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Cattle Health Monitoring System using IoT

Sumit D Kuldharan[1], Shivani S Kadake[2], Nilesh K Kamble[3], Mohit M Bhavsar[4], and Dr. Kishor N Honwadkar[5]
Students, Department of Computer Engineering[1,2,3,4]
Professor, Department of Computer Engineering[5]
Smt. Kashibai Navale College of Engineering, Pune, Maharashtra, India

Abstract: *Diseases negatively impact the productivity of dairy cows and the production of milk. The challenge lies in the early detection and treatment of sick cows, due to the lack of continuous monitoring and the limited knowledge of breeders about various diseases. To address this issue, this study presents the development of a comprehensive dairy cattle health manage- ment system, aimed at monitoring cow health and detecting and treating diseases. By collecting temperature and pulse data from sensors, the system is able to assess the health condition of cows and distinguish between normal and abnormal results.*

Keywords: Internet of things (IoT), Temperature, HeartRate, Milk Production, Sensor, Cloud, Farmer, Doctor

I. INTRODUCTION

In rural areas of developing countries like India, many people depend on cattle for their livelihood, relying on dairy products and manual labor for agriculture. However, unavail- ability of veterinary care in these areas can make it difficult to monitor the health of their cattle and detect any signs of deterioration. This can result in costly trips to urban areas, with the potential of being a waste of time and resources if the cattle's health is not actually poor. To address this issue, this paper presents a solution in the form of an online cattle health monitoring system. With limited research focused on cattle health and the importance of agriculture and animal husbandry in improving a country's economy, this system represents a step forward in improving the well-being of cattle. Regular monitoring of cattle health is crucial to prevent the spread of communicable diseases and maintain production quality and quantity. In the past, monitoring cattle health was a manual and labor-intensive process, but this system aims to automate this process with minimal human intervention. In India, where a significant portion of the population still relies on cattle for their livelihood, it is crucial to maintain the health of these animals. The absence of veterinary services in rural areas makes it difficult for farmers to monitor the well- being of their cattle, and if the animals fall ill, the farmers have to bear the high cost of traveling to urban areas for medical attention. To tackle this issue, this paper presents an online cattle health monitoring system that enables farmers to monitor their cattle's health in real-time. This system can measure parameters like heart rate, temperature, rumination and body humidity. The agriculture sector plays a crucial role in the development of a country, with India's agriculture sector contributing 18% of its Gross Domestic Product and employing 50% of its workforce. The well-being of cattle is an essential factor in maintaining the productivity and quality of food and non-food products. Regular monitoring of cattle health can prevent the spread of communicable diseases and increase production. This system aims to simplify the effort of laborers by automating the process of cattle health monitoring, analyzing data for any possible illness, and requiring minimal human intervention.

1.1 Problem Identification

Developing countries such as India heavily rely on cattle farming for their economic growth, but the lack of advanced technology and resources makes it difficult for farmers to monitor the health of their cattle effectively. Most of these people depend on dairy products and use cattle for agricultural purposes, which means that the health of their cattle directly impacts their financial stability. However, in rural areas, there is a scarcity of veterinarians, and many farmers have to travel far distances to access their services, which can be costly and time-consuming. Moreover, in the absence of proper monitoring, cattle health deteriorates, leading to a decrease in productivity and quality of dairy products. In the traditional method of monitoring, cattle health was assessed manually, which was a labor-intensive task and required a

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lot of human intervention. This method also made it challenging to detect any signs of sickness in the early stages.
In view of this, there is a need for an automated systemthat can monitor the health of cattle regularly, analyze the data, and identify any possible signs of sickness, reducing the effort required from farmers and improving the well-being of their cattle.

II. MOTIVATION

Cattle farming is an essential part of the agricultural sector, and the health of the cattle is crucial for maintaining produc- tivity and profitability. However, monitoring the health of the cattle is a challenging and time-consuming task for farmers. Therefore, there is a need for an automated system that can continuously monitor the vital parameters of the cattle and provide real-time information to the farmer. Such a systemcan help farmers detect health issues early, provide prompt treatment, and reduce the risk of cattle death. The developmentof such a system can greatly benefit the cattle farming industryand improve the well-being of the cattle.

III. RELATED WORK

Over the past few years, there has been an increasing interestin the monitoring of cattle health to enhance agricultural productivity. Many researchers have developed various systems to monitor the health of cattle and to detect signs of diseases. Some of these systems use wearable devices, such as sensors and monitoring systems that are placed on the cattle to gather data about their health conditions. Other systems use non- invasive techniques such as imaging and monitoring of the cattle's behavior patterns. Some of these systems also include decision support systems that use machine learning algorithmsto analyze the collected data and to provide insights into the health of the cattle.
However, despite the numerous advancements in cattle health monitoring systems, there are still challenges that need to be addressed. For example, the cost of these systems remains high, which makes them inaccessible to many farmersand rural communities. Additionally, many of these systems require a significant amount of technical expertise to install and operate, which can be a barrier for farmers who lack such expertise. Finally, many of these systems have limited capabilities, such as the ability to detect only a few types of diseases, which can lead to the spread of other diseases thatare not being monitored.
The need for a low-cost, easy-to-use, and comprehensive cattle health monitoring system that is accessible to farmers and rural communities in developing countries is evident. To address this need, it is crucial to conduct further research on cattle health monitoring systems that are affordable, accessible,and easy to use, while also being able to detect a wide range of diseases. In recent years, there has been a growing interest in monitoring the health of cattle to improve the productivity of the agricultural sector. Many researchers have developed various systems to monitor the health of cattle and to detect signs of diseases. Some of these systems use wearable devices, such as sensors and monitoring systems that are placed on the cattle to gather data about their health conditions. Other systems use non-invasive techniques such as imaging and monitoring of the cattle's behavior patterns. Some of these systems also include decision support systems that use machine learning algorithms to analyze the collected data and to provide insights into the health of the cattle.
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IV. LITERATURE SURVEY

In recent years, monitoring the health of cattle has becomea growing concern as a result of increasing health issues anda decrease in milk production. The literature survey for this project aims to explore existing works and technologies that have been developed for cattle health monitoring.

[1] This paper proposes a solution to these problems bypresenting a monitoring system that continuously tracks the health parameters of cattle using three sensors. The system consists of a temperature and humidity sensor, a heart rate sensor, and a rumination sensor, all of which are connectedto an Atmega328p microcontroller. The collected data is then transferred from the Atmega328p to a NodeMCU device through serial communication, which requires network con- nectivity due to the presence of an ESP module. The data is finally transmitted to the ThingSpeak online platform, where itis visualized and analyzed using the MATLAB Analysis Tool available on the platform.

[2] An innovative animal health monitoring system that leverages IoT technology has been developed to provide real-time monitoring of crucial physiological parameters such as body temperature, heart rate, and rumination, along with the surrounding temperature and humidity. The system makes use of multiple sensors that are placed on the animal's body to gather health data, which is processed by a Raspberry Pi3, acting as the core controller, that has built-in Wi-Fi. The collected information is displayed on a monitor and transmitted to the cloud, where it can be accessed from any location using the internet and an android application. [3]Cattle farming is a crucial aspect of agriculture and maintaining the health of a large number of cattle can be a challenging task.To address this challenge, this study proposes the developmentof an IoT-based system for monitoring the temperature and heartbeat rate of cattle in real-time. The system utilizes sensorssuch as temperature and heart rate sensors and software like ThingSpeak and Rasbian OS to gather and analyze the data. The temperature and heartbeat rate of cattle are monitored and transmitted to the Raspberry Pi, which then sends the information to the ThingSpeak software for display. The software shows the temperature, heartbeat rate, and location of the cattle and includes a hyperlink that leads to a map displaying the location of the cattle. The collected data is also sent to the cloud, where it is monitored for any discrepancies. If any issues are detected, an alert message is sent to the user.

V. METHODOLOGY

5.1 Overall Approach

This system contains the collar placed around the neck of cow with temperature sensor and heart rate sensors. It records the data periodically and stores it on the cloud. Farmers can seethe temperature and heart rate of cow directly through androidapplication. If the temperature or heart rate are abnormal then it sends alert to the farmer. Also it suggests the treatments andseason wise disease precautions. Doctors are also connected with farmers using android application. Doctor can schedules visits also they can alerted if the connected farmer cow is abnormal.

5.2 Measurement Parameters

The measurement parameters in this system can refer to various physiological and environmental factors that are being monitored to assess the health and well-being of the cattle. These can include:

1. Body temperature: This is an important parameter that indicates the internal body temperature of the animal and can indicate any potential health issues.
2. Heart rate: The heart rate of the animal can also indicatepotential health problems and is important to monitor.
3. Surrounding temperature and humidity: These environ- mental parameters can also impact the health of the cattle and are important to monitor
4. Rumination: This refers to the process of regurgitation and re-chewing of food by the cattle and is an important indicator of digestive health.

All these parameters are collected and monitored continuously by the system through various sensors and then processed and analyzed to identify any potential health problems. Normal physiological parameters of cattle:

Parameter	Normal Value
Body temperature	101.5 - 102.5°F
Heart rate	40-100 beats per minute

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Respiration rate	40-100 beats per minute
Rumination rate	1-4 times per minute

Table I: Normal Measurements Values

5.3 Proposed System Architecture

The proposed cattle health monitoring system consists of multiple components that work together to provide real-time information about the health status of the cattle. The temperature sensor and heart rate sensor are attached to the cattle and continuously monitor their temperature and heart rate. These sensors collect the data and transmit it to the microcontroller. The microcontroller is responsible for processing the data from the sensors, validating it and storing it. The microcontroller is connected to a cloud storage platform, such as Firebase, where the processed data is uploaded. The cloud platform provides access to the data through a user- friendly interface, allowing the farmer to view the real-time information about the cattle. In case the temperature or heart rate of the cattle exceeds the normal limits, the microcontroller sends an alert to the farmer as well as the veterinarian. The veterinarian can then take necessary actions and provide the required treatment to the cattle. The architecture also includes an Android app that allows the farmer to view the information about the cattle from anywhere and at any time. The app is connected to the cloud platform and provides a real-time view of the cattle's temperature, heart rate and other physiological parameters. Overall, the system architecture provides a complete solution for monitoring the health of the cattle, ensuring that the farmer has real-time information about the cattle's health and can take necessary actions in case of any health issues.

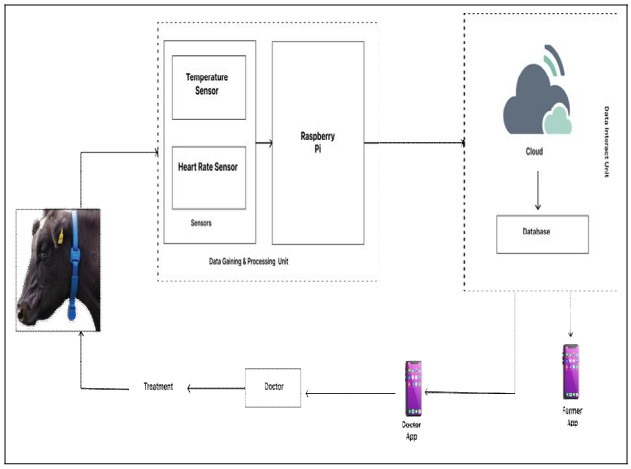

Fig. 1. Proposed System Architecture.

5.4 Communication Protocol

The communication protocol used in this project is Serial Communication. The temperature and heart rate sensors collect the data and send it to the microcontroller. The microcontroller processes the data and sends it to the cloud storage using the serial communication protocol. The data is transmitted using the serial communication protocol as it provides re- liable, secure and fast data transmission. Additionally, the serial communication protocol enables the microcontroller to communicate with other devices such as the cloud storage and alert system. The serial communication protocol used in this project is the RS-232 protocol which is commonly used in IoT applications for data transmission.

VI. CHALLENGES

- Integration of sensors with microcontroller: The compatibility of the sensors with the microcontroller used in the system needs to be ensured.
- Data Processing: High accuracy and efficient data processing is a crucial challenge in this project, as it is important to make sure that the recorded data is correct and the analysis is done accurately.
- Data Transmission: The transmission of data from the microcontroller to the cloud storage is a challenging task

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as it should be done securely and with a fast data rate.

- Power Management: The system should have efficient power management, as it will be installed in remote locations and may not have access to a power source.
- Cost Effectiveness: The cost of the system should be rea- sonable, and the components used should be affordable, while still ensuring quality and reliability
- Real-time Monitoring: Real-time monitoring of the health parameters is crucial in this project. The system shouldbe able to provide real-time updates to the farmer and thedoctor.
- User Interaction: The system should be easy to use and accessible to the farmer and the doctor. The user interfaceshould be user-friendly and easy to navigate.

VII. APPLICATIONS

1. Livestock Monitoring: This system can be used to con- tinuously monitor the health parameters of cattle and alert the farmer in case of any health abnormalities.
2. Disease Prevention: With real-time monitoring, the sys- tem can detect and prevent diseases before they spread and become serious.
3. Livestock Management: The system helps in keeping track of the health status of all the cattle in a farm, reducing the time and effort required to manually inspecteach animal.
4. Feed Management: With real-time monitoring of rumi- nation, the farmer can assess the feeding patterns of the cattle and make necessary changes to improve their health.
5. Breeding Management: The system can assist in breed- ing management by detecting changes in health parameters during pregnancy and other critical stages of the cattle's life cycle.

VIII. LIMITATIONS

1. Maintenance: Regular maintenance of the sensors, microcontroller, and other components may be necessary to ensure accurate and reliable data collection and trans-mission.
2. Power Availability: The system relies on a constant power supply, which can be disrupted in areas with unreliable power supply.
3. Compatibility: Compatibility with different breeds and species of cattle may be a challenge, as different breeds may have different parameters for what is considered normal.

IX. CONCLUSION

The cow health monitoring system highlights the impor- tance of technology in enhancing animal health and farming practices. The system provides a cost- effective and efficient way to monitor the vital signs of cows in real-time and make necessary interventions to improve their health and well-being.The implementation of the time-series analysis and machine learning algorithms makes it a robust solution for farmers and stakeholders to monitor the health of their cattle. Despite some limitations such as battery issues and server failures, the system underlines has shown significant potential in improvingthe quality of life for cows and the overall farming industry.

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