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Cattle Health Monitoring System using IoT

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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, Heart Rate, 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.

II. RELATED WORK

Over the past few years, there has been an increasing interest in the monitoring of cattle health to enhance agricultural pro- ductivity. 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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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 farmers and 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 that are 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.

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III. PROPOSED SYSTEM

Sensors base technology use for biomedical application, size is the one of the important constraint. The sensors base device must be moderate in size and weight. However the sensors use in such device must able to detect body temperature and heart beats which is play important role in medical treatment.

3.1 Overall Design

Fig. 1. Overall Design.

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3.2 System Architecture

The 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 DS18B20 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 ESP8266. The ESP8266 is responsible for processing the data from the sensors, validating it and storing it.

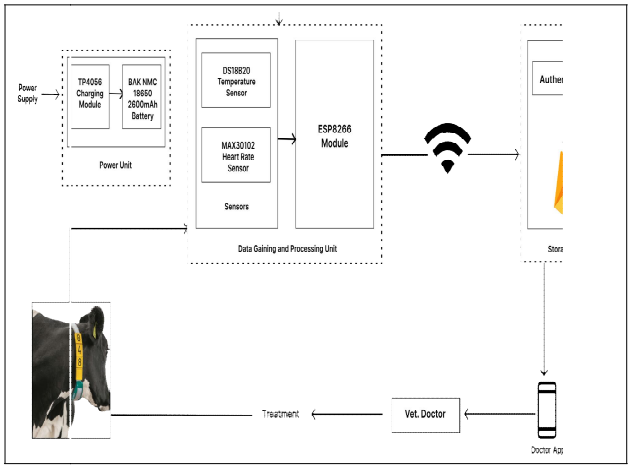

Fig. 2. System Architecture.

The ESP8266 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 ESP8266 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.

IV. HARDWARE COMPONENTS

4.1 DS18B20 Temperature Sensor

Fig. 3. DS18B20 Sensor Module

The DS18B20 is one type of temperature sensor and it supplies 9-bit to 12-bit readings of temperature. These values show the temperature of a particular device. The communication of this sensor can be done through a one-wire bus protocol which uses one data line to communicate with an inner microprocessor. The accuracy of this sensor is ±0.5°C.

4.2 MAX30102 Sensor

The MAX30102 sensor module is typically used in wearable devices such as smart watches and fitness trackers, where it provides continuous monitoring of heart rate and oxygen saturation. The module can also be used in medical equipment such as patient monitors and pulse oximeters for non-invasive monitoring of vital signs.

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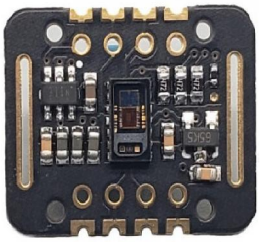

Fig. 4. MAX30102 Sensor Module

4.3 ESP8266 WiFi Module

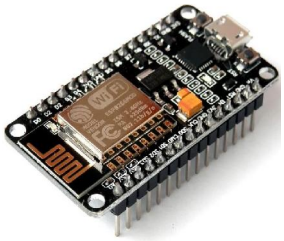

Fig. 5. ESP8266 WiFi Module

The continuously sensed data from thermistor and heartbeat sensors are transferred by the ESP 8266 WiFi module to the server. The ESP8266 is a small module which allows microcontrollers to connect to Wi-Fi network and make simple TCP/IP connections. In this system the ESP8266 collects data from sensors and sends it to firebase database.

4.4 TP4056 1A Li-ion lithium Battery Charging Module

This TP4056 1A Li-Ion Battery Charging Board Type C with Current Protection is a tiny module, perfect for charging single cell 3.7V 1 Ah or higher lithium-ion (Li-Ion) cells such as 16550s that don't have their own protection circuit. Based on the TP4056 charger IC and DW01 battery protection IC this module will offer 1A charge current then cut off when finished.

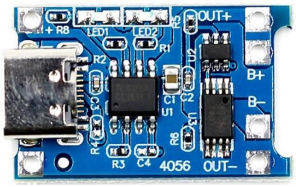

Fig. 6. TP4056 1A Li-ion lithium Battery Charging Module

4.5 BAK NMC 18650 2600mAh (3c) Lithium-Ion 3.6V Battery

Fig. 7. BAK NMC 18650 2600mAh (3c)

BAK NMC 18650 2600mAh (3c) Lithium-Ion 3.6V Bat- tery is a single cell compact and powerful battery cell with 2600mAh capacity. It is very convenient to install in your project where 3.6 Volt with high capacity is needed.

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V. SYSTEM MODULES

There are some modules of the system. The main modules of the system as given below:

1. Cow Collar- This module comprises various temperature and heart rate sensors, to collect and transmit data to the web admin app. It also includes the TP4056 1A Li-ion lithium Battery Charging Module to power the system.
2. Web Admin App- This module serves as the system's backbone, allowing authorized users to manage and monitor the various components. All the treatments, suggestions, and service areas are managed from here.
3. Farmer App- This module is designed for farmers to access and view real-time data regarding their cattle's health. It provides farmers with alerts when any ab- normal conditions are detected, allowing them to take necessary actions.
4. Doctor App- This module is designed for veterinarians to access data and reports about cattle's health. The doctor app provides veterinarians with the ability to access data about the health of cattle remotely, improving their ability to provide necessary medical care.

VI. METHODOLOGY

6.1 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 see the temperature and heart rate of cow directly through android application. If the temperature or heart rate are abnormal then it sends alert to the farmer. Also it suggests the treatments and seasonwise 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.

6.2 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 indicate potential 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

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
Respiration rate	40-100 beats per minute

TABLE I: Normal Measurements Values

VII. RESULTS

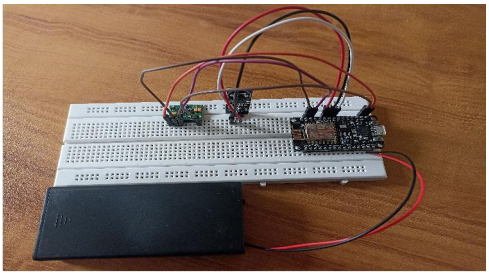

Fig. 8. Hardware Connections

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Fig. 9. Cow Collar

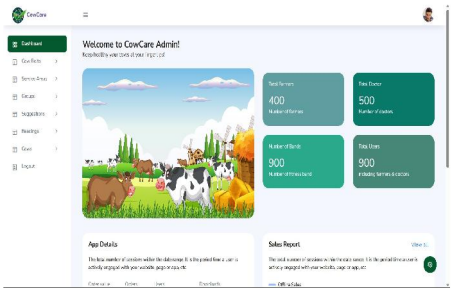

Fig. 10. Admin Dashboard

Fig. 11. Farmer Dashboard

VIII. APPLICATIONS

- 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.
- Disease Prevention: With real-time monitoring, the sys- tem can detect and prevent diseases before they spread and become serious.
- 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 inspect each animal.
- 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.
- 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.

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IX. CONCLUSION

The cow health monitoring system highlights the importance 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 improving the quality of life for cows and the overall farming industry.

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