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Artificial Neural Networks (ANNs) in Livestock Production

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Abstract

An area of artificial intelligence research known as "artificial neural networks" (ANNs) is the study of machine learning. Artificial neural networks are typically utilised in engineering, economics, or medicine; nonetheless, their use in food processing or animal management is conceivable. Artificial neural networks, for instance, can be used to accurately forecast milk production per 305-day lactation, per hectare of pasture, per cow, or per farm, as well as the identification or prediction of mastitis. Mastitis can be detected automatically by utilising a system that combines sensor measures of milk yield, milk temperature, and milk's electrical conductivity. The ANN technology has contributed immensely in disease diagnosis, field of animal reproduction, animal nutrition, animal behaviour as well as in poultry industry.

Keywords: ANN, livestock, production, reproduction,

Introduction

The objective of ANN research is to create machine learning systems based on a biological model of the brain, more specifically the bioelectrical activity of the brain's neurons. Early livestock productivity forecasting is crucial for strategic farm management decisions that result in cost-effective and profitable livestock production. Therefore, in order to determine the accuracy of prediction, researchers created and applied several mathematical algorithms. However, it is a difficult task to accurately anticipate livestock output due to the complexity of data sets and high-order non-linearity among the individuals regarding various production features. Due to its reliable and efficient management of the complexity of huge datasets, the artificial neural network (ANN), a machine learning programme, acquired appeal in the field of animal research in this context. In the field of livestock and related fields, artificial neural networks have a wide range of uses, including the prediction of milk production, the prediction of bull breeding values, the prediction of mastitis and lameness, the detection of estrous, the prediction of mastitis and lameness, the detection of cows with difficulties undergoing artificial insemination, the prediction of in-vitro fertilisation success rates, the prediction of manure nutrient content, and the prediction of volatile fatty acids in the rumen of dairy animals.

Basics of ANN

The majority of neural networks are computer simulations that are done on standard computers. The neural network is nothing more than a collection of neurons connected together, exactly like in the brain, with the output from one neuron feeding into the input of others until the desired result is obtained (Rosenblatt, 1961). Various neural network architectures have been created over time. The initial ANN design was a feed forward neural network. Information in this network only travels in one direction, from the input neurons through any hidden neurons to the output nodes. The network doesn't contain any loops or cycles. The

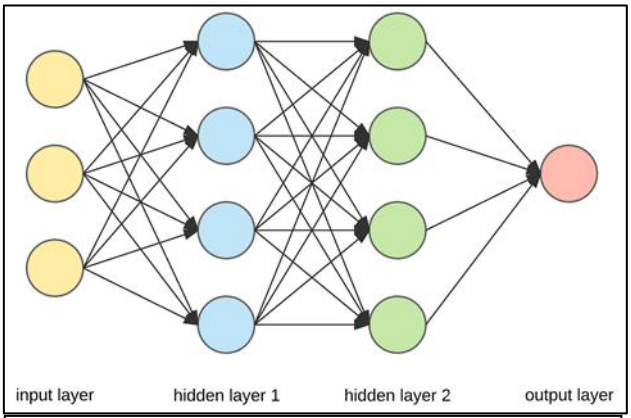

Fig.1. Input and output training pattern for the ANN

most basic form of feed-forward ANN is the perceptron (a linear classifier). There is an input layer of source nodes in these networks that projects onto the following layer of neurons. A response is produced by the output layer in response to an input. One or more hidden layers—intermediate layers of neurons—exist between the network's output and external input. Figure 1 shows the input and output training pattern for the ANN.

Application of ANN in forecasting milk production

Dairy animals' milk production, which is typically depicted as a lactation curve, follows a non-linear pattern; as a result, the non-linear function should be used to forecast lactation milk output. The limitations of current approaches for projecting the milk yield from dairy animals include their inability to account for non-linearity and their failure to take into account the interdependence of the independent variables they use. Artificial neural networks can be used to forecast the lifetime milk production of dairy cows.

Application of ANN in forecasting occurrence of mastitis

In the area of prediction and classification problems, Neural Netwrok (NN) outperforms conventional statistical methods. Therefore, it is suggested that artificial intelligence approaches be used to create a model for mastitis detection. Application of a NN employing electrical conductivity (EC), milk production rate, milk flow, and days in milk to create a mastitis detection model with adequate accuracy has been carried out. With such a management tool, mastitis might be detected early and with the least amount of manpower.

Application of ANN in disease diagnosis

Animals suffering from numerous diseases release a peculiar, offensive aroma from their skin, excrement, breath, mouth, urine, milk, and semen. These odours are generated in the form of volatile organic compounds (VOCs) in a variety of illness situations. In numerous illness diagnosis applications in human medicine, many electronic nasal devices based on diverse technologies and chemical detection sensors have been deployed. The creation of a sensor-based portable electronic nose (e-nose) might be able to recognise different volatile organic chemicals emitted when agricultural animals are ill. Since different volatile substances emitted by farm animals, especially during various disease circumstances, can be identified using the idea of sensor-based electronic nose (e-nose) mechanisms, farmers would be able to make the best decisions for their operations. This will allow farmers to make the right decisions for overall profitable dairy farming.

Application of ANN in animal reproduction

Using the input variables average calving interval, cow body condition index, lactation number, pregnancy length, sex of calf from previous calving, and cow age, the ANN and multivariate adaptive regression spline were more accurate in detecting cows with artificial insemination difficulties. With the use of phenotypic characteristics and the potential for fertilisation of frozen spermatozoa from cattle and buffalo, the ANN may be able to forecast the generation of semen in rams. Recently, attempts have been made to predict the success rate of the treatment in human patients undergoing fertility treatment for a baby using IVF data, which has opened up a new vista in the cattle sector.

Application of ANN in animal nutrition

Despite an expanding livestock population, there is a growing gap between the amount of feed and fodder needed and what is available. This is partly because fodder production is taking place in fewer areas and crop leftovers are less readily available as fodder. The use of computer programming is essential for improving the management of animal dung, waste, and feed. With a greater coefficient of determination (R2), modelling efficiency statistics, and a lower mean squared error of prediction, artificial neural networks can be used to estimate the amount of nutrients in dairy manure as well as the proportions of various volatile fatty acids in the rumen of dairy animals.

Application of ANN in poultry industry

The ANN model might be a useful tool for identifying trends in data and properly forecasting the egg output of laying hens based on age research. On an industrial scale, an artificial neural network (ANN) was utilised to forecast the final temperature of chicken carcasses. The prediction of plasma hormones and liver enzymes in grill chicken was made by Moharrery and Kargar (2007) using six diet parameters as input variables. They discovered that grill chickens fed diets on the known range of the energy and protein concentration most effectively identify

performance, plasma hormones, or liver enzymes. When adequate data is available, it can also be used for management of breeders, broiler breeder serological interpretation, and hatcheries.

Conclusion

Health monitoring, early disease diagnosis, and general animal management are crucial components for precision animal farming and are all made possible by artificial intelligence. ANN could therefore be used as efficient forecasting and management information systems on the occurrence of diseases, particularly of epidemic and endemic nature, as well as effective and integrated surveillance, vigilance, prevention, and control mechanisms for better productivity and safety of farm animals.

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