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A study about the common diseases in cattle and It's AHM sensors based on IOT

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Abstract
Today more than ever, outbreaks of some animal diseases, particularly those harmful to humans (zoonoses) can cause considerable economic and social upheaval and send a wave of panic across the globe. The recent health crises due to bovine spongiform encephalopathy and foot-and-mouth disease are a good illustration of this new trend. The current avian influenza epizootic also shows how a serious health event for the animal kingdom can have a global impact on the rural economy and consumers and constitute a threat to public health. The Internet of Things (IoT) is expected to be a real game changer in food and farming. However, an important challenge for large-scale uptake of IoT is to deal with the huge heterogeneity of this domain. This paper develops and applies an architecture framework for modelling IoT-based systems in the agriculture and food domain. The framework provides a valuable help to model, in a timely, punctual and coherent way, the architecture of IoT-based systems of this diverse set of use cases. National Veterinary Services are crucial to prevention, detection and monitoring of animal diseases, including diseases transmissible to humans. The database server will process the input parameters, which predict the disease and display the solution onto the users Smart-phone or PC where android app resides using TCP/IP protocol. Finally this study proposes the Animal Health Monitoring and contributing the Precision Agriculture which helps enhancing the productivity and save the time through IOT. Thus, the purpose of using IOT to fulfil the gap between farmers and the expertise.

Keywords: IOT based network, technology, cattle, diseases, health, AHM

Introduction

Currently Smart farming addresses basic needs of farmers, such as helping farmers to automate farming. In the proposed approach an open and low-cost concept used for smart fog(edge) system to create smart farm animal welfare monitoring. The position of the animals are collected for analysis purpose. Different sensors are used for sensing the temperature, humidity, animal behaviour and disease detection of animal like cattle, poultry farms, stables. Smart Farming relays on basic needs of farmers, such as helping farmers to make farming. Instead of Farmer visiting the cattle or Poultry farms again and again for observing their health condition, we are using a computing and sensor-based methods controlled by Arduino module. To Achieve this, we have installed our system in the Poultry farms and cattle sheds through sensors. The measured data is stored at the consumers database, the consumer is allowed to extract this data through an android application installed in his/her mobile. It includes another feature of alarming i.e., if temperature of poultry farm exceeds or increases, sensor senses the temperature and Arduino compares it with the prescribed safe range and if not in range signals an alarm, further the cloud pushes it to the consumers mobile app and notifies .

The Internet of Things (IoT) is a very promising paradigm to drastically improve productivity and sustainability because it has the potential to achieve new level. IoT comprises smart webs of connected and context-sensitive objects that can be identified, sensed and controlled remotely. IoT-based systems are often fragmented, use different data platforms with limited interoperability and in particular more advanced applications are still in an early stage of development. IoT systems should function as interoperable nodes within a well-aligned software ecosystem that maximizes reuse and synergies across multiple IoT systems. In such an ecosystem, technology companies can concentrate on the development of components that fit best to their core competencies.

The architecture of IoT-based systems is similar to other information systems, but with special requirements concerning the remote identification, sensing and control of smart objects by using sensors and actuators. There are several initiatives working toward standardized architectures to overcome fragmentation in IoT development.

Wireless Sensor Network is the ideal candidate to provide effective and economically viable solutions for a large variety of applications ranging from health monitoring, agriculture, environmental monitoring to military operations and multifunctional wireless sensor nodes installed in distributed geographical area for monitoring specific scenario. WSNs create the significant impact on a wide range of monitoring area by the coordinated effort of the wireless sensor nodes. The wireless sensor node works on battery power to communicate with other network sensor node.

In the WSN based Animal Health Monitoring system, the cattle body sensors sends data like heart beats, respiration, body temperature while Environment sensor sends data like water pollution level, soil infection level, dust level in air and humidity data. All these sensory data should be created on the regular interval and needs to be small in size. The WSN based Animal Health Monitoring setup is on users android mobile or PC which is connected to the internet.

An important aspect of farm automation that is currently being researched is the area of automated animal health monitoring. In this research, we have identified specific

diseases which are common in dairy animals which can be identified through the use of non-invasive, low-cost, sensor technology. These diseases have been mapped to specific aspects of animal behaviour that have been mapped to the three sensors which are most significant to identify these diseases. The identified sensors will be shown to be vital in the development of the next generation of health monitoring system for dairy animals. Such a system will allow the automatic identification of animal health events, greatly increasing overall herd health and yield while reducing animal health inspection and long-term animal healthcare costs.

Review of literature

Chetana Pawar *et al*. proposed a system which will not only improve individual animal health, but it also identifies and prevents widespread diseases, whether it originated from natural causes or from biological attacks. Such a system would help in early diagnosis of diseases. The system consists of four different sensors i.e. Temperature sensor, Heart rate sensor, Rumination sensor and Rumination sensor. For the implementation of the sensor module, we used Zigbee device and Arduino Microcontroller. The Graphical user interface (GUI) is used to display the values on the PC. The device is very important as well as helpful for the health care of animals.

Seena P. *et al*. has proposed a system which allows obtaining data patterns with the help of Nave Bayesian theorem. Researcher experimented on data gathered from tertiary health care centres which survey the people from various areas of Kottayam and Alappuzha, Kerala, India. Nave Bayesian algorithm reveals the chances of different dermatological disease and also, finds out the percentage of occurrence of each disease.

Manju Suresh *et al*. presents a low-cost animal health monitoring system to monitor the health parameter such as body temperature, heart rate, and their postures. Posture sensing is the main feature of this system. Three accurate sensors are used to measure these health parameters. If the parameters that we got are not in the normal range, quickly recognize that the animals are not well.

A Patil clarify propelled cows wellbeing checking framework for cows. Here sensors are utilized for identifying different wellbeing parameters of the bovine, for example, body temperature, mugginess and breath and so forth The sensors are interfaced with Arduino UNO and after that it will show the diagram on the I graph application through ESP8266 Wifi module. This propelled cows wellbeing checking framework can swap this manual procedure for perceiving the different maladies. This framework is especially useful for ranchers and furthermore for specialists since it is exact than manual perception.

Meenakshi .M explains In the Wireless Sensor Based cattle health monitoring system, critical parameters affecting cattle health which includes body temperature, respiration, humidity, heartbeat and rumination are continuously monitored. This advanced cattle health monitoring system can replace this manual process for recognizing the various diseases. This system is very much helpful for farmers and also for doctors because it is accurate than manual observation.

Research methodology

Research methodology is the details regarding methods adopted to conduct this study. For conducting this study, secondary data, and primary data were used. Consulted with veterinary experts to know different kind of health problem related to the cattle. This study mainly focused to cow related diseases and precaution and solution by using IoT technology.

Data Analysis

Diseases of Farming Animals

1. *Mastitis* : Mastitis is a swelling of the breasts gland and tissue in the mammary gland and is a leading endemic disease of dairy cattle. It produces an immune response to bacterial invasion of the teat canal by various bacterial sources on the farm and may also happen as a consequence of chemical, mechanical or thermal injury to the udder.
2. *Lameness:* It is an abnormal gait or stance of an animal that is the result of dysfunction of the locomotor system. In the horse, it is most commonly caused by pain, but can be due to neurologic or mechanical dysfunction. Lameness is a common veterinary problem in racehorses, sport horses, and pleasure horses. It is one of the most costly health problems for the equine industry, both monetarily for the cost of diagnosis and treatment, and for the cost of time off resulting in loss-of-use.
3. *Cystic ovarian disease*: Cystic ovarian disease :in cows is usually seen in the first two months post calving. Traditionally cysts have been defined as anovulatory follicular structures (diameter, >25 mm) that persist for 10 or more days in the absence of a functional corpus luteum and are accompanied by abnormal oestrous behaviour (irregular oestrus intervals, nymphomania or anoestrus). However, recent data using ultrasonography indicate that follicles typically ovulate at 17 mm in diameter, so follicles that persist at 17mm or greater may be considered to be "cystic."
4. Displaced abomasum : Displaced abomasum in cattle occurs when the abomasum, also known as the true stomach, which typically resides on the floor of the abdomen, fills with gas and rises to the top of the abdomen, where it is said to be ‘displaced’. When the abomasum moves from its normal position it prevents the natural passage of gas and feed through the digestive system, creating a restriction.
5. Ketosis: Ketosis is characterized by depression and partial anorexia. Seldom, it transpires in cows in late gestation. In adding to the loss of appetence, symptoms of nervous dysfunction, as well as pica, incoordination and abnormal gait, anomalous licking, bawling, and hostility are sporadically observed.
6. Milk Fever :Milk fever also known as postparturient hypocalcemia or parturient paresis, portrayed by reduced levels of blood calcium. [19] It is a metabolic disease defined by decreased blood calcium levels (Hypocalcaemia) which results in decreased productive longevity by 3 years and decreased yield.
7. Retained Placenta :The inability to shed the placental membrane even after 24 hours after birthing. A part of the placenta is seen loosely hanging from the birth canal after the birthing.
8. Diarrhea: Pestivirus is responsible for this disease. If infected cow passes watery stool with mucous several times a day. It causes loss of water and salt, weakness,

thinning, inappetence and death if not treated properly and in time.

9. Pneumonia: It is a multifactorial disease. It weakens the immune system of the cattle and causes symptoms like fever, depression, serious nasal and eye discharge, inappetence, stiff gait, cold and cough in the cattle.

Precautions by Using IOT Based Technology

In last two decades, researchers have developed several applications for sensor technology. The commonly researched fields in sensor technology are robotics, defence and military, industrial production processes, entertainment, which are comparatively less urgent than other bigger global issues such as natural disasters, determination of non-sustainable resources, health monitoring disease control, and many more.

Sensors fall into two categories: Attached and Non-attached.

A. *Attached Sensors:* They may be on-cow sensors that are fitted on the outside of the cow's body, or in-cow sensors that are inside the body (e.g., rumen bolus or implant).

B. *Non attached Sensors:* They are off-cow sensors that cows pass by, over, or through for measurement. Two distinct forms of non attached sensors are in-line and on-line sensors. In-line sensors take measurements in a continuous flow of product from the cow. The only available option for in-line measurement is in the milk line. On-line sensors automatically take a sample (milk, for example,) that is analysed by the sensor.

Types of Sensing Technologies

In order to aid the farmer, sensor systems have been developed to automatically determine the physiological and behavioural indicators. These indicators (or features or parameters) are used as input for subsequent data analysis methods. The existing approaches for sensor-based data acquisition could be classified in two categories:

1) Immobile sensors located in the barn: Cows in a barn usually have a repetitive daily routine, i.e. they are at known locations at fixed times (during milking and feeding). Therefore, sensors can be placed at fixed locations where the cows regularly have to pass. Typical sensors of this type are temperature measurements of the udder or of the face in an automatic milking station. Another example is the measurement of breath composition.

Another kind of immobile sensors are surveillance cameras. When the typically occupied area is in the field of view of the camera, it can continuously provide information for the cows in the herd. However, the reliability of this information is limited by the "optical" conditions in a barn.

2) Mobile sensor boxes attached to the cow (external sensors): In order to monitor cows throughout a day, the most reliable way is to attach sensors at individual cow (e.g. by a neck collar or an ankle ribbon). Typical sensors of this kind are accelerometers, pedometers, vibration sensors, thermometers for temperature measurements (at hypodermal level), humidity sensors (at skin level), etc.

Here system introduces a brand new application which consist of architecture for animal health monitoring that will aim to achieve smart Animal Health Monitoring as well as fill the gap between farmers and expertise by giving the solutions on animal disease.

Body Temperature Sensor: The normal body temperature is different in different types of animals. So, the normal body temperature of cattle 38.5 degree Celsius, buffalo 38.2 degree Celsius, cat's normal body temperature can range from 38.1 degree Celsius to 39.2 degree Celsius and dog's 38.3 to 39.2 degree Celsius. A change in the temperature of the body is the sign of ill health. The body can only work properly at a certain temperature.

Humidity Sensor: Environmental factor such as humidity must be carefully monitored because they affect metabolism and behaviour. The parameters have affected the performance and animal of health both directly and indirectly. Humidity has a large impact on animal health. It affects the animal health both animals and plants to cool themselves through evaporation perception formation.

Heart Rate Sensor: Basically the heart rate measurement is an indirect method. Heart rate is a reliable indicator of an impact that stress and agitation have an animal.

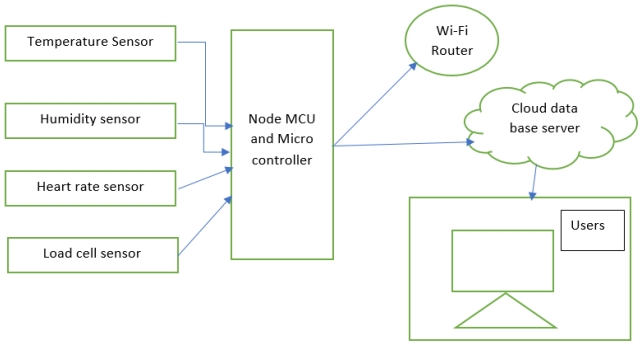

Fig 1: Block diagram of animal health monitoring

Fig.1 shows the layout of basic Animal health monitoring system which consists of four modules: sensors, microcontroller, database, and user. The sensors are mounted on the animal body, they collect the physical data of animals which will be transmitted to the controller. Naive Bayes is applied on the sensor data for the classification of data. After data transmission data analysis and processing will take place and provide the event service to the end user. The main processing unit is the controller node MCU have its own wi-fi device. IoT interface will happen by using Wi-Fi router and data stored in the cloud database server

Table 1: Diseases and IOT technology

Diseases	Aspect of Animal Health	Behavioural changes	Sensor(IOT) as precautions
Fever	High Temperature, Discomfort.	Less Activity, High / Low Temperature, Mooning	Temperature, Accelerometer, Microphone.
Lameness	Motion Change	Sitting Or Standing, Less Grazing, Abnormal Back Arch	GPS, Load Sensor, Accelerometer, Pedometer.
Oestrus	Hormone Level Change		Accelerometer
Mastitis	Yield	Behavioural Change Can't Define Well	Accelerometer

Ovarian Cysts	Yield, Temperature, Change In Milk Quantity	High/ Low Grazing And Temperature, Electrical Conductivity.	Electrical Conductor, Pressure Sensor, Temperature.
Displaced Abomasum	Feeding		Accelerometer
Ketosis	Breath Ketones	Grazing, Eating, Rumination, Breath Smell	Accelerometer, Microphone, Gas Sensor
Milk Fever	Movement/ Motion		Accelerometer
Retained Placenta	Weight, Fever, Heart Respiratory Rate	Excitement/ Stiffness, Mooning, Pulse, Weakness, Temperature,	Accelerometer, Microphone, Load Sensor, Temperature Sensor, Heart Beat Sensor
Heifer Diarrhoea	Fever	High Temperature	Temp Sensor
Heifer Pneumonia	Nasal Discharge, Cough, Increased Respirator Y Rate, Decrease Appetite	Running, Nose, Coughing Sound, Sound of Breathing, Less Grazing/ Feeding	Microphone, Accelerometer

Findings

This research has identified three primary sensors; Temperature, Accelerometer and Microphone that are essentially required to determine the health quotient of the cattle. Further work on the system utilizing these three sensor types will lead to the develop of the next generation, non-invasive, wearable animal health monitoring system which will gather relevant sensory information, such as activity, and alterations in head and neck movement and relate the gathered animal data to predict or identify animal health events. Contribution IoT in animal health monitor area is that inevitable.

Conclusion

This research has been undertaken in order to establish specific sensor IOT s as a significant means to monitor animal health and to ensure animal well-being in the fast changing conditions of automated farms. Due to the high demand and supply of dairy products, dairy cattle are in a constant demand for high yield, leading to the need of continuously monitoring of their health to ensure their fitness as it directly affects the health of the consumers. Moreover, the overall economy in the dairy farming industry depends on the herds' health. Now a day the improvement in animal health care monitoring is rapidly increasing. The proposed system is Animal Health Monitoring (AHM) which helps to farmers for achieving productivity and monitoring the animal health. And implements a good and affordable animal health monitoring system. The proposed system is fully automated, free from human interference, the user can monitor the health condition of the animal from the remote location and g*et al*erted through his mobile phone in case any changes are found in the health condition of the animal. The system consists of nodeMCU microcontroller, animal body temperature, humidity, heart rate and load cell sensors. For analysis and classification of data, Naive Bayes algorithm is implemented.

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