



Research Article

ARTIFICIAL INTELLIGENCE: EMERGING TECHNIQUE FOR ANIMAL MANAGEMENT

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ABSTRACT

In real world, brain is central processing unit in biological organisms. In case of human being it consists of 10⁽¹¹⁾ neurons which realizes information processing mostly based on commonsense reasoning. Nowadays, artificial intelligence is been tried for implementing biological intelligence through computers. Various approaches like Artificial Neural Network (ANN), Symbolic Artificial intelligence, Fuzzy system have been partially successful in implementation of heuristic from biological intelligence. In this article, artificial intelligence how can be used in animal management has been discussed.

Key words:

Artificial intelligence, Dairy, Management

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INTRODUCTION

The world human population is growing at rapid rate, creating wide gap between food demand and supply. Food/feed safety has become hot topic of discussion as food/feed quality affects health of animal and final consumers (humans) leading to various diseases. Nowadays biosensors have gained recognition in global market due to their importance in helping disease diagnosis, assessing food quality and in keeping eye on our livestock. Artificial intelligence role cannot be denied in improving our livestock health status by timely judgement of medical problems and helping in its eradication. Advanced techniques like drones, robots, blockchain, augmented reality, internet of things and virtual reality using sensors play key role in animal management and provision of quality food for all. In precision livestock farming sound analyzers, sweat¹⁻⁷ and salivary sensing sero-diagnosis, image-detection techniques are used to detect animal ailments. Agriculture including animal husbandry can be made more efficient using technologies like artificial intelligence, machine learning. Ireland-based startup (TERRA NutriTech) by using these modern technologies have been able to reduce labor, waste through water system and provide precise mineral delivery thereby enhancing farmer's income.

Applications of artificial intelligence in animal management

Livestock and Poultry Farm Monitoring: Artificial intelligence is helping farmers in accumulating, analyzing data through which consumer behavior (buying pattern) can be

predicted. Mostly local farmers do not have knowledge about fodder quality and are unable to analyze its impact on milk quality. Fodder quantity and quality, lifestyle of animal and weather, all these factors affect milk quantity and quality. Use of artificial intelligence and machine learning in dairy industry will help in automation of farm processes and produce information which is related to farm's operational history. These smarter techniques (artificial intelligence, robotics and sensors) would enable proper utilization of resources like land, water and energy and revolutionize future farming aided with robots, drones and intelligent monitoring system. Health of farm animal is assessed using camera and artificial intelligence. Artificial Intelligence powered image analysis observation enables early detection of illness and injuries which further causes impact on milk production and quality. Emerging technologies are affecting agriculture for optimizing profit and management. Robotic milking machines, automatic calf feeders and brushes for cow have added to the farmer's comfort. Artificial Intelligence enabled sensors⁸⁻¹¹ in automated milking unit are able to analyze milk quality and report abnormalities if any present in the product. Data system monitor's cow's activities 24 hours for detection of lameness, estrus and dry matter intake. Cainthus (Technology Company of Ireland) has created cow facial recognition system which helps in monitoring all animals through smart camera's system which are located on barn roof. Data in next step is sent to server located on farm. Artificial intelligence is used to identify and track cow behavior to develop daily animal performance indicators. Cainthus vision system also helps in identifying aggressive animal in herd or erratic feeding pattern. This technology in coming days would be applied for beef cattle, hogs and poultry. Artificial intelligence (AI) is

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advantageous for farmers as it help in monitoring farm, forecasting process and optimization of farm animal growth through selection of best animals for breeding. It helps in tackling problem of parasites, biosecurity and other diseases as 24 hour vigilance report (eating, drinking, movement, body temperature, sickness, and stress level) is available. Management⁹ through precise, smart data of real time has made task of management more feasible. Artificial intelligence helps farmers is analyzing data collected through sensors and provide interpretations and solutions mimicking human decision making. Sense Time solutions detect and chart cows daily activities like rumination, eating and pattern of walking and when information is paired with artificial intelligence software early solutions which are proactive are available. Farmer is able to get all information related to reproduction, nutrition and health (mastitis, laminitis) of each animal. Artificial intelligence has helped in talking to animals (dolphin, porpoises, rhesus macaques, white-cheeked gibbons). Gavagai AB (Sweden company) is developing program to decipher dolphin speak using AI analysis software. About forty human languages have already been mastered through this program. Dolphins are considered as second –most intelligent animal next to humans on Earth. Cetacean Hearing and Telemetry (CHAT) is first effective animal translator.

Health monitoring: Connecterra (startup company, Netherlands) have developed artificial intelligence based system which enables farmers to run farm in profitable manner without additional staff being hired. Intelligent dairy farmer assistant (IDA), through advanced sensor hardware combined with deep learning algorithms creates patterns which help in spotting irregular behavior. IDA combines artificial intelligence and motion sensors. Motion sensing devices transmit cow movement to AI program. Storage and alignment of sensor data is done with cow's real world behavior. Suppose if a cow stops eating for 4 hours, notification comes to farmer through his smart phone /tablet and so, that specific animal after identification can be treated, which further reduces veterinary expenditure for treatment. IDA provides farmers gain deeper understanding through insights of real-life time data of animals along with complete information and advice. IDA's functionality is continually upgraded by connecterra. Example AskIDA is able to measure the impact of changes done on farm while cow ranking tool helps in selection of cow to be bred based on her performance. Even in poultry houses, artificial intelligence is used for monitoring and controlling environment. Software tracks the information collected by sensors, AI adjusts house conditions while alerting farmer through smart phone/tablet about sick/ill bird. Machine learning approach is used for automatically detecting and tracking pig in pen through cameras thereby studying their behavior. Analysis tools help data scientists in analyzing and visualizing data in order to study trends and patterns but AI provides data in real time predictive analysis for diseases. The root cause/agent of disease spread, prediction of geographical areas which would be affected can be identified and in advance, so preventive measures can be taken by veterinarians, pharmaceutical companies along with farmers. Smart cameras on drones or mounted at fixed locations of farm recognizes the faces of different animals and inform where human interactions or actions are needed. Images of black arch and gait of cow taken through waterproof and dust proof Microsoft Kinect camera has allowed early detection of disease. Hoof health is important of dairy cattle. Hoof injuries and illness

(lameness) can lead to life threatening diseases along with declined production and quality of dairy products. This camera-based sensor is capable of measuring distance after being set in barn and takes cow gait images which through machine learning help in detecting lame cows¹²⁻¹⁴. Automated milking machines, feeding robots and wearable sensors will be part of smart cow house in future. Next-generation cameras which have normalized different vegetation index are able to capture light spectra which cannot be seen by human eye, so used for detecting real time in-line meat quality and assess food safety. Allflex Young Stock™ Application has been launched by Allflex Livestock Intelligence for new born calves until they attain age of six months for monitoring their health through ear tagging. This helps farmer in detecting onset of health issues (respiratory diseases, gastrointestinal disorders before appearance of clinical symptoms. SENSEHUB® Beef Monitoring System (first heat and health monitoring system) aids farmer in getting linked with his/her herd anywhere and anytime. All these systems alerts the farmer about his animal weight¹⁵ distress, rumination time¹⁶ insemination time, conception rate, health issues requiring intervention, difficult calving and post natal care. After 2008, companies like Destron Fearing, Cox and Ritchey, Merko, OS ID and Aleis joined Allflex family. Last year that is in 2019 Antellic Company comprising of Sure Petcare, Allflex Livestock Intelligence and biomark have joined MSD Animal Health for operation as single unit. Modern farms have started using robotics system to deliver vaccines and other medicines which is usually integrated and automated. In this injecting process robot first reads RFID tags on cow's ear to get information related to health and vaccination record. If injection is required, robotic injection system is directed towards injection site on cow's neck which positions itself for delivering medication.

Detection of Estrus: Heat (estrus) detection which is base of successful dairy has been possible through application of artificial intelligence. Motion sensors¹⁷⁻²² on collar tied to cow's neck collects 24 hour data related to cow which is processed by artificial intelligence component of dairy automation system for having insights on heat stress, feed efficiency changes and estrous status. Specific hormones are released due to estrous which affect behavior and movement of cow. In heat condition, cow stands for longer duration still for other cow to mount on her. Collected data is compared with stored data for prediction in advance of ovulation period which usually starts 24-32 hours of onset of standing heat giving sufficient time for preparation of artificial insemination of cow to farmer.

Facial recognition: Artificial intelligence has made possible counting of sheep, pig, cattle accurately via facial recognition using UTS and AI- based video technology. This is vital for estimating nutritional status and behavior analysis of animal, calculation of stock density, allowance of pen space and need of feed stores. Data is collected of need by abattoirs and saleyards. Facial recognition eliminates stress of device fitting and help in easy monitoring with minimum interaction of entire herd. Doing so, individual monitoring can be done of group behavior, lameness can be detected and accurate record can be maintained of feeding habits. Accurate biometric identification, traceability via ear tags, boluses is very crucial for safety, efficiency and health of animal. Sometimes diseases do get transferred from animal to human via products like milk

and meat. Moreover animal epidemics cause economic costs losses both at domestic and export level in addition to increasing expenditure on disease control along with preventive measures. Farm4Trade, Experimental Zoo prophylactic Institute of Abruzzo and Molise and AiMagelab Research Laboratory of Department of Engineering Enzo Ferrari of the University of Modena and Reggio Emilia in collaboration developed first system of animal recognition which is contactless and capable of using cattle faeces images using Artificial intelligence with computer vision based technology involving convolutive neural networks(CNN). Mobile application acquiring cattle faeces images and video streams has been created which later archive collection media. Data collection through smartphone application has enabled one to reproduce, faithful, real farm condition. In recognition system which mostly has accuracy range between 85-90%, image of front profile is combined with atleast one side view of that specific animal. Because unlike humans left and right profile don't share any symmetry in animals. It is difficult to tamper biometric recognition system, so internationally adopted for verification process. SERKET (Animal Recognition software) has been successful in swine industry which detects anomalies in pig by identifying behavior. The major benefits of biometric animal identification are (1) most strong and healthy method for avoiding theft and identity problems (2) helps in identification and reduction of errors which may occur during transportation, loading and unloading operations (3) Animal welfare protection and guarantee (4) Animal's race can be easily distinguished (5) Infectious diseases can be controlled by controlling their spread (6) Pharmaceutical doses can be controlled (7) Strategies can be better planned for development of agriculture sector.

Impact on dairy and poultry Industry

Role of use of advanced techniques like drones, robots, 3-D printing, augmented reality, virtual reality, blockchain, internet of things in dairy enterprise cannot be ignored. Drones have been helpful in land survey and in measuring growth of pastures. Drones with algorithms identifies cow separating them from deer/other animal. When in combination with thermal imaging, it is easy to trace cow movement in field. In free ranging birds, it becomes easy to detect cannibalism and feather picking. The infection symptoms (nasal secretions, saliva secretions) and nutritional deficiencies can be well noted by polygon tool using target shape and texture and help farmer in saving chick life. Data annotation tools are required for detecting deformities of bone and decreased growth. In dairy robotic milking is no new surprise. Lely's Astronaut A5 and Delavan's voluntary milking system has increased efficiency, reduced labor hiring²³ and most important, allow animal to decide their time for milking. Milkbots (Robotic milkers) first clean udder, identifies teat and further proceeds for automatic milking. In DeLaval there is facility of rotary platform, allowing farmer to maximize milking performance of herd in safe and comfortable environment. MiRobot is used for larger operations. Lely Graze way system and Lely Qwes cow recognition system permits cow to move forward for grazing in pasture after being milked when they step into selection box. Through robots, milking action can be performed more than two times a day. At the same time, when animal becomes stationary for milking, transponders/sensors can be used for medical/health check-up, analyzing speed, quality and amount

of milk along with feed intake of cow and its heat cycle. Robots are also used for cleaning, sanitizing the farm which is pre-requisite for biosecurity. In coming days, it is expected that robots may assist in calving process. 3D printed foods eg cheese has become a challenge. Cheese can be duplicated through 3D printing due to easily changeable form from solid to liquid state. Research indicates that printed cheese has less stickiness, is softer and melts easily compared to non-printed cheese. It is a challenge to prepare printed food with low cost, improved taste, better nutritional value and acceptable to consumer for creation of demand. A step forward, Perfect Day (Startup company, San Francisco) has combined 3D printing with gene sequencing for creation of fermentation product of yeast which has milk taste, mainly prepared to meet demand of vegetarians or individuals intolerant to dairy products. The integration of digital information in real time with the environment of user is augmented reality. This technique can be of use in making food more appealing visually and in deciding serving sizes. Apple's ARKit provides food nutritional knowledge to consumer. Both good and bad food products would become available to meet consumer demand. At the same time, using this technique producer can monitor and do evaluation of his animal. Individual animal information overlaid through goggle glasses help farmer in evaluating milk quality after assessing complete information. Augmented reality in combination with sensor data, mostly considered reliable can be used by veterinarians for inspecting, observing and providing recommendations for disease management. In virtual reality technique, digital environment is made to interact within real way using electronic equipment. This may be of advantage in dairy industry for increasing farm safety and efficiency through tours and training. Becca (dairy cooperative Fonterra and solutions company, New Zealand) using this technique have navigated manufacturing, distribution sites without personal visitation for developing health and safety training technology. Employees of this company are able to identify hazards and experience them in simulated conditions thus enhancing their learning without being exposed in real life.

Through this technology, at the same time labor costs are reduced which would be needed to provide training on safety measures. This techniques is in use for teaching veterinary students about gynecological problems. DeLaval's virtual reality films enable viewer's to have glimpse of farm in 360 degree. Example Hamra Farm (Sweden) shows the techniques like robotic milking machines, cleaners, brushes which they use in film. Block chain is the technique making consumer aware about their food origin It creates connectivity and allow one to trace food for assuring its safety. It assures competitive advantage and allows consumer to select food. Colabriq and Applifarm values online ledgers which are incorruptible for tracing data on which we can rely. Internet of things provides connectivity between technologies within industry of dairy for increasing efficiency, production and Profitability. Agriwebb Company uses this technology for record keeping at farm which includes field management, operations, biosecurity, grazing and inventory while Stellapps leverages this technique for offering products varying from herd management to milk quality evaluation, payment and monitoring of cold chain. IoT applications also involve Dell Technologies which is working with Chitale (dairy producer). SCiO (Consumer physics) is working in collaboration with Cargill for creation of Reveal which is an app for delivering feed contents in minutes using

micro spectrometer with calibrations of near Infrared. KEENAN In Touch system provides information to farmers related to nutrition for best feed formulation. Its feed mixers give uniform balanced feed. Cloud-based system help producers in monitoring feed wastage allowing making necessary required changes for improving efficiency and at same time reducing cost.

CONCLUSION

In near future, with advanced technologies, it would become easier for humans (consumers) to obtain quality food with least cost.

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