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INTERNET OF THINGS AND SMART LIVESTOCK ARE CHANGING THE FUTURE OF AGRICULTURE

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Abstract
The aim of the study is to design a device capable of preventing livestock theft by providing early system information when things go awry. Such a device adopts a working device called RFID tag which transmits waves to the receiver (RFID reader) and each tag has a unique identity which is transmitted to the computer for further processing. Internet of Things (IoT) and smart livestock are two such technologies that are changing the future of agriculture. IoT is a system of connected devices and objects that can communicate with each other over the Internet. In the context of agriculture, IoT can be used to monitor and manage farms more efficiently, thereby increasing productivity and reducing costs. Smart livestock is the application of IoT technology in livestock farming to improve the health and welfare of animals and increase productivity. By using IoT sensors to monitor animal health, manage animal nutrition, track animal movement, and enable remote management, farmers can optimize their farms and get better results. The impact of these technologies on the future of agriculture is significant. By leveraging the power of IoT and smart livestock, farmers can reduce their environmental footprint, improve animal welfare, and increase the sustainability of their operations. Additionally, these technologies can help farmers remain competitive in a rapidly changing global market. In India, where agriculture is a major source of income for many rural communities, the use of IoT and smart livestock could have a significant impact on the livelihoods of millions of people. By adopting these technologies, Indian farmers can increase their yields, reduce wastage and improve the quality of their products. As a result, the future of agriculture in India and across the world is looking brighter than ever.
Keywords: Livestock, Wireless Sensor Network, Monitoring, RFID, Socket Programming

I. Introduction

India is a country that is rich in a variety of plants and animals. Animals can be easily found, no wonder the type of work that many people are involved in. People in this country are farming and raising livestock. The animals that are kept heavily in most parts of India are cows, buffaloes and goats, their model of keeping is keeping the animal in a certain area and then the owner can have direct control over the livestock. Usually, these animals are kept in areas that are open, this gives rise to a new problem, namely livestock theft, which can cause huge losses to ranchers and farmers. goes.

To prevent theft, keep an eye on livestock owners directly. When the number of livestock is still low, of course it is possible the activity still feels light, but naturally the number of animals will increase daily. Of course, supervise many livestock (tens or hundreds) it is quite a difficult activity as many livestock require a large field of view while the field of view of the human eye is limited and count the total farm animals (to ensure that nothing is missing) certainly have boring jobs. Also, it is impossible for the owners to supervise the animals where the cattle are all day, given that they have other potentially unavoidable activities.

Based on the above description, the researchers attempted to create an application that involves the use of computers and wireless sensor networks to detect the status of livestock (whether they are still in the designated area or not). And send information to the animal parents. With this application the livestock no longer needs to be directly supervised because the owner supervision process can be done elsewhere. The application will inform the status of the farm animals (as visual) and will send an alert if the livestock being monitored has left the specified area. With this alert, the owner can make the

animal aware of the attempted theft so act quickly so the theft is less likely. Database via Zigbee wireless communication based on room light controlling and scheduling system design. The aim of this study is to design.

Internet of Things (IoT) refers to a system of connected devices and objects that can communicate with each other over the Internet. This technology allows for real-time monitoring, data collection, and remote control of physical equipment and systems. In the context of smart livestock, IoT can be used to monitor and manage livestock farms more efficiently. Smart livestock is the application of IoT technology in livestock farming to improve the health and welfare of animals and increase productivity. In India, where livestock farming is a major source of income for many rural communities, the use of IoT in livestock farming could have a significant impact on the livelihoods of millions of people.

1.1 Research Problem Formulation

1. Some of the ways IoT is being used in smart livestock in India include: Monitoring animal health: IoT sensors can be used to monitor the health of individual animals and detect any signs of illness or disease early. This can help farmers take timely action to prevent the spread of disease and reduce the risk of livestock loss.
2. Managing livestock nutrition: IoT sensors can be used to monitor livestock's feed and water intake, which can help farmers ensure they're getting the right nutrients and more or less Avoid feeding
3. Animal movement tracking: IoT sensors can be used to track animal movement within a farm, helping farmers identify any areas of congestion or under-utilization and optimize space use Can do.
4. Remote management: IoT technology enables farmers to remotely monitor and control various aspects of their farms, such as temperature and humidity levels, feeding schedules, and water supply. This can save time and reduce labor costs, as well as improve the overall efficiency of the farm.
5. Overall, the use of IoT technology in smart livestock in India has the potential to transform the way livestock is farmed, leading to higher productivity, better animal health and better livelihoods for farmers.

II. Literature

India is one of the largest producers of milk in the world, with the dairy sector playing a significant role in the country's economy. Animal farming in India can become more efficient and sustainable with the help of IoT. In this literature review, we will explore the current status of IoT-based animal husbandry in India.

(A). IoT based smart farming for livestock management in India: A review by Singh et al. (2020). This review article provides an overview of IoT-based smart agriculture systems for livestock management in India. The authors discuss the various components of an IoT-based system, including sensors, communication networks, and data analytics, and how they can be used to monitor and manage livestock. They also discuss the challenges and opportunities for implementing IoT-based systems in India, including issues related to cost, infrastructure, and suser adoption.

(B). Smart Agriculture for Livestock Management using IoT in India by Gupta et al. (2020), This research article describes the development of an IoT-based system for livestock management in India. The system includes sensors to monitor cattle behavior, health and milk production, as well as a mobile application for farmers to access the data collected by the sensors. The authors conducted a pilot study to test the system and found that it improved the efficiency and productivity of animal husbandry. M. Geeta and N. "IoT-Based Livestock Management System for Dairy Cattle Reproductive Cycle Prediction" by Balaji. This paper presents an IoT-based livestock management system for predicting the reproductive cycle of dairy cattle. The authors use machine learning algorithms to analyses data collected from IoT sensors and predict the optimal time for breeding, thereby improving herd fertility and productivity.

(C). IoT based smart farming for sustainable agriculture in India: A review by Senthil Kumar et al. (2019), This review article provides an overview of IoT-based smart agriculture systems for sustainable agriculture in India, including cattle farming. The authors discuss the benefits of using IoT in agriculture, including improved efficiency, reduced costs, and increased sustainability. They also discuss the challenges and opportunities of implementing IoT-based systems in India, including issues related to data privacy and security.
(D). An IoT based smart farming system for milk production in India by Manikandan et al. (2019), This research article describes the development of an IoT-based system for milk production in India. The system includes sensors to monitor milk production, as well as a mobile application for farmers to access the data collected by the sensors. The authors conducted a pilot study to test the system and found that it improved the efficiency and productivity of milk production.
Overall, the literature suggests that IoT-based cattle farming has the potential to improve the efficiency, productivity, and sustainability of animal husbandry in India. However, there are still some challenges to be resolved, including issues related to cost, infrastructure and user adoption. The literature review highlights the potential of IoT technology to transform the future of animal husbandry by improving efficiency, sustainability and profitability. The use of IoT-enabled precision livestock farming can lead to real-time monitoring of animal health and behavior, optimized resource management, and improved productivity. The integration of machine learning algorithms and big data analytics could also lead to more accurate predictions of breeding cycles and the overall health and well-being of herds. [1, 2]

III. Material and Methods

The research will be carried out in the animal husbandry sector of Jaipur district of Rajasthan. Each object to be tracked, that is each cow, will be paired/attached with an RFID tag. This RFID tag will be read by the RFID reader (when the tag is within the RFID reader's reading range). When the tag is read by the RFID reader it will store the tag's data, in addition each tag will have a number unique as an identifier and differentiator for each RFID tag, this RFID reader will be connected to the arduino and Use of wi-Fi Shield transmission medium. The Wi-Fi Shield will act as a Wi-Fi client, which is in charge of sending data to the access point and later forwarding it to computers for display on monitors to make it easier for users to monitor livestock status.
The data is in the form of location conditions and information about the animals used for this research will be taken from farms in the Jaipur district of Rajasthan. This is the phase of gathering architectural information and data. The process is more of a literature study that refers to references domestically and abroad. The evaluation leads to the collection of information about sensor characteristics that it intends to further relate to the study of the data.[3],[4].

3.1 Data Analysis

Design phase at this stage, the researcher made direct observations Gabduram Meena, a cattle herder from Jaipur, used to frequently attend cattle fairs, but when the pandemic struck in 2020, the fairs were closed and the laws on animal trade tightened. Meena found help on the web -- an app-based cattle marketplace from a company called MoooFarm. Meanwhile, Krishna Ji, a cattle researcher in Gurugram, is trying to use the Animal app to sell his cow. Many of their peers use apps to buy and sell livestock at a good price, and they have received many inquiries. Meena and Krishna are two of those modern-day smartphone-savvy ranchers who are using the app to manage livestock. Turning to the web. According to Jitesh Arora, co-founder and chief technology officer of MoooFarm, the livestock management industry is a $70-80 billion opportunity, were cattle discovery and pricing present challenges for farmers. This has also drawn investor interest. In July 2021, Animal raised $14 million (roughly Rs. 102.62 crores) in Series B funding. In January this year, MoooFarm raised $2.4 million (₹18 crore) in seed funding. The government, too, has launched apps such as e-Gopala in August 2020

to help farmers choose better quality livestock and improve dairy production. “India is one of the largest milk and dairy producing countries in the world. But despite its size, India's dairy industry is still fragmented," said Anand Ramanathan, partner, Deloitte India. He pointed out that the digital marketplace enables farmers to physically verify cattle breeds and milk production claims for startups, technology implementation doesn't end with building an online marketplace. MoFarm verifies each cattle entry on its platform, Arora said. His company started with the classifieds model, where farmers could post an ad. post and sell cattle. LT has since shifted to an inventory model, procuring cattle using a mix of human intervention and technology. Arora said MoooFarm uses video and image-based machine learning (ML) is running a pilot to use the model to identify which cattle to buy and which to discard. It is working with ML to identify cows before the pandemic. It has developed a Developed an algorithm that could use smartphone cameras to distinguish one cow from another. Arora said the project was put on hold due to the pandemic, but has resumed. It is currently in the development stage. Maharashtra's Chitale Dairy is using Radio Frequency Identification (RFID) tags to identify thousands of animals on its many farms. It has also moved its entire application stack to the cloud. It has improved access to real-time information about animals, their health as well as milk processing plants. “We are using AI/ML models to optimize performance in our milk processing plant. The model has been programmed in the plant to detect and alert us to any deviation from the norm, said Vishwas Chitale, CEO and CTO of Chitale Dairy. Bengaluru-based Hydrogreens Agri Solutions, on the other hand, uses IoT sensors to monitor temperature and humidity levels in warehouses and control water and air flow to provide high-quality fodder for farmers. “Farmers have increased the yield by 2-3 litres by using green fodder,” said Vasant Madhav Kamath, founder of Hydrogreens. Mooo Farm also uses ML for cattle pricing. Arora said its algorithms can tell farmers the best prices for their livestock based on their location and time of year. He added that cattle trading has seen a 10x revenue growth in 2021, and is a major source of revenue for MoooFarm with 4-5% margin per transaction. The startup claims to have over 1.5 million users right now, even though it is focusing on only three markets - Rajasthan, Punjab and Haryana. Animal, on the other hand, claims to have reached out to over 8 million dairy farmers and facilitated the sale of 850,000 cattle in the past two years. According to Ramanathan, the growth in this sector is a result of increasing internet connectivity. "The farmer segment owning 10-30 cattle is growing rapidly and needs access to these digital apps to improve farm management practices and quality and transport services, he said. MoooFarm claims that it is handling 1,000 calls for veterinary services every day. MoooFarm also uses ML for cattle pricing. Arora said its algorithms can tell farmers the best prices for their livestock based on their location and time of year. He said that the cattle business has seen a 10x revenue growth in 2021, and interestingly, despite investments of hundreds of crores of rupees, Ramanathan believes that livestock management apps are still at a nascent stage. The rate of adoption of such technologies is low compared to the size of the overall cattle industry, he added. However, he added that the ease of use and availability in local languages associated with most of these solutions will help increase adoption. Based on the observations obtained the researcher will design a livestock monitoring system as shown below. Planning Phase, at this stage, the researcher is planning to build a monitoring system for the movement of livestock using wireless sensor networks. Implementation phase, at this stage, the researcher will create a monitoring system for the movement of livestock using a sensor network and simple wireless for testing. System test phase, the author uses the white-box test method in the system research created by the author to implement, to prove that the created sensor system achieves the research objectives, namely: setting up a wireless sensor network system, some cows Installing the RFID sensor on monitor its position, installing the livestock monitoring application on the owner's computer, comparing the visualization results with the application installed on the owner's computer, made the real position of the cow to test the success rate of the wireless sensor, Evaluation phase, this phase will be a very important phase to determine whether the system created can be subsequently applied to animal husbandry in general. [5,6,7].

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Efforts to increase the productivity and quality of livestock products are based on several factors. These include global climate change, degradation of agricultural/livestock land and lifestyle demands for the consumption of quality livestock products. As well as the population which increases every year, it will automatically increase the demand for food for livestock products. On the other hand, this situation is a challenge that creates problems and constraints for farmers and the livestock industry. That is, the inability to achieve a financial balance between input costs, production operating costs and the low selling price of the product. So strong is the competition between independent farmers and livestock companies to keep the business going by increasing efficiency. Meanwhile, those who cannot afford it will lose money and go bankrupt. Therefore, it is necessary to apply IoT (Internet of Thing) in livestock business management by using internet systems and other devices. To improve business efficiency, avoid budget/financial deficits, and be able to sustain managed businesses.[7][8][9]
This model includes hardware and software. Hardware consists of sensors for data collection or using cameras in the field, data input devices, data senders to data centers, data centers and data processors, data outputs that can be accessed on a PC, laptop or mobile phone (Figure 1) . .

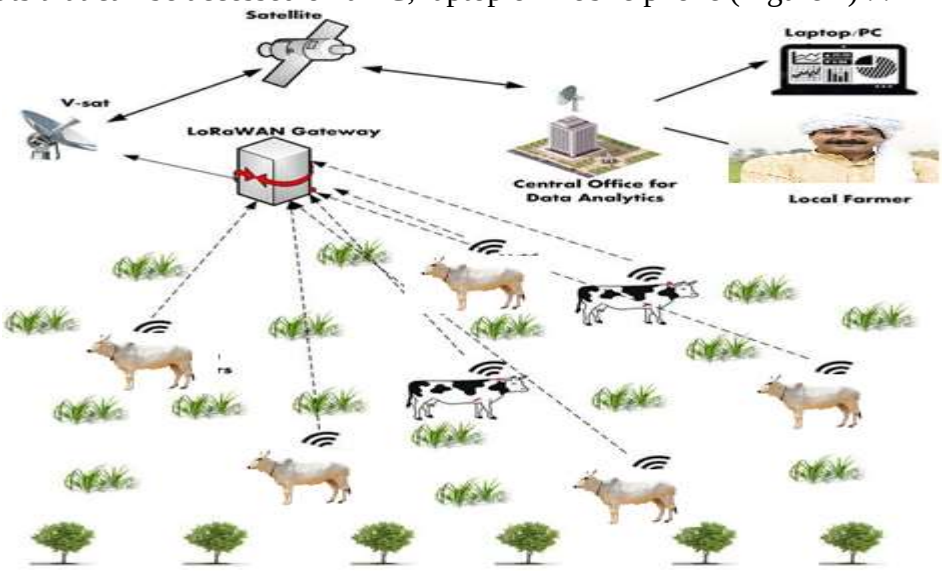

Figure 1. IoT system in animal husbandry

The above image shows the IoT working system in Smart Cattle Management. Cattlemen are equipped with two types of equipment, namely sensors that record the position of cows and equipment to identify cows (such as chips for cow numbers). The sensor is equipped with a data message sender and cow identification, which can be received by GPRS, then forwarded to the internet system (cloud) which is then received online by laptop or cell phone (such as Android system) May go.
Meanwhile, software is used to capture and process data with outputs as required, for example numbers, averages, rankings, time limits, etc. so that decisions can be made quickly and accurately.
Data is input into the system according to the needs and objectives of livestock management. For example, a complete livestock management system needs to include basic data: breed, sex, age, feed and feed management of livestock. While the data to be analysed may include nutritional status of livestock, body condition score (BCS), reproductive status, marital success, birth weight, weaning weight, growth, body composition, body colour and health status. [10], [11].

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Figure 2. Illustration of monitoring animal grazing conditions in a grassland

In addition, Figure-2 is an example of grassland animal grazing status monitoring issued from the perspective of a pasture that is controlled for its survival, condition, and health using heat sensors, interactions, and activities. The results of motion sensor readings equipped with temporary storage traps and transmitters are sent to the receiver or receiver to be forwarded to the server to be directly stored or read by a computer or laptop or mobile device. So it is in this reader that we analyse and monitor livestock, so that we can take strategic steps to determine what treatment should be given to individual livestock.

"Many challenges to the welfare of animals in the world – including lack of supervision, provision of feed, risk of predation, and long-distance transport for slaughter – arise from constraints imposed by the harsh climatic and geographic conditions in which they are often reared. goes.

3.3. Scope of use if IoT in Smart Farming

Smart farming is the application of all technologies or creations in the livestock sector to enhance business efficiency and effectiveness, so as to achieve higher income and profit than the application of new technology or creations. IoT is the main supporting technology in smart farming application in livestock sector which is very helpful in monitoring, documenting and data analysis. Then decisions and action can be taken immediately by the officials without waiting for data collection, then tabulation and data analysis which takes very long time and requires additional labour which is quite tiring.

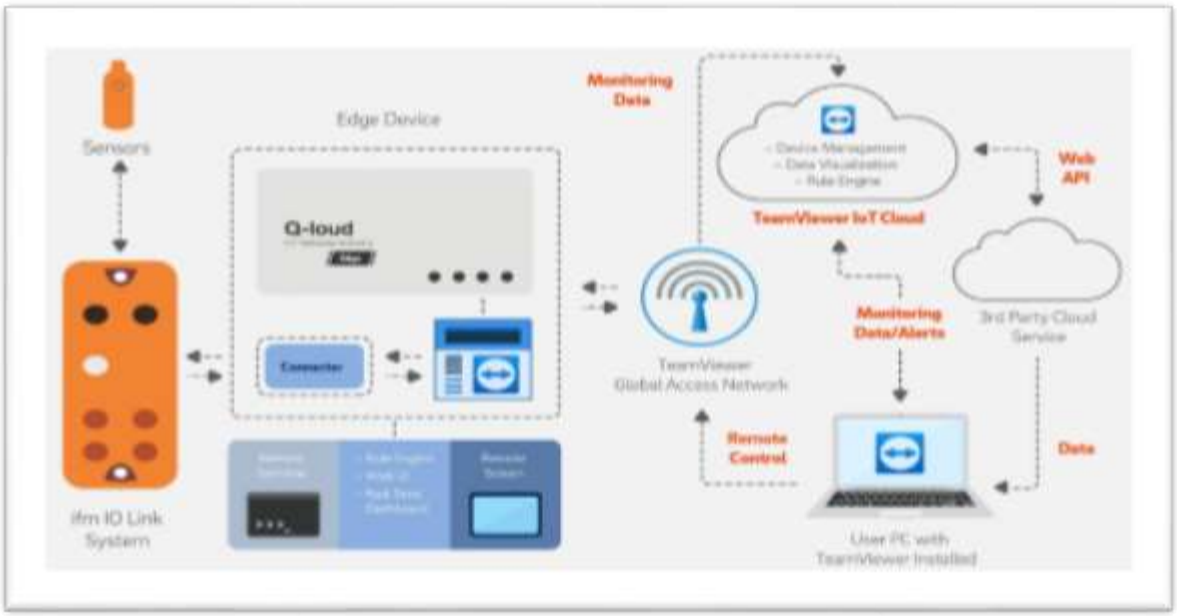

Figure 3. IoT in Smart Dairy Farms

According to Phil Dawsey of UB Precision AG Biotech Company, benefits gained after implementing IoT on dairy farms include: [12]

1. Monitoring and recording of livestock breeding. By knowing the breeding conditions and its operation, breeders will get certainty of fertility and will be able to increase the income of the farmer;
2. Monitoring of feeding behaviour in animals. Using IoT, farmers can remotely monitor how active the cattle are eating, the status of the feed, using an application installed on their cell phone or computer, so that they can be easily controlled when the animal runs out of feed. Can go There are livestock that are less active in eating;
3. Monitor livestock health. IoT also makes it possible to remotely monitor the health status of livestock based on physical or physiological characteristics of the livestock. At the same time (real time) breeders can directly detect the general health status of each animal, so that they can carry out further handling and inspection immediately;
4. Monitoring of milk production. Milk production, which is the main daily product of dairy farming, can be recorded every day and the data can be automatically analysed by this system, so that the farmer can monitor the normality of milk production for each individual animal. can;
5. Tracking the location of livestock. IoT can also be designed to track the condition of livestock individually so that they can easily administer treatments for animals that need to be handled, for example cattle that are about to give birth, cattle in heat, Livestock with health problems, etc.

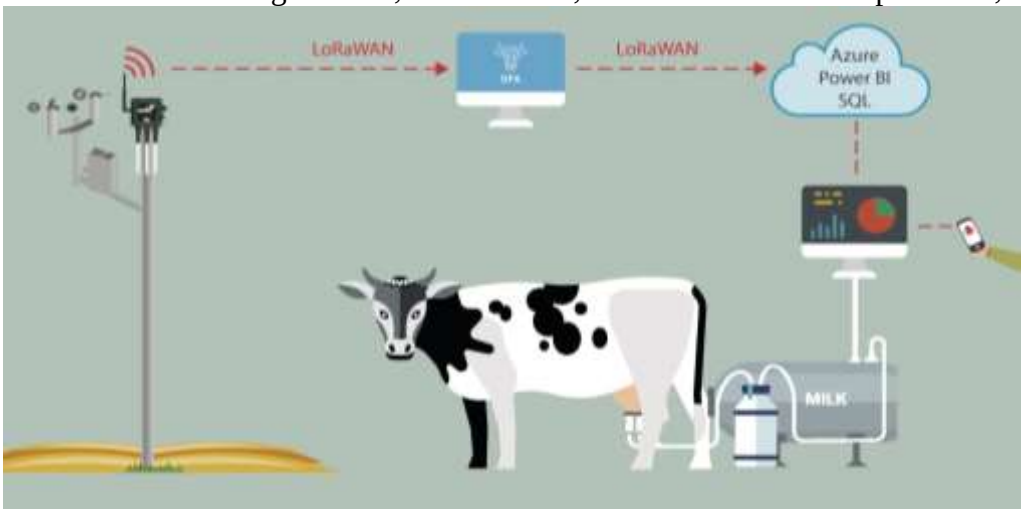

Figure 4. Application of IoT to control milk production in dairy cows

The use of IoT in the practice of Smart Dairy Farming provides information collection services with an accuracy of 92 - 97% about ambient temperature, humidity, air pressure, cow condition and many other parameters, which can obviously increase milk production. are capable of. 18 percent. This is a very significant increase in business efficiency so that it can support the optimization and sustainability of business.

3.4 Fertility Cycle Management

The Internet of Things is quite efficient during the reproductive cycle of animals. IoT devices can inform farmers when animals are in heat and it goes into labour which makes the breeding cycle of animals safer for farmers.

With the help of IoT enabled wearable devices, farmers can eliminate the manual process through continuous monitoring of livestock to check the health of the cow till the birth of the calf. In the case of farmed cows, an advanced system enabled with IoT devices could help farmers restrict sick animals to corrals away from the rest of the herd. IoT enabled connected device to assist farmer in creating virtual fencing through downhill for artificial insemination.

These studies demonstrate the potential of IoT technology for reproductive cycle management in animal husbandry. The use of IoT sensors and machine learning algorithms allows accurate prediction

and monitoring of oestrous cycles, which can help farmers optimize breeding and increase their overall herd fertility. The technology also allows for real-time monitoring of the cow's health status, which can be used to detect potential health issues affecting fertility. With continued advances in IoT technology, we can expect to see even more innovative and effective applications of IoT in breeding cycle management and other areas of animal husbandry in the future. [10,11,12].

3.5 Predictive Algorithms

The process of using predictive algorithms typically involves several steps:

Data Collection: Historical data relevant to the prediction task is collected and organized. This data may include various attributes or features that describe the past events or situations being studied.

Data Pre-processing: The collected data is pre-processed to handle missing values, outliers, and inconsistencies. This step ensures that the data is in a suitable format for analysis.

Feature Selection/Engineering: Relevant features are selected or engineered from the available data. Feature selection involves identifying the most informative attributes, while feature engineering may involve creating new variables or transforming existing ones to improve prediction accuracy.

Model Training: Predictive algorithms are trained using the prepared historical data. The algorithms learn from the patterns and relationships present in the data to build a model that can make predictions.

Model Evaluation: The trained model is evaluated to assess its performance. This is done by using a separate dataset called a validation set or by using techniques such as cross-validation. The evaluation metrics used may depend on the specific prediction task, such as accuracy, precision, recall, or mean squared error.

Prediction: Once the model is trained and validated, it can be used to make predictions on new, unseen data. The historical patterns and relationships captured by the model are utilized to forecast future outcomes based on the input data.

Predictive algorithms applied to proposed domains and prediction tasks.

Start

Step 1: Data Collection

Gather relevant historical data

Organize the collected data

Step 2: Data Pre-processing

Handle missing values, outliers, and inconsistencies

Normalize or scale the data if required

Step 3: Feature Selection/Engineering

Select informative features from the data

Engineer new features if necessary

Step 4: Model Training

Choose an appropriate predictive algorithm

Split the data into training and validation sets

Train the algorithm using the training set

Step 5: Model Evaluation

Evaluate the performance of the trained model

Use a validation set or cross-validation techniques

Calculate evaluation metrics (e.g., accuracy, precision, recall, etc.)

Step 6: Prediction

Apply the trained model to new, unseen data

Use the historical patterns and relationships captured by the model

Generate predictions or forecasts for future outcomes

End

This proposed step of algorithm represents a generalized process, and the specific steps involved may vary depending on the prediction task, the complexity of the data, and the chosen predictive algorithm.

IV. Conclusion

The future of agriculture is smart: The development and implementation of Internet of Things (IoT) technology in animal husbandry has brought about significant changes in the industry. Smart livestock farming using IoT is becoming increasingly popular and is expected to change the future of animal husbandry. Using IoT technology, farmers can remotely and in real time monitor the health and behaviour of their livestock, thereby detecting potential health problems early and enabling them to take necessary action immediately.

Furthermore, IoT-enabled precision livestock farming allows farmers to manage their resources efficiently, resulting in cost savings and increased productivity. Data collected from IoT sensors can be used to optimize feed and water consumption, monitor growth rates, and manage herd health, which ultimately improves the quality of products produced.

Data collected through IoT connected devices is vital for farmers by which they can connect their farm through internet round the clock. Farmers are thus able to observe the health, feeding practices, breeding cycles and location of the animals. They can keep an eye on the movement of animals as well as on grazing herds. The Internet of Things is the foundation of smart livestock farming. In addition, it is important to automate each task and to detect and notify individual incidents. This requires automatic personal identification and biometric information in cattle and pigs. Products and services have already been introduced, and a number of sensors are used to detect and notify of different events. If sensors are required for every service, it is stressful for the animals. Therefore, reducing the number of non-contact sensing technologies and sensors is essential in the future. In order to automatically identify individuals and understand biometric information, it will be necessary to improve image recognition technology.

Finally, the Internet of Things and smart livestock are revolutionizing cattle farming by making it more efficient, sustainable and profitable. With continued advances in technology, the future of animal husbandry is promising, and we can expect to see even more innovative applications of IoT in the industry in the years to come.

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