

GPS Based Health Alert System for Livestock Herd for Remote Access

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Abstract— This project presents a GPS-based health alert system for livestock herd monitoring using Internet of Things (IoT), embedded systems, and wireless communication technologies. Managing large livestock herds in remote and wide geographical areas using traditional methods is difficult, labor-intensive, and often ineffective. Farmers frequently face problems such as delayed disease detection, animal theft, wandering livestock, and lack of real-time monitoring, which lead to economic losses and reduced farm productivity. To overcome these challenges, the proposed system introduces a wearable smart neckband integrated with sensors such as GPS module, temperature sensor, and accelerometer. The system is built around the ESP32 microcontroller, which processes real-time data and enables wireless communication through Wi-Fi/GSM technology. The temperature sensor continuously monitors the body temperature of livestock, while the accelerometer tracks animal movement and activity patterns. The GPS module provides live location tracking and geofencing functionality. The collected sensor data is continuously compared with predefined threshold values to identify abnormal conditions such as fever, prolonged inactivity, or movement outside the predefined geographical boundary. Whenever an abnormal condition is detected, the system immediately generates an alert and sends the real-time location and health information to the farmer through a Telegram bot or mobile

monitoring interface. The system operates using a rechargeable Li-ion battery, making it portable and suitable for remote environments. The proposed model provides an efficient, low-cost, and reliable solution for smart livestock monitoring and helps improve livestock safety, productivity, and farm management.

Keywords— *IoT, Livestock Monitoring, GPS Tracking, ESP32, Health Monitoring, Telegram Bot, Remote Access.*

INTRODUCTION

Livestock farming is an important part of the agricultural economy and contributes significantly to rural livelihoods and food production. Farmers managing large herds often face difficulties in continuously monitoring the health and location of livestock, especially in remote grazing areas. Traditional livestock management methods mainly depend on manual observation, which is time-consuming, labor-intensive, and reactive in nature. This frequently results in delayed identification of diseases, increased mortality rates, animal theft, and economic losses.

In recent years, advancements in Internet of Things (IoT), embedded systems, GPS tracking, and wireless communication technologies have enabled the development of smart monitoring systems for agriculture and livestock management. IoT-based livestock monitoring systems provide real-time tracking, remote access, automated alerts, and efficient herd management. Such systems reduce the dependency on manual supervision and improve the overall efficiency of livestock farming.

The proposed GPS-Based Health Alert System for Livestock Herd for Remote Access is designed to address

these challenges by integrating sensors, GPS technology, and wireless communication into a wearable smart neckband. The system continuously monitors livestock health parameters such as body temperature and movement activity while also tracking real-time location. The collected data is processed using the ESP32 microcontroller and transmitted to the farmer through a Telegram bot or mobile monitoring system. Whenever abnormal conditions such as high temperature, inactivity, or geofence violations are detected, the system immediately generates an alert to notify the farmer. This enables quick intervention and prevents possible losses. The proposed system offers a low-cost, portable, and efficient solution for modern precision livestock farming.

A. LITERATURE SURVEY

This literature review focuses on recent developments in IoT-based livestock monitoring systems and smart animal health management technologies. A. B. Bhatla et al. [1] developed a real-time cattle health monitoring system using IoT, ThingSpeak, and mobile applications. Their system continuously monitored cattle body temperature and location and generated alerts during abnormal conditions. The proposed model improved livestock safety and enabled remote monitoring for farmers. S. Montalván et al. [2] presented a comprehensive review on cattle tracking technologies using GPS and GNSS systems. The study emphasized the importance of real-time tracking systems in precision livestock farming and discussed various wireless communication techniques for remote monitoring. S. Nyamuryekung'e [3] explained the role of IoT in precision livestock management and highlighted the advantages of sensor-based health monitoring systems. The study focused on improving farm productivity through automated monitoring and real-time decision-making. M. Modak et al. [4] proposed an IoT-based health surveillance system for livestock that integrated wearable sensors and wireless communication technologies. Their

work demonstrated the importance of continuous monitoring and remote accessibility in reducing disease spread and improving livestock welfare. Lukas Schulthess et al. [5] developed a LoRa-based cattle monitoring system suitable for remote locations and alpine pastures. The proposed system used GPS and low-power communication technologies to improve livestock tracking and monitoring over long distances. Hitesh Mohapatra [6] introduced a LoRa IoT framework integrated with machine learning for remote livestock monitoring. The study highlighted the effectiveness of combining IoT, wearable devices, and predictive analysis for smart agriculture applications. D. Dhakshinamoorthy et al. [7] focused on cattle behavior classification and heat detection using sensor data. Their research demonstrated that accelerometer-based activity monitoring could effectively identify abnormal animal behavior and health conditions. M. Lamanna et al. [8] studied wearable collar technologies for dairy cows and discussed the integration of GPS and sensor technologies for continuous livestock health monitoring. S. R. Vanga et al. [9] developed a smart cattle health monitoring system for heat stress management using sensors and wireless communication. Their work proved that real-time alerts and remote access significantly improve livestock care and disease prevention. D. Kaur and A. K. Virk [10] proposed an IoT-based smart neck collar for disease detection and health monitoring in dairy cows. The study showed that wearable monitoring devices can improve livestock productivity and reduce health-related losses. The reviewed papers collectively emphasize the growing importance of IoT, GPS, wearable sensors, and wireless communication technologies in livestock monitoring systems. These technologies provide real-time monitoring, automated alerts, remote accessibility, and improved precision farming.

B. PROPOSED METHODOLOGY

The proposed system is implemented as a smart wearable neckband that continuously monitors livestock health and location in real time. The system mainly consists of sensors, GPS module, ESP32 microcontroller, communication module, and a mobile monitoring interface.

The temperature sensor continuously measures the body temperature of livestock to identify fever or abnormal health conditions. The accelerometer monitors animal activity patterns such as movement, inactivity, or abnormal behavior. The GPS module tracks the real-time location of the animal and supports geofencing functionality. The collected sensor data is transmitted to the ESP32 microcontroller, which processes the information and compares it with predefined threshold values. If the system detects abnormal conditions such as high body temperature, prolonged inactivity, or movement outside the predefined geographical boundary, an alert message is generated immediately. The ESP32 microcontroller uses Wi-Fi/GSM communication to send the alert notification along with the live GPS location to the farmer through a Telegram bot or mobile monitoring application. This enables farmers to remotely monitor livestock and take immediate action during emergency situations. The system operates continuously using a rechargeable Li-ion battery, making it portable and suitable for remote environments where constant supervision is difficult.

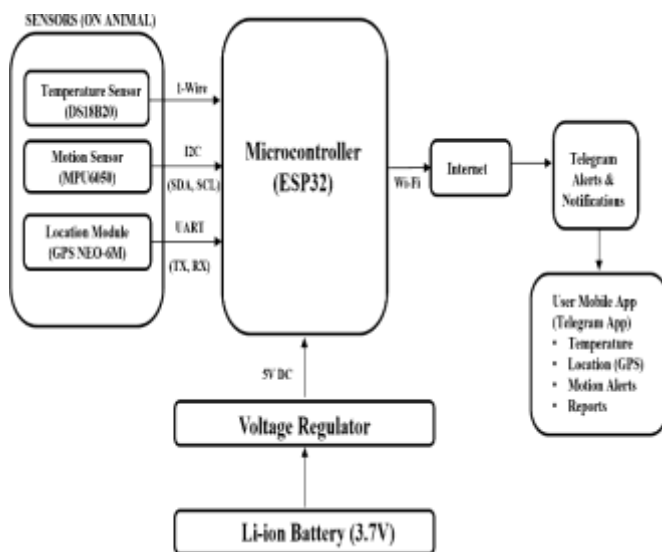


Fig 1: General block diagram of the proposed livestock monitoring system

I. HARDWARE COMPONENTS

ESP32 Microcontroller acts as the main processing unit of the system. It processes sensor data, performs threshold comparisons, and handles wireless communication. The ESP32 provides low power consumption, built-in Wi-Fi capability, and efficient real-time data processing.

GPS Module is used for real-time livestock location tracking. It continuously monitors the geographical position of the animal and supports geofencing applications.

Temperature Sensor continuously measures livestock body temperature. It helps detect fever, infections, and heat stress conditions.

Accelerometer (MPU6050) monitors livestock movement and activity patterns. It detects inactivity, abnormal movement, or falls, which may indicate health issues.

The rechargeable **Li-ion battery** provides portable power supply to the entire system and ensures continuous operation in remote areas.



Fig 2: Circuit diagram and sensor interfacing of the proposed system

II. SOFTWARE IMPLEMENTATION

Arduino IDE

Arduino IDE is used for programming and firmware development of the ESP32 microcontroller. It supports easy sensor integration and wireless communication configuration.

Embedded C/C++

Embedded C/C++ programming language is used to develop the system logic, sensor interfacing, data processing, and alert generation.

Telegram Bot API

Telegram Bot API is used to send real-time notifications, GPS location, and health alerts to farmers through mobile devices.

Mobile Monitoring Interface

The mobile monitoring interface allows farmers to remotely access livestock health status, live GPS location, and alert notifications.

III. SYSTEM IMPLEMENTATION AND RESULTS

The proposed GPS-Based Health Alert System for Livestock Herd for Remote Access was successfully implemented using ESP32, GPS module, temperature sensor, accelerometer, GSM/Wi-Fi communication, and a Telegram-based mobile alert system. The developed prototype continuously monitors the livestock's health condition and geographical location in real time.

The complete system is implemented in the form of a wearable smart neckband attached to livestock animals.



Fig 3: Prototype implementation of smart livestock wearable neckband

The ESP32 microcontroller acts as the central processing unit and continuously collects data from the connected sensors. The temperature sensor measures the body temperature of the animal, while the accelerometer detects activity patterns such as movement, walking, resting, or prolonged inactivity.

The GPS module continuously tracks the live location of the livestock and supports geofencing functionality. The collected sensor data is processed by the ESP32 and compared with predefined threshold values. When abnormal conditions are detected, such as fever, low activity, or movement outside the predefined grazing boundary, the system immediately generates an alert notification. These alerts are transmitted to the farmer through Wi-Fi/GSM communication using a Telegram bot interface.

The implemented system successfully demonstrated the following operations:

1. Temperature Monitoring

The temperature sensor continuously measures the body temperature of livestock animals. If the measured temperature exceeds the predefined threshold value, the system identifies a possible fever or heat stress condition and sends an alert notification to the farmer. This enables early disease detection and quick medical attention.

2. Activity Monitoring Using Accelerometer

The accelerometer monitors livestock movement and activity patterns in real time. If the animal remains inactive for an unusually long period, the system detects abnormal behavior and generates a health alert. This feature helps identify sickness, injury, or fatigue conditions.

3. GPS-Based Real-Time Tracking

The GPS module provides continuous live location tracking of the livestock herd. Farmers can monitor the exact location of animals remotely through the mobile monitoring interface. The system also supports geofencing functionality, which generates alerts whenever an animal moves outside the predefined grazing area.

4. Mobile Alert and Remote Monitoring

The Telegram Bot API is used to send real-time alerts, GPS coordinates, and livestock health status directly to the farmer's smartphone. The farmer can remotely monitor livestock conditions from any location with internet connectivity. This significantly reduces the need for manual supervision.

5. Power Management

The system operates using a rechargeable Li-ion battery, which provides portability and uninterrupted operation in remote farming environments. The low-power ESP32 microcontroller helps improve battery efficiency for continuous monitoring applications. The developed prototype proved to be reliable, cost-

effective, and efficient for smart livestock monitoring applications. The implementation successfully achieved real-time health monitoring, location tracking, and automated alert generation for improved livestock management.

The Telegram Bot API is used to send real-time alerts, GPS coordinates, and livestock health status directly to the farmer's smartphone. The real-time monitoring results obtained from the Telegram bot interface are shown in Fig 4.

[TELEGRAM SCREENSHOTS]

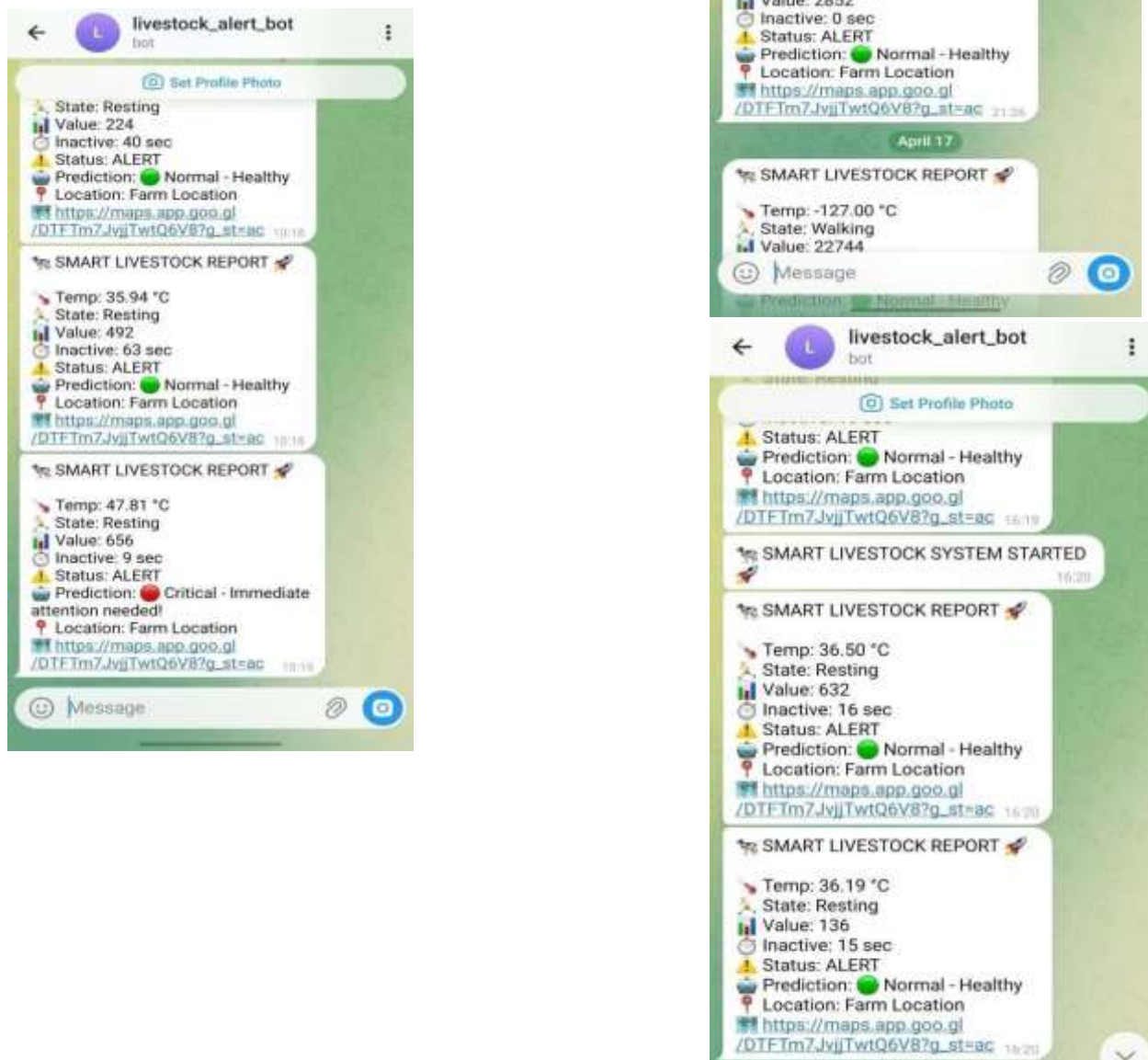


Fig 4: Experimental results showing real-time livestock health monitoring and alert notifications through Telegram bot.

The developed system successfully generated real-time

health monitoring alerts and transmitted them to the farmer through the Telegram bot interface. The monitoring system continuously tracked important livestock parameters such as body temperature, movement activity, inactivity duration, and GPS location. Whenever abnormal conditions such as high temperature or prolonged inactivity were detected, the system automatically generated alert notifications along with live GPS location details.

The Telegram interface displayed the livestock health status, prediction results, activity condition, and geographical location in real time. The generated alerts enabled farmers to remotely monitor livestock conditions and take immediate action during emergency situations. The implementation results demonstrate that the proposed system provides reliable, low-cost, and efficient remote livestock monitoring using IoT and wireless communication technologies.

IV. ADVANTAGES

- Provides real-time livestock health monitoring.
- Enables continuous GPS-based livestock tracking.
- Supports remote access and monitoring from anywhere.
- Detects diseases and abnormal conditions at an early stage.
- Reduces livestock theft and accidental loss.
- Improves farm productivity and management efficiency.
- Minimizes manual supervision and labor requirements.

CONCLUSION

The The project successfully demonstrates a GPS-Based Health Alert System for Livestock Herd for Remote Access using IoT, embedded systems, and wireless communication technologies. The developed system integrates GPS tracking, health monitoring sensors, ESP32 microcontroller, and mobile communication to provide continuous real-time livestock monitoring.

The proposed model effectively monitors livestock body temperature, movement activity, and geographical location. Whenever abnormal conditions

- Provides immediate alerts during emergency situations.
- Portable and suitable for remote grazing environments.
- Low-cost and energy-efficient monitoring solution.

V. LIMITATIONS

- Battery life limitations during long-term operation.
- Depends on Wi-Fi/GSM network availability in remote areas.
- Sensor accuracy may be affected by harsh environmental conditions.
- Requires weatherproof casing for outdoor usage.
- Large-scale deployment may require higher infrastructure cost.

VI. APPLICATIONS

- Dairy farm livestock monitoring.
- Sheep and goat farm management.
- Smart agriculture and precision farming systems.
- Veterinary health monitoring applications.
- Large cattle ranches and grazing fields.
- Livestock theft prevention systems.
- Remote animal tracking and monitoring.
- Research applications in animal behavior analysis.
- Automated farm management systems.

such as fever, prolonged inactivity, or geofence violations are detected, the system immediately generates alert notifications and transmits them to the farmer through a Telegram-based mobile interface. This allows farmers to take quick action and prevent livestock losses.

The implementation results prove that the integration of IoT and wearable sensor technologies can provide an efficient, reliable, and low-cost solution for modern livestock management. The proposed system significantly improves livestock safety, reduces manual effort, enhances farm productivity, and supports

precision farming practices.

Furthermore, the developed system is portable, scalable, and suitable for deployment in remote agricultural environments. Future enhancements may include machine learning-based disease prediction, cloud-based analytics, solar-powered battery systems, and large-scale smart agriculture integration to further improve system performance and reliability.

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