healthcare costs.

III. METHODOLOGY

In this paper we are using IoT technology to monitor the livestock shelter and the K-means clustering, which is a widely used unsupervised machine learning algorithm used for partitioning a dataset into a predetermined number of clusters. This paper explains an economical shelter solution integrated with IoT and machine learning technologies to continuously monitor and manage environmental risks. Equipped with sensors such as the DHT11 for temperature and humidity, the MQ6 for gas detection, and an NPN transistor for soil moisture, the shelter monitors key environmental parameters affecting livestock welfare. The Arduino IDE software is employed to gather real-time sensor data and conduct predictive analysis using the K means machine learning algorithm, facilitated by the K means. Through predictive analysis, the system detects potential abnormalities like high temperatures, excessive humidity, elevated soil moisture, or the presence of harmful gases within the shelter. The algorithm assigns data points to the nearest cluster centroid iteratively, then recalculates the centroids based on the mean of the assigned data points. This process continues until the centroids converge, typically resulting in clusters with minimal within-cluster variance. K-means clustering is widely used for tasks such as customer segmentation, image processing, and anomaly detection.

IV. SYSTEM ARCHITECTURE

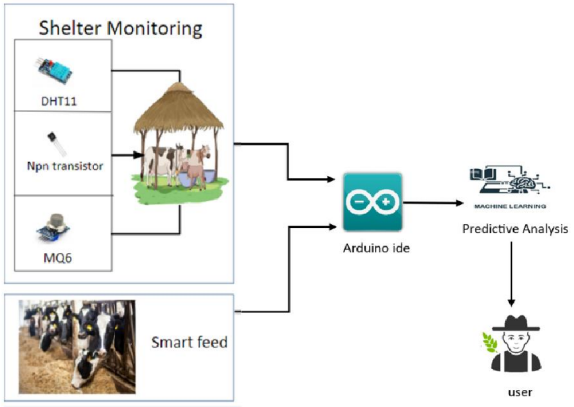

Fig 1: System Architecture

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In this Figure, using the sensing device like DHT11, MQ6, NPN which collect the data and then it sends the data collected from the sensor to the Arduino ide and then the predictive analysis is done using the machine learning algorithm called K means clustering and if any deviation occurs in the cattle's environment it will alert the user via buzzer sound and cattle taker can also monitor the environmental condition in the blynk application.

Environmental Monitoring Module

In this paper we going to monitor the cattle shelter environment using following sensors: Temperature Sensor monitors the temperature inside the cattle shelter. The optimal temperature range for maintaining cattle health within the shelter is between 30 to 40 degrees Celsius. The DHT11 sensor is utilized to monitor the temperature within the cattle shelter. Humidity Sensor measures the humidity level within the shelter It's important to maintain humidity within a healthy range of 40 to 70 percent for optimal conditions. This range ensures that the environment is neither too dry nor too humid, providing a comfortable atmosphere. The humidity level within the cattle shelter is monitored using the DHT11 sensor. Soil Moisture Sensor determines the moisture level of the soil in shelter. Excess moisture in the soil can cause health related issues among the cattle. The NPN transistor can be used to detect the presence of excess moisture in soil. Gas Sensor detects any harmful gases present in the shelter.MQ6 can be used to detect presence of noxious gases like methane, hydrogen sulphide, etc.

Data Acquisition and Analysis:

The Data Acquisition Module responsible for collecting data from an array of sensors strategically deployed within the shelter environment. These sensors, including temperature, humidity, and gas level sensors, continually gather information on crucial environmental parameters affecting the well-being of the animals. Operating in real-time, this module continuously reads the data generated by the sensors. In the Data Analysis Module employs machine learning algorithms to conduct predictive analysis based on clustered data. This module utilizes advanced analytical techniques and machine learning algorithms to improve shelter monitoring effectiveness and enhance animal well-being.

Name of the animal	Temperature		Humidity		Gas Level	
	Higher Bound	Lower bound	Higher Bound	Lower bound	Higher Bound	Lower bound
Cow	38°C	20°C	80	40	600ppm	170ppm
Goat	38°C	25°C	70	40	600ppm	170ppm
Pig	38°C	20°C	80	40	700ppm	200ppm

Table: Threshold value for each parameter

V. SMART FEEDING MECHANISM

A "smart feeding module" in this module would be a mechanism designed to dispense food to animals at predefined intervals, such as every 2 hours, using a servo motor for control. The smart feeding module would consist of a container for the food, a mechanism to dispense the food (which could be controlled by a servo motor), and electronic components for controlling the timing and operation of the system. The control system could be implemented using a microcontroller such as an Arduino. This microcontroller would be programmed to control the servo motor and manage the timing of food dispensing. The programming logic would involve setting up a timer to trigger the servo motor at predefined intervals (e.g., every 2 hours). When the timer reaches the specified interval, the microcontroller sends a signal to the servo motor to actuate, releasing a predetermined amount of food into the feeding area. The system would require a power source to operate the servo motor and the control electronics. This could be a battery or a mains power

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supply depending on the application. Once the system is assembled, it would need to be tested and calibrated to ensure that the correct amount of food is dispensed at the desired intervals.

VI. HARWARE IMPLEMENTATION

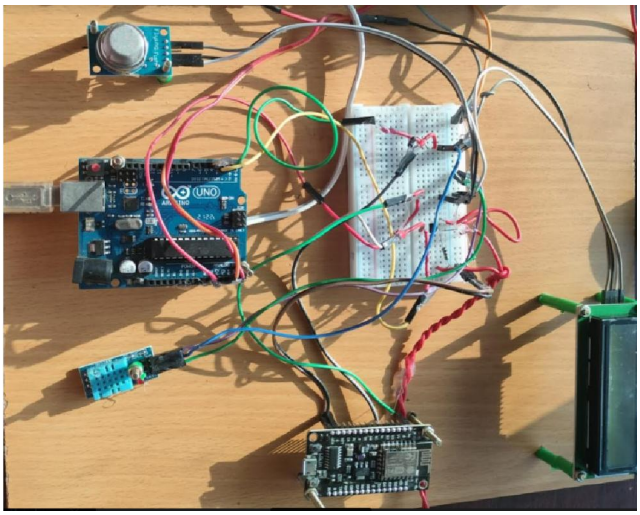

Figure 2: Hardware Installation

VII. CONCLUSION

In conclusion, the cattle shelter management system offers an effective and efficient means of ensuring optimal environmental conditions and prompt action when necessary. By combining sensor technology, and predictive analysis, the system gives the ability to the owners to actively monitor and manage their cattle shelter, improving the productivity. While the proposed system holds great promise in safeguarding livestock welfare, reducing health risks, and enhancing overall productivity, it must address the mentioned above challenges to realize its full potential. By doing so, the system can significantly contribute to the sustainability and profitability of livestock farming in India, empowering farmers to ensure the well-being of their animals and secure their livelihoods for generations to come.

VIII. FUTURE ENHANCEMENT

Future enhancements include incorporating advanced sensor technologies for comprehensive monitoring, refining predictive algorithms for more accurate forecasts, Using IoT and AI.The Automated decision-making, developing user-friendly mobile applications, fostering collaboration for innovation, and providing comprehensive training and educational programs for farmers.

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