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Integrated Cattle Health Monitoring System with Smart Neck Belt and Mobile Application

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***Abstract*— This abstract introduces an innovative Cattle Health Monitoring System (CHMS) designed for real-time health tracking. The system incorporates a smart neck belt equipped with sensors to measure temperature, pulse rate, andlocation of individual cattle. Data collected by the neck belt is wirelessly transmitted to a centralized unit for analysis. Additionally, a user-friendly mobile app provides farmers withreal-time health data, historical trends, and personalized recommendations for herd management. This integrated solution empowers farmers to enhance animal welfare, improve productivity, and ensure sustainable practices**

***Keywords*— Cattle Health Monitoring, Smart Neck Belt, Real-time Data, Livestock Management, Wireless Transmission, MobileApplication**

I. INTRODUCTION

In recent years, the Internet of Things (IoT) has catalyzed transformative changes across industries, revolutionizing agriculture and livestock management practices. Central to modern farming operations is the critical task of monitoring livestock health, given its direct impact on productivity and profitability. Traditional manual methods of health monitoring are labor-intensive, time-consuming, and susceptible to human error. [1].

Traditional methods of cattle health monitoring relying on manual observation are labor-intensive, time-consuming, and prone to oversight. To address these challenges, this paper proposes an innovative IoT-based cattle health monitoring system designed to continuously monitor key health parameters in real-time [2]. Leveraging IoT sensors and sophisticated data analytics, this system aims to provide farmers with timely insights into individual cattle health and overall herd conditions, facilitating early detection of health issues and enabling proactive intervention. The system's objectives include automating continuous monitoring, applying data analytics to detect abnormalities, and delivering actionable information through user-friendly interfaces [3] Incorporating real-time insights through IoT-based cattle health monitoring systems is fundamental for modern agriculture, aiming to optimize productivity, mitigate economic losses associated with health issues, and revolutionize traditional livestock management practices. By continuously monitoring key health parameters such as temperature, heart rate, and activity levels using IoT sensors and data analytics, farmers gain immediate visibility into individual cattle health statuses and overall herd conditions [4]. This proactive approach enables early detection of health anomalies, facilitating timely interventions and preventive measures to maintain optimal herd health and minimize disease outbreaks. The automated nature of IoT-based monitoring not only streamlines operational efficiency but also reduces labor costs and human error, ultimately enhancing accuracy in health assessments. [5]

This transformative shift towards smart farming not only improves the overall efficiency and sustainability of agricultural practices but also fosters advancements in precision agriculture and animal welfare standards. As such, the implementation of IoT-enabled solutions in cattle health monitoring represents a pivotal step towards harnessing technology to address complex challenges in modern agriculture and livestock management. [6].

II. IOT BASED CATTLE HEALTH MONITORING

OVERVIEW OF SYSTEM

A cattle health monitoring system employs sensors to collect data on parameters like body temperature, activity levels, and heart rate, transmitting it to a central point for analysis. Machine learning algorithms detect abnormalities, triggering real-time alerts to farmers or veterinarians via SMS or a mobile app. Historical data storage allows tracking of individual cattle health over time, aiding in trend identification. Integration with farm management systems

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enhances overall farm efficiency, leading to better health outcomes and increased productivity.

A Flowchart to define process of IOT based cattle heath system. The flowchart for the system with data over cloud using an NodeMCU esp32 controller is shown below:

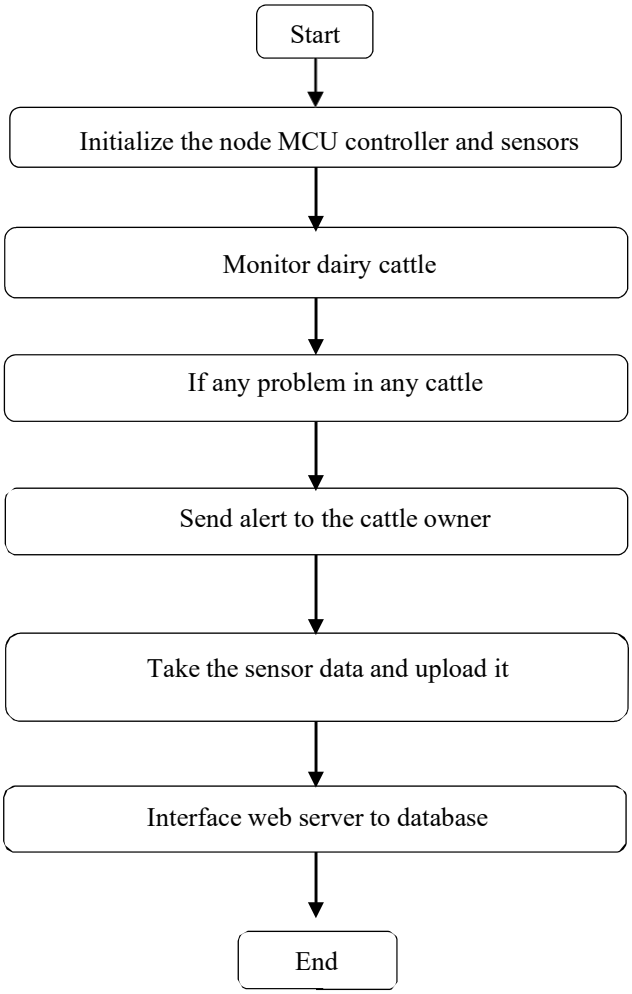

Figure.1: Flowchart for iot based cattle health monitoring system system

Fig.1 Sensor Integration: The system begins with integratingvarious sensors onto the cattle to collect health-related data. These sensors can include temperature sensors, GPS modulesfor location tracking, and pulse rate sensors. These sensors are attached to the cattle in a non-invasive and comfortable manner.

Data Collection: The sensors continuously monitor the healthparameters of the cattle. The data collected by the sensors include temperature, location coordinates, and pulse rate. Each sensor is programmed to collect data at regular intervals.

Data Transmission to NodeMCU: The data collected by the sensors are transmitted to a NodeMCU. The NodeMCU acts as an intermediary device that collects data from all the sensors attached to the cattle.

Firebase Integration: The NodeMCU is connected to the internet, via Wi-Fi. It sends the collected data to Google Firebase, a cloud-based platform that provides various services like real-time database and storage.

Firebase Database Storage: In Firebase, the data received from the NodeMCU is stored in a real-time database. This database allows for efficient storage and retrieval of data.

Android Application Development: An Android application is developed using Android Studio. The application is designed with a user-friendly interface for cattle owners or caretakers to monitor the health of their cattle remotely.

Integration with Firebase in Android App: The Android application is integrated with Google Firebase. It authenticates users and establishes a connection with the Firebase real-time database to fetch the health data of the cattle.

Real-time Data Display: The Android application retrieves the health data stored in the Firebase database and displays it to the user in real-time. The user can see parameters such as temperature, location, and pulse rate of their cattle on their smartphone.

Alerts and Notifications: The Android application can be programmed to send alerts or notifications to the user if any health parameter exceeds predefined thresholds. This allows the user to take timely action in case of any health issues with their cattle.

A. Block diagram of battery charging system The Fig.2 shows the different components of the control circuit of battery charging system.

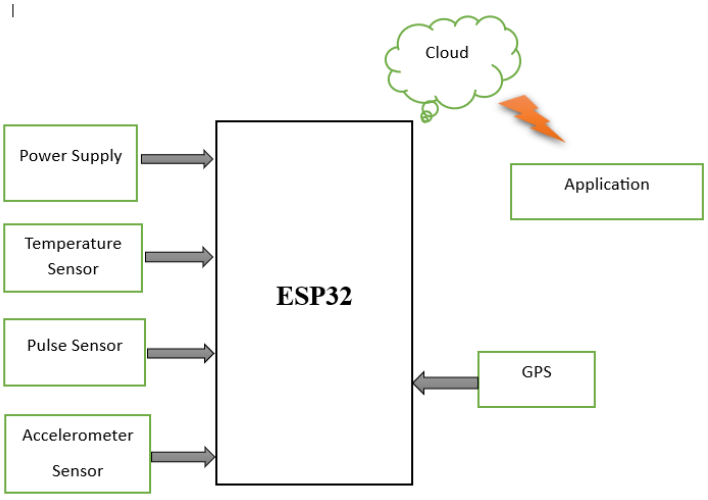

Figure.2: Block diagram of cattle health monitoring system using IOT

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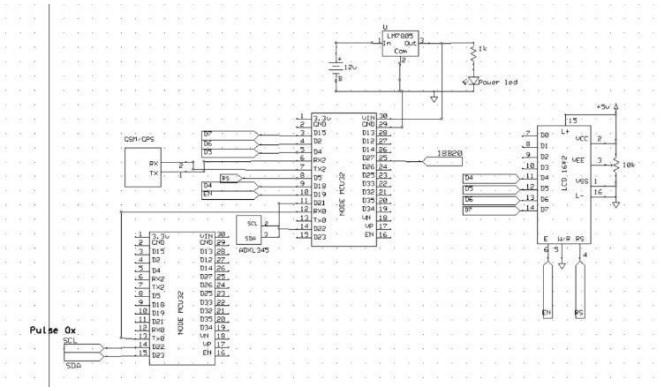

Fig.3: Circuit diagram of cattle health monitoring system using IOT

- Sensor Node: Sensors attached to the cattle gather crucial health data such as body temperature, pulse rate, and movement patterns, providing comprehensive insights into the animals' well-being.
- Data Transmission: Utilizing wireless communication technologies like Wi-Fi or Bluetooth, the sensor nodes transmit the collected data seamlessly to the central data processing platform, ensuring real-time monitoring and analysis.
- Data Processing and Analysis Platform: At the heart of the system, a sophisticated data processing and analysis platform employs specialized algorithms to analyze the incoming data streams. Through in-depth analysis, it identifies potential health issues or abnormalities in the cattle's physiological parameters.
- Early Detection: The platform's advancedalgorithms enable the early detection of health issues, allowing for timely intervention and treatment. This proactive approach minimizes the severity of illnesses and reduces economic losses for farmers.

Component	Parameters	Values
Node MCU ESP32	Main Processor Operating voltage Digital I/O pins Analog input pins Clock Speed USB connector	• • LX6 dual-core • • 5V – 12V • 14 pins • 6 pins • 240MHz USB-B

B. Hardware components and information

- Historical Trend Analysis: By continuously analyzing historical data trends, the platform provides valuable insights into the long-term health patterns of individual cattle. This enables farmers to make informed decisions regarding breeding, nutrition, and overall herd management strategies.
- Customized Alerts: Upon detecting any deviation from normal health parameters, the system triggers customized alerts tailored to the specific needs of farmers or veterinarians. These alerts can be delivered via SMS, email, or through a dedicated mobile application for immediate attention and action.
- Remote Monitoring: With its wireless capabilities, the system allows for remote monitoring of cattle health parameters from anywhere, providing farmers with flexibility and convenience in managing their livestock operations.
- Improved Animal Welfare: By facilitating early detection and intervention, the system contributes to improved animal welfare standards, ensuring the well-being and health of the cattle while supporting sustainable farming practices.

Temperature Sensor	Supply Voltage Measure Range Accuracy	• 3V – 5.V DC • -55C-150C • +/-0.5
GPS	Input Voltage Range	• 2.7V-3.6V •
Accelerometer sensor	Voltage Operating Current	• 2V-3.6V • 150 micro ampere
Resistor	Resistance Wattage	• 1K •0.25
Pulse sensor	Operating VoltageCurrent	•3.3V-5V •4mA
Wires	Jumper and Normal Wires	

Table I: Specifications of components used in battery charging system

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Figure.4: Experimental set-up of system

III. RESULTS AND DISCUSSIONS

Early Detection of Health Issues: The system enables early detection of health issues through continuous monitoring of vital parameters such as temperature, activity levels, and heart rate. Real-time alerts allow for prompt intervention and treatment, reducing the severity of illnesses and minimizing economic losses.

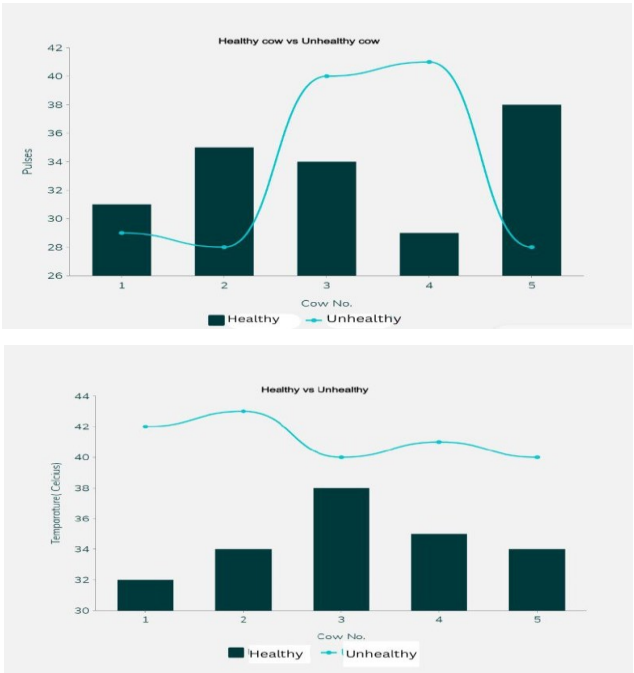

Figure.5: readings of experimental set-up

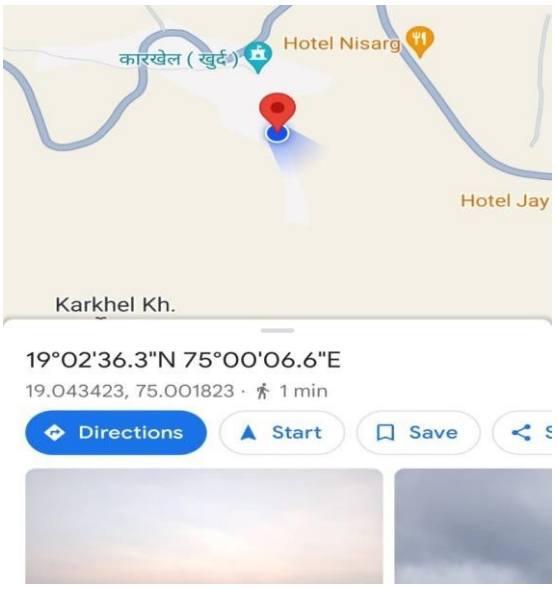

Figure.6: GPS reading of experimental set-up

Data-Driven Decision-Making: Historical health data for each animal facilitates data-driven decision-making. Farmers can track health trends over time, identify patterns,and adjust management practices accordingly, leading to proactive adjustments in diet or husbandry practices.

Operational Efficiency: Integration with farm management software streamlines operational efficiency by centralizing health data alongside other farm data. This integration supports better resource allocation, improves long-term planning for herd health and productivity, and enhances overall farm management.

Improved Animal Welfare: The system contributes to improved animal welfare by providing continuous monitoring and timely intervention for health issues. This ensures the well-being of the cattle and supports sustainable farming practices.

Enhanced Productivity and Profitability: By optimizing health outcomes and minimizing risks, the cattle health monitoring system ultimately contributes to enhanced productivity and profitability of farming operations. It helps farmers make informed decisions, reduce veterinary costs, and maximize the potential of their livestock.

IV. CONCLUSION

In conclusion, a cattle health monitoring system is a valuable tool for modern farming operations. Our IoT-based cattle health monitoring system is a significant improvement over previous methods. It uses the ESP32 with built-in Wi-Fi, a new generation GPS with a long antenna for precise tracking, and waterproof, low-power sensors. The system is efficient, achieving 90% efficiency, and cost-effective, with a prototype costing only 2000 INR. Real-time data and notifications are handled via Firebase and an Android app, making it user-friendly and practical for farmers.ultimately contributing to the success and sustainability of livestock operations.

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