Better Livestock Health Management Using Sensors And Data Analysis

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Abstract - Our society is raising animals on such a large scale in an industrial setting. The major problem we are facing is that it is hard to monitor animal individually so as to avoid the spread of diseases. In such a situation, biosensors are used to detect various diseases caused in animals. Biosensors are devices that have the potential to quantify physiological, immunological and behavioral responses. Pedometer, accelerometer, nedap etc…… are the sensors to detect heat, temperature etc. Not only sensors but also some other technologies and some models were used to detect diseases. Some chips, cloud computing and the Lo RaWAN method, mobile apps and SMS are also helpful to detect diseases. This paper analyses and discusses the scope for different technologies and methods to help animal health management from a data analysis perspective. These technologies will identify animal health events, will increase the overall herd health and yield in the case of farm animals.

keywords - Bio sensing, Sensors, Pedometer, Accelerometer.

I. Introduction

Sensor is a device that measures a physiological or behavioral parameter of an individual cow and enables automated, on-farm detection of changes in this condition that is related to a health event (such as disease) and requires action on the part of the farmer (such as treatment). There are mainly two types of sensors: attached sensors and non-attached sensors. Attached sensors are on cow sensors or in cow sensors that fitted on the inside or outside of cow's body. Where non-attached sensors are off cow sensors that cows pass by, over or, through by measurements. Several sensors are used to detect diseases, sensors are accelerometer, pedometer, gas sensor, biosensors, electrical nose.

Given the use of sensors on animals and the degree to which they affect our daily lives, the development of sensor systems for animals has been relatively limited. These concerns should also receive more attention in the future study and development of sensor technology. In that regard, the focus of this study will be on identifying and mapping animal diseases to the appropriate sensors.

II. LITERATURE SURVEY

The paper 'Sensor Technologies For Animal Health Monitoring' by miss Amrutha Helwatkar, Danial Reodrants, Joseph Walsh. This paper effectively describes sensors, why we use sensors on animals, types of sensors. In 1980, a lot of work has been put in to developing sensors that measures several parameters from an individual cow. The initial work recognized an individual cow followed by sensing electrical conductivity of milk and activity measurement using sensors like accelerometer and pedometers. Then this paper is discussing about the types of sensing technologies, cow health events / diseases.

Table1. Disease Mapped To Sensors

Disease	Aspect of animal health	Behavioural changes	Sensor
Fever	High temperature	High/low temperature	Temperature
	Discomfort	Less activity	Accelerometer
		Mooing	Microphone
Lameness	Motion changes	Standing or sitting	Accelerometer pedometers
		Abnormal back arch	GPS
Oestrus	Hormonal level(EG progesterone)		Accelerometer (Around neck)
Mastitis	Yield	Not well defined	Accelerometer (pedometer)
Ovarian cyst	Yield	Less/more grazing	Pressure sensor
	Temperature	High/low	Temperature

		temperature	
	Milk quality	Electrical conductivity	Electrical conductivity sensor
Displaced abomasum	Feeding		Accelerometer
Ketosis	Breath ketosis	Grazing	Accelerometer (pedometer)
		Eating rumination	Microphone
		Breathe smell	Gas sensor
Milk fever	Movement/motion		Accelerometer
Retained placenta		Excitement/ stiffness	Accelerometer (pedometer)
	Weight	Weight shifting/ weakness	Load sensor
	Fever	Temperature	Temperature sensor
	Heart/respiratory rate	Pulse	Heartbeat sensor
Heifer diarhea	Fever	High temperature	Temperature sensor
Heifer pneumonia	Nasal discharge	Running nose	
	Cough	Coughing sound	Microphone
	Increased respiratory rate	Sound of breathing	Microphone
	Decreased appetite	Less Grazing/Feeding	Accelerometer (pedometer)

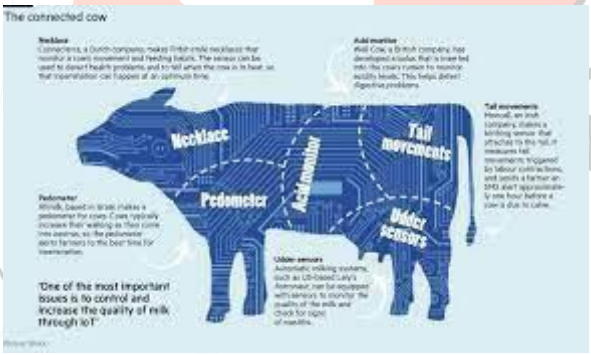

Figure1, Sensors connected to cow

Figure2, Accelerometer sensor is attached to the neck of cow.

Figure3, nose band pressure sense

The paper “Monitoring Cattle Disease with Linguistable Bio-Sensors Utilizing LoRaWAN Method and Case Studies” by

Heejin Kim, Youngjeon Min and Byongiu Choi in 2018. Due to decreased farm productivity, livestock illnesses cause a loss in farm income.
chronic disease developments or even culling. Therefore, monitoring the health condition of livestock in real-time to predict and swiftly respond to any diseases is very important because it directly affects the profit and productivity of farms. For an effective disease prediction system, we propose a cattle disease monitoring method with orally administered bio-sensors utilizing Long Range Wide-Area Network (LoRaWAN). This paper effectively discussing about monitoring livestock devices, LoRaWAN application case, cattle disease prediction system.

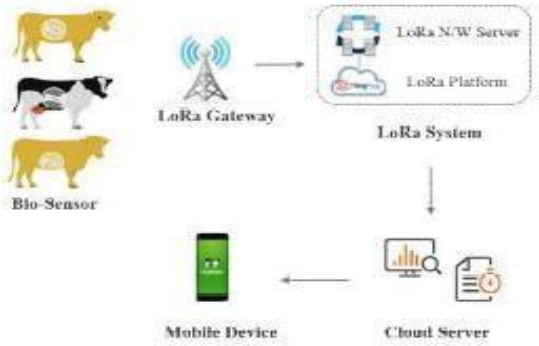

Figure4, diagram of proposed disease prediction systems

Figure5, diagram of mobile application screens.

The Great Range Wide-Area Network (LoRaWAN) is a sort of Low Power Wide Area Network technology that transmits data wirelessly over long distances while consuming little power. Compared to existing wireless communications technology such as Wi-Fi or ZigBee, LoRaWAN has longer communication systems. This model also used in various fields. This method enables accurate disease monitoring by transmitting body temperature data without loss. This model is implemented in 2019 and now its continuing the usages in Switzerland, USA.
The May 2018 article by Hazael and Jackson Phiri titled "Real Time Sensing and Monitoring of Environmental Conditions in A Chicken House." The environmental conditions in a chicken house need to be regularly monitored in order to ensure the quality of the hens produced and lower the mortality rate, as this study successfully explains. Additionally, safeguarding against revenue losses is equally crucial as preventing chicken theft in a poultry coop. The topics covered in this essay include chicken farming, environmental issues, monitoring technology, sensing and monitoring techniques, mobile apps, and SMS.

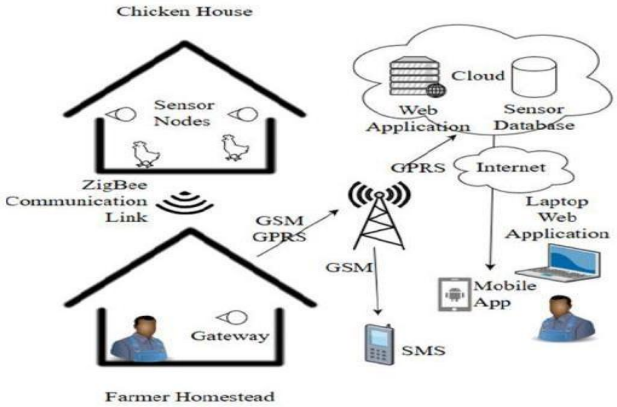

Figure6, Chicken house sensing and monitoring model

In future, we will build a prototype to test the model and obtain empirical data concerning the performance of the system. The future work will also include reducing the power consumption of the nodes on the sensing side to enable

them to be solar powered.

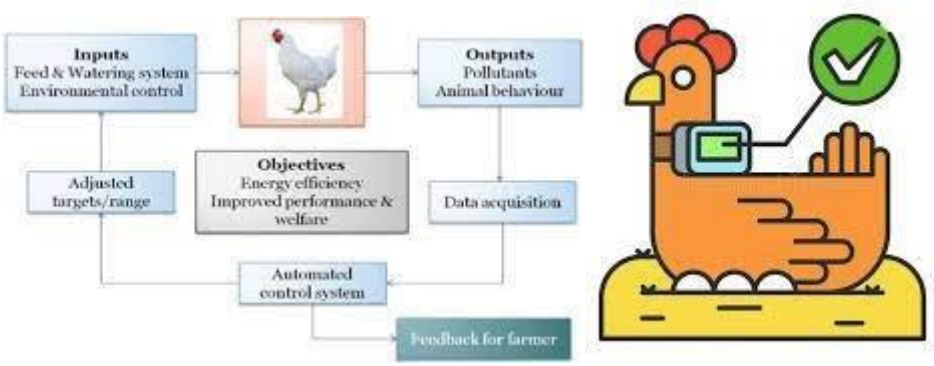

Figure7, Monitoring system in poultry

Biometric sensors monitor behavior and psychological parameters of livestock, allowing farmers to evaluate. Today wide variety of sensors are available, they are invasive and non-invasive sensors. Non-invasive sensors are fitted around in barn in surveillance cameras, sensors in feeding system to monitor animal weight and feed intake. Pedometers, GPS, MEMS to control behavior. Invasive sensors which are swallowed or implanted in an animal to monitoring internal psychological measures such that rumen health body temperature and vaginal pressure. TIR-Thermal Infrared Imaging can be used to monitor body temperature in place of invasive thermometer that required restraint and handling of animals. TIR of the eye region and general skin temperature can monitor stress and detect diseases. RFID devises they embedded in ear tags and collars to monitor a wide variety of behavior such that general activity rating and drinking. Microphones allow monitoring of vocalization and coughing helping farmers to welfare issues before they become severe. Facial detection technologies are based on an animals face for identification of individuals or to detect changes related to affective stales.

The use of biometric and biological sensors in the cattle industry has allowed better monitoring of major welfare concerns and provide better husbandry activities and providing valuable insights into productive skills. The disease caused to cattle's are mastitis, cystic ovarian, lameness, displaced abomasum and and ketosis can be cured by biosensors. NEFA and BHBA can also be detected using sensors. NEFA indicates negative energy balance and can symptomatic health risk that need to addressed immediately. Metabolism disorders indicated by high levels of NEFA in the blood can lead to loss of appetite, decreased milk production, reproductive issues, mammary issues and immune system dysfunction. Another issues is the disease caused by elevated levels of beta hydro butyrate. This can be detected by quantum dots based biosensor by Tuteja in using 2D MOS_2 nanostructure based electrochemical immunosensor, Veerapandian used electrochemical biometric sensors of ruthenium dye sensitized graphene oxide(GO) Nano sheets, screen electrode (SPE) sensors also are being developed to detect both NEFA and BHBA. The use of biosensors used in poultry that maintain good health. Poultry production is the spread of diseases. PLF sensing platforms and modules may be able to detect changes in temperature in animal habitats and notify farmers to take appropriate action. Non-invasive heart rate monitors the incubation temperature and detect cardiovascular defects of chicken embryos. Semaphore apps have been developed for easy monitoring of embryo heartrate.

Meachene Learning used to detect chicken vocalization. The use of biometric sensors led to advance in big data analytics. Big data analytics is the analytics of large sets of data. Big data are characterized by four major attributes known as 4V's model:

1) Quantity of data
2) Speed of accessing or using the data.
3) Different forms of data.
4) Cleaning and editing the data.

PLF-proper use of big data analytics and modeling to inform management about nutrition needs, reproductive status and declining trends in productively that may indicate animal health and welfare issues. ML is a branch of AI that uses Algorithm for statistical prediction and inference. ML techniques are used in animal genetics research to predict phenotypes based on genotype information, identifying outliers in a population and genotype imputation. ML also been used to detect mastitis from automated milking technologies on dairy farms. ML and big data analytics have the potential to improve welfare and productivity in dairy cattle.

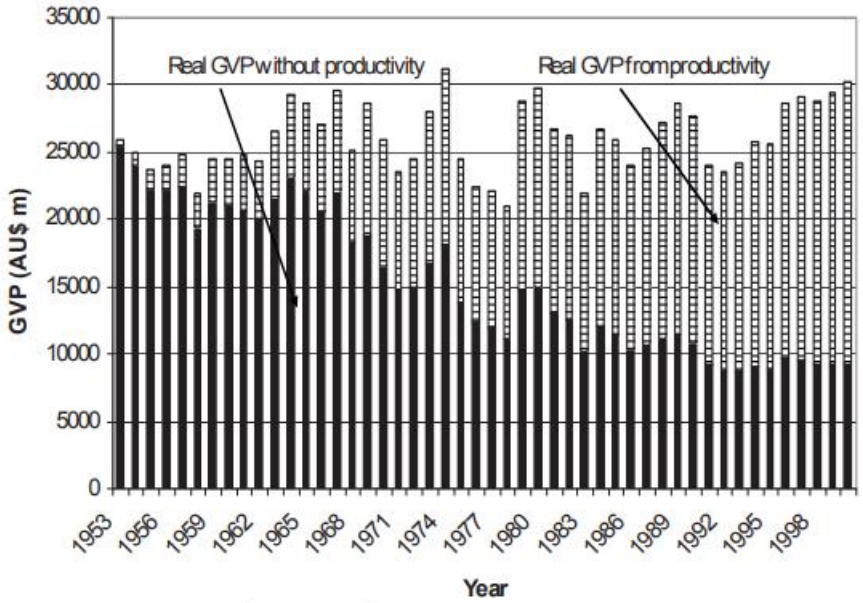

Figure 8: Precision livestock farming: A suite of electronic systems to ensure. Gross value of Australian agricultural production (GVP) in the year 2000 in real dollar value terms, showing the proportion due to productivity improvement (Mullen, 2002). [7]

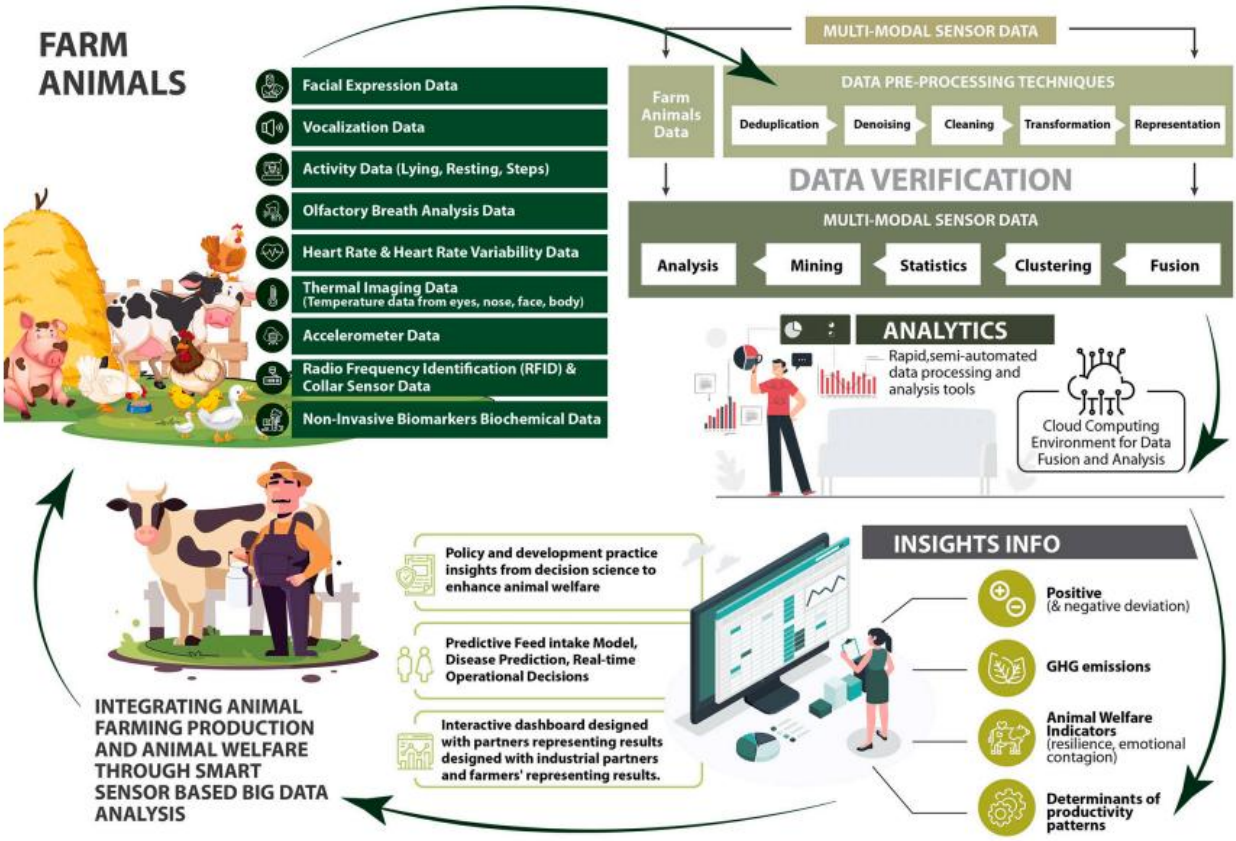

Figure 9: Big Data for Animal Farming: The chain of sensors-based big data applications in precision livestock farming.[8]

Ⅲ. Conclusion

This research has been undertaken in order to establish specific sensor technologies as a significant means to monitor animal health and to ensure animal well-being in the fast-changing conditions of automated farms. Several cattle diseases have been studied in depth and analysis of the symptoms associated with these conditions. These symptoms were then mapped to the type of sensors that would be able to measure the said behavior. This paper proposes the technologies should be improved for detecting the inner diseases caused in animals.

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