Upgrading Animal Farming using Machine Learning and Sensors

Sanskar Agrawal

Date - 1st September of 2022

Abstract
This report is based on the problems faced in animal farming by farmers, which are basically feed and disease management, with use of sensors to collect data then analysing them with the help of machine learning and predict the result to handle the situation more economically and take safety measures at the right time.

1.0 Introduction

The consumption of animal and animal related products has been increasing constantly and it is estimated that the farmers need to increase their production by 70% and meet the global demand of meat and animal products.

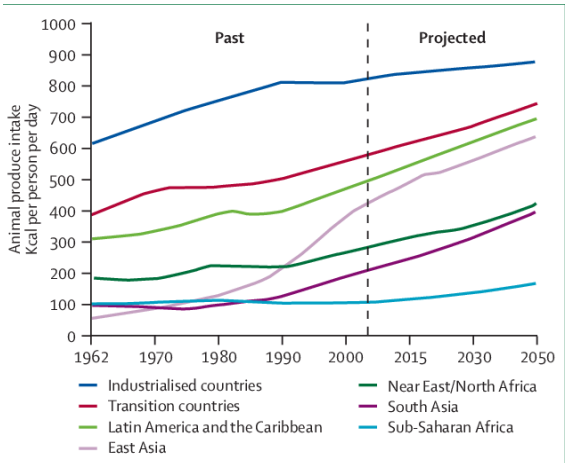


Fig1: Showing trends of consumption of animal products

Since land and other natural resources are limited, to meet their growing demands will need more effective ways for growing more animals per hectare. This implies that the manual process of animal farming is no longer efficient. This leads to the need for improved techniques, with the help of machine learning, artificial intelligence, sensors, and cloud computing, we can achieve this as these technologies are already transforming several industries.

Two major problems faced by every farmer are feed and disease management. As farmers need to assess feed rates, identify and treat disease, this lowers their production as it restrain the number of animals that can be cared for. If fewer people can take care of a larger number of animals, this removes the bottleneck in increasing the production as well as profits.

To apply this we need a large volume of datasets, some of them are air quality data, local weather data, voice signals of animals. Various sensors can help in collecting this data and stirring this data remotely and then using machine learning to analyse and predict results. Sensors along with ML models to evaluate animal behaviours. 3 axis accelerometer, magnetometer, optical sensors along with ML modelscan help us classify and predict animal behaviour.

This systems has two benefits:

1. Enable fewer frames to take care of more animals, in ture lowering production cost.
2. Such a system can notify farmers about the possibilities of disease, even during the preclinical stage. This helps in taking timely action and preventing catastrophic losses.

2.0 Customer Needs Assessment

Problems like disease and feed management need significant human intervention, which restricts the number of animals for farmers. To deal with this problem, farmers can either increase human resources, which is not economical for them or use technologies like AI and ML that help them in monitoring animals and can increase their production.

3.0 Target specification

1. **Disease management:-** Developing a system that can notify farmers about the disease in their preclinical stage and hence can take timely action and prevent from the spread of disease. Recording of the changes in environment, body weight, milk and egg production and then through machine learning models analysing them to predict results.
2. **Feed management:-** System that can calculate feed efficiency, for this we need to record data of the amount of feed intake, weight gained by the animal, the amount of milk and egg produced wherever applicable.

4.0 External search on use of Machine learning in Animal Farming

Various research papers have been published on how machine learning can help in increasing the production and make it more economical for the farmers. Various sensors can help in recording specific data for a certain disease, like coccidiosis, which is a intestinal infection that spreads quickly among birds and can be identified by constantly monitoring air quality, that is concentration of volatile organic compounds increases, as the number of infected birds

increases. Another example is that the cows affected by mastitis, an udder disease, ends up in producing low quality and quantity milk, moer examples are listed below

Disease	Algorithm(s)	Parameter detected
Mastitis	Bag of Words (BoW), Gradient Boosted Trees (GBT)	Somatic cell Count (SSC), Electrical Conductivity (EC)
Lameness	Fog computing, Classification and regressive tree (CART) XGBoost algorithm	Leg movement, Neck movement and Image/Video data
Postpartum disease	Random Forest Algorithm (RFA)	Lactose yield, Protein production, Milk yield
Coccidiosis	Principal Component Analysis (PCA)	Volatile Organic Compounds (VOC) in air
African Swine Flu	Optical flow algorithm	Mobility, speed, direction

Table 1

5.0 Benchmarking

Comparison between services with or without machine learning in animal

S.no.	Services	Without machine learning	With machine learning
1.	Human resources	Need more number of people or reduces efficiency of their to manga certain number animal	Need much less people, reduces the workload of farmer and allows them to work more efficiently

2.	Disease management	A farmer may predict possibilities of disease, but a small error can lead to spreading of disease	Will give almost accurate prediction through daily monitoring and will notify farmer about the abnormalities and hence can take timely action and prevent from spreading of disease
3.	Feed management	It is hard for framers to balance between bulk feeding and concentrated feeding	Through tracking of weight gained by the animal, egg and milk produced feed efficiency will increase

6.0 Applicable Patents

1. **Method and system for monitoring animals:-** This method monitors animals help notify when they are ready for slaughter
   Link: https://patents.google.com/patent/CA2266730A1

7.0 Applicable Standards

1. Government regulation for animal farming

8.0 Business Opportunity

There are various factors that give this product good business opportunity like:

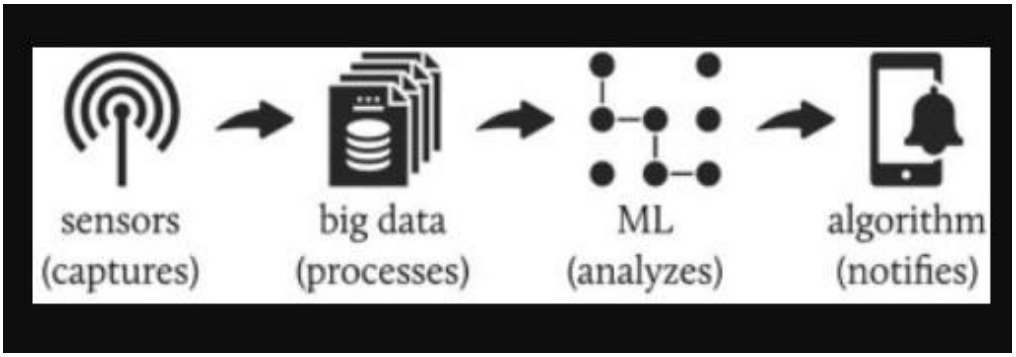
1. Increase demand of animal and animal related products are increasing, owing to the the growth in population
2. Rising initiatives by world wide governments supporting AI based animal farming

9.0 Concept Generation

The generation of this idea was from, how to meet the growing demands and what are the major challenges faced by the farmers in achieving these demands.

10.0 Final Service Prototype

1. **Installation of sensors and cameras:** Sensors need to be installed that will help in recording data related to changes in the environment, body weight of animals, production of milk and egg wherever applicable.
2. Remotely storing of this data in a highly efficient computer
3. **Use of ML models:** Using different algorithms for different purposes like whether it's for feed management or disease identification and in case of disease which disease is taken account for(refer table1) machine learning models need to be developed. For feed management ARIMA model can be used.



11.0 Team Require to Develop

1. 1 electrical engineer
2. 2 software engineer

12.0 References

1. https://www.sciencedirect.com/science/article/pii/S2214180420301343#bb0120
2. https://www.sciencedirect.com/science/article/pii/S2214180420301343#bb0120
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