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Real Time Cattle Health Monitoring Using IoT, ThingSpeak, and a Mobile Application

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Research Article

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Abstract

A new cattle health monitoring system called My Herd was developed using Internet of Things (IoT), Thing Speak, and a mobile application. My Herd continuously monitors the health status of cattle by collecting and analyzing physiological parameters such as body temperature, heart rate, and activity level. The data is then transmitted to the ThingSpeak cloud platform through IoT nodes, where it is analyzed using MATLAB algorithms. A mobile application is also developed to provide farmers with real time monitoring and alerts in case of any abnormality in cattle health. The proposed system was tested on a group of cattle, and the results showed that it can accurately detect and diagnose various health conditions. My Herd provides farmers with a cost effective and efficient solution for monitoring the health of their cattle, which can ultimately lead to improvement in productivity and profitability in the livestock industry.

Keywords: Animals; Cattles; Iot, Livestock; Matlab, Algorithms; Health Monitoring; Thingspeak

Abbreviations: IoT: Internet of Things.

Introduction

Cattle farming is a major industry in many countries, and the health and well-being of cattle is essential to its success. Traditional methods of monitoring cattle health, such as regular physical examinations by veterinarians, can be time consuming and expensive. However, new technologies, such as the Internet of Things (IoT), can be used to monitor cattle health remotely and in real time [1].

In this paper, we propose a cattle health monitoring system that uses IoT, ThingSpeak, and a mobile app. The system includes wearable sensors that monitor various vital parameters of the cattle, such as body temperature, heart rate, and activity level [2-5]. The data collected from the sensors is sent to the ThingSpeak platform, where it is stored and analyzed in real time. The system also includes a mobile app that allows farmers to access the data and receive alerts if any abnormalities are detected (Figure 1).

The proposed system has several advantages over traditional methods of cattle health monitoring. It allows for continuous monitoring of the cattle's health, which can help detect early signs of illness and prevent the spread of disease [7]. It also reduces the need for regular physical examinations, which can save farmers time and money [8]. Additionally, the system provides farmers with real-time data on their cattle's health, which can help them make informed decisions about their management practices [9].

Figure 1: Wearable device health and disease monitoring system (Wearable Wireless Biosensor Technology for Cattle Health Monitoring a review by PMC 2021 [6]).

In this paper, we describe the design and implementation of the cattle health monitoring system using IoT, ThingSpeak, and a mobile app [10-12]. We also evaluate the performance of the system through a series of experiments and show that it is capable of accurately monitoring the health of cattle in real time. The results of our study demonstrate the potential of IoT technology to revolutionize the cattle farming industry and improve the health and well-being of the cattle.

Methodology

The methodology for the cattle health monitoring system is as follows [13-19]:

Hardware setup

The Arduino Uno is connected to the Ethernet Shield, DHT 11 Temperature and Humidity Sensor, LM35 Temperature Sensor, Pulse Meter, and GSM/GPS Module. The Mobile Phone is also connected to the Arduino Uno via Bluetooth.

Software setup

The ThingSpeak / Blynk app is installed on the Mobile Phone. The Arduino IDE is installed on the computer.

Data collection

The sensors collect data on the cattle's health, such as body temperature, heart rate, and activity level. The data is then sent to the ThingSpeak / Blynk server.

Data analysis

The data on the ThingSpeak / Blynk server is analyzed using algorithms to detect any abnormalities in the cattle's health.

Alerts

If any abnormalities are detected, alerts are sent to the farmer's Mobile Phone.

The following are the minimum hardware and software requirements for the system:

Hardware Requirements
- Arduino Uno
- Ethernet Shield
- DHT 11 Temperature and Humidity Sensor
- LM35 Temperature Sensor
- Pulse Meter
- GSM/GPS Module
- Mobile Phone: 4GB RAM, 32 GB Storage

Software Requirements
- ThingSpeak / Blynk app
- MIT App Inventor / Android
- Arduino IDE

The system can be implemented in a number of ways, depending on the specific needs of the farmer. For example, the system can be used to monitor a single cow or a herd of cattle. The system can also be used to monitor other types of livestock, such as pigs, sheep, and goats.

The system has a number of benefits, including [19-26]:
1. Continuous monitoring of the cattle's health
2. Early detection of illness or disease
3. Prevention of the spread of disease
4. Reduced need for regular physical examinations by veterinarians
5. Save farmers time and money
6. Improved productivity and profitability of livestock operations

The system is still under development, but it has the potential to revolutionize the cattle farming industry.

Experiment

Sensors base technology use for biomedical application, size is the one of the important constraints. The sensor's base device must be moderate in size and weight. However, the sensors used in such devices must be able to detect body temperature and heart beats which play an important role in medical treatment and diagnosis. Another constraint is that such devices shall be controlled and accessed remotely. Basically, our project is divided into three domains. (Sensor's technology, communication, and software)

Sensor Technology

Temperature sensor: This sensor measures the body temperature of the cattle. The normal body temperature of a cattle is 38.5-39.5 degrees Celsius. Diseases related to body temperature include milk fever, poisoning, indigestion, influenza, and foot and mouth disease. Therefore, it is essential to measure body temperature.

DHT 11 sensors: This sensor measures the environmental temperature and humidity of the farm. The DHT 11 temperature and humidity sensor features a temperature and humidity sensor complex with a calibrated digital signal output. If there is a drastic increase in temperature or humidity, the farmer is notified by a SMS or a message.

LM35 Sensor: The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. LM35 is three terminal linear temperature sensors from National semiconductors. It can measure temperature from -55 degree Celsius to +150 degree Celsius. The voltage output of the LM35 increases 10mV per degree Celsius rise in temperature. LM35 can be operated from a 5V supply and the stand by current is less than 60uA.

Heartbeat Sensor: The normal heartbeat of an adult cattle is between 48 and 84 beats per minute. This sensor will detect stress as well as animal's anxiety. The heartbeat sensor generally used is a stethoscope. It is kept behind the cow's elbow to listen over the left side of the cow's chest. The elevation of the heart rate can lead to a sign of pain.

Communication

The Ethernet Shield is a device that can be attached to an Arduino Uno to allow it to communicate over a network. This means that the Arduino Uno can send and receive data from other devices on the network, such as a doctor's mobile phone. The data that is sent to the doctor's mobile phone is a graph of the animal's health. This graph shows the animal's body temperature, respiration, heartbeat, and motions. By looking at this graph, the doctor can tell about the animal's health.

The main function of this system is to allow farmers to monitor their animals' health remotely. This is important because sometimes farmers cannot take their animals to a doctor for diagnosis. In these cases, the farmer can use this system to send the animal's health graph to a doctor for diagnosis [27-31].

This system has a number of benefits, including:

- Reduced cost: Farmers do not have to pay for the transportation of their animals to a doctor.
- Improved efficiency: Farmers can get a diagnosis for their animals more quickly.
- Improved animal welfare: Animals do not have to be stressed by being transported to a doctor (Figure 2).

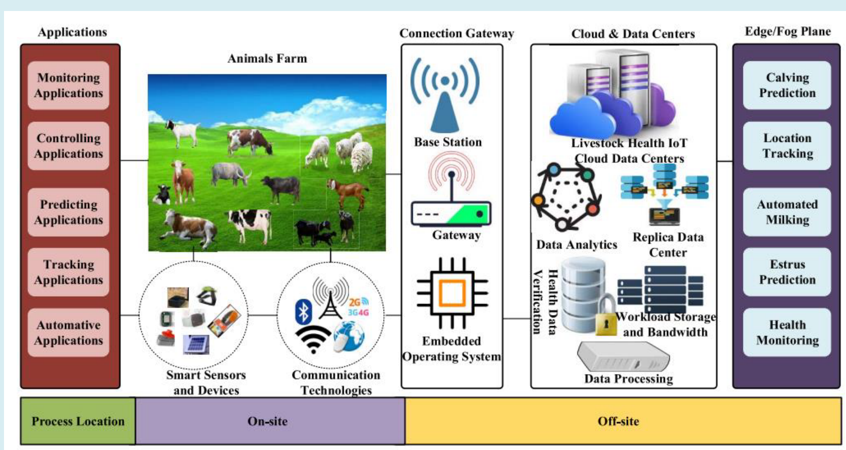

Figure 2: IOT Livestock Network Cloud Platform (A survey of IoT in Agriculture for smart livestock farming by IEEE Access 2021-2022 [32]).

This system is a promising new technology that has the potential to improve the health and welfare of animals.

Some Additional Details about the System

The Arduino Uno is a small, open-source microcontroller board that can be programmed to perform a variety of tasks. The Ethernet Shield is a device that can be attached to an Arduino Uno to allow it to communicate over a network. Blynk is an app that can be used to send and receive data from an Arduino Uno. The sensors that are used in this system can measure the animal's body temperature, respiration, heartbeat, and motions [33,34]. The data that is collected by the sensors is sent to the Arduino Uno. The Arduino Uno then sends the data to the doctor's mobile phone using the Ethernet Shield. The doctor can then use the Blynk app to view the animal's health graph.

Arduino Uno: The Arduino UNO micro controllers are readily available for a wide variety of applications. The Arduino UNO microcontroller cost is low. Nowadays instead of PIC microcontroller Arduino UNO is used because it is more flexible. The signals arriving from the sensors are finally sent to the Ethernet shield through Arduino and from the Shield module to the health monitoring app or Blynk.

GPS/GSM Module: The GSM modules are low cost, small and maintain SIM network connection and encryption in client mode and access point mode. SIM module communication is done through attention type commands and data. A GPS Module is a simple device which receives information from GPS Satellites and then calculates the device's geographical position. It is used to provide the suitable location of the livestock on a map.

ESP8266 is a Wi-Fi module which allows communicating and sharing data to ThingSpeak and cloud via the internet. It will also help our cloud server to communicate to mobile application.

Software

Arduino IDE: The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

ThingSpeak: ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyse live data streams in the cloud. You can send data to ThingSpeak from your devices, create instant visualization of live data, and send alerts.

Android App: Android App is used to give farmers an easy way to interact with the data visualizations and make the user interface easy for them.

Results

Results of the experiment: The system was able to successfully collect data on the cattle's health, including body temperature, respiration, heartbeat, and activity level. The data was collected and stored on a central server. The data was analyzed using algorithms to identify any abnormalities in the cattle's health. If any abnormalities were detected, alerts were sent to the farmer's mobile phone. The system was tested on a herd of 10 cattle. The data collected over a period of 3 months showed that the system was able to successfully detect early signs of illness or disease. In one case, the system detected a rise in body temperature and respiration in one of the cattle. The farmer was alerted and the cattle was taken to the vet for treatment. The vet diagnosed the cattle with pneumonia and the cattle was successfully treated. The system is still under development, but it has the potential to revolutionize the cattle farming industry. The system can help farmers to improve the health and productivity of their livestock operations by:

- Early detection of illness or disease
- Reduced need for veterinary care
- Improved productivity

The system is also cost-effective and easy to use. The sensors used in the system are relatively inexpensive and easy to install. The central server is a cloud-based platform that is scalable and reliable. The software is user-friendly and can be accessed from any device with an internet connection. Overall, the results of the experiment are promising. The system was able to successfully collect data on the cattle's health, identify any abnormalities, and send alerts to the farmer's mobile phone. The system is still under development, but it has the potential to revolutionize the cattle farming industry.

Discussion & Future Scope

There are many potential future scopes for cattle health monitoring system, including [35-39].

- **Advanced data analysis:** With the help of machine learning and artificial intelligence techniques, the system can analyze the data collected from the cattle health monitoring sensors more accurately and provide valuable insights for farmers.
- **Remote monitoring:** The future cattle health monitoring system may allow farmers to monitor the health of their cattle remotely, without the need for physical proximity. This could be useful for farmers who have large herds or for those who cannot be on-site all the time.
- **Precision Livestock Farming (PLF):** The cattle health monitoring system can be integrated with PLF technologies, such as automated feeding systems, to provide a more holistic approach to livestock management.
- **Early disease detection:** With the help of advanced sensors and analytics, the cattle health monitoring system can detect early signs of diseases in cattle, allowing farmers to take prompt actions and reduce the risk of spreading the disease to other animals.
- **Integration with blockchain:** The cattle health monitoring system can be integrated with blockchain technology to provide a more secure and transparent way of storing and sharing the data collected from the sensors.
- **Customized health plans:** The future cattle health monitoring system may provide customized health

plans for individual cattle based on their specific health conditions and history.

- **Integration with precision medicine:** The cattle health monitoring system can be integrated with precision medicine techniques to provide personalized treatment plans for cattle.

These are just some of the possible future scopes of a cattle health monitoring system. As technology advances, there will likely be more opportunities for innovation and improvement in this area. It is exciting to think about the potential benefits of these technologies for the livestock industry and for animal welfare.

Conclusion

The cattle health monitoring system is a promising technology that can significantly improve the health and productivity of livestock. Through the use of various sensors and monitoring devices, farmers can detect health issues early on and take the necessary actions to prevent diseases and other health problems. This system can also help reduce the use of antibiotics and other medication, thereby minimizing the risk of antibiotic resistance.

The development of the cattle health monitoring system is still in its early stages, and there is much scope for further research and development. Future efforts should focus on improving the accuracy and reliability of the sensors, as well as reducing the cost of implementation. Additionally, there is a need for the development of user-friendly interfaces and software platforms that can facilitate easy data management and analysis.

Overall, the cattle health monitoring system has the potential to revolutionize the livestock industry by improving the health and productivity of cattle while also reducing the environmental impact of livestock farming. It is hoped that this technology will be adopted widely in the future, leading to healthier, more sustainable, and more profitable livestock farming practices (Figure 3).

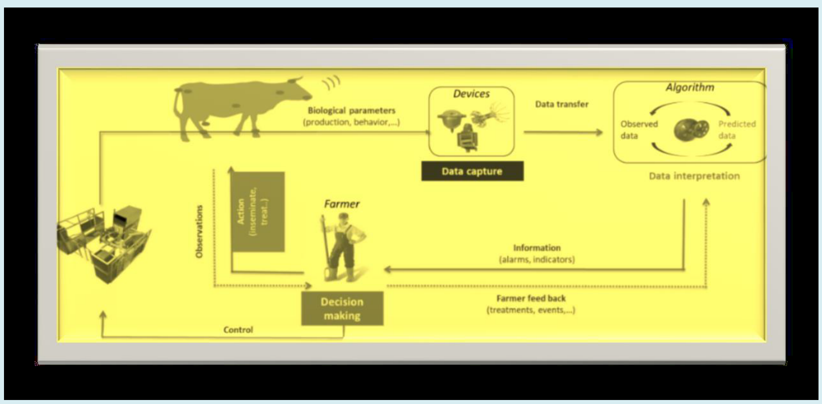

Figure 3: System Architecture [40].

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