WILDLIFE TRACKING AND MONITORING SYSTEM

Phase – 2

Dr. Venumadhava.M, K Bhoomika, Lekha Sahiti.P, M.N.Tejashwini, Sahana.M.
Dept of CS - AI&ML
Proudhadevaraya Institute of Technology, Hospet, Karnataka, India

Abstract

Monitoring animal health is crucial for effective livestock management and wildlife protection. Traditional manual observation methods require significant human effort and often fail to identify health issues at an early stage. With recent progress in Internet of Things (IoT) technologies, wearable sensors, and cloud platforms, automated animal monitoring has become more reliable and efficient.

This study proposes an IoT-enabled wearable collar designed for continuous observation of animal physiological parameters and activity behavior. The system incorporates sensors for heart rate, body temperature, motion detection, and geographical location, all integrated with a microcontroller for real-time data communication to a cloud-based database. The collected information is displayed through an online dashboard to support health analysis and early disease identification. The proposed solution enhances monitoring precision, minimizes manual intervention, and offers a scalable approach suitable for both livestock and wildlife monitoring.

Keywords: Internet of Things, Wearable Devices, Animal Monitoring, GPS Tracking, Cloud Database, Firebase

1. Introduction

Ensuring the health and safety of animals is a key requirement in both agricultural management and wildlife conservation. Conventional monitoring practices primarily depend on routine inspections and human judgment, which are inefficient and prone to errors, particularly when managing large animal populations or animals in open environments. As a result, early symptoms of illness or abnormal behavior may remain undetected until serious conditions develop.

The integration of IoT and wearable sensing technologies has introduced new possibilities for automated animal monitoring. Sensor-enabled wearable collars allow continuous and non-invasive tracking of vital parameters such as heart rate, body temperature, and physical activity. When supported by cloud computing infrastructure, these systems enable real-time data access, historical data analysis, and intelligent decision support. This work presents the development of a cost-effective and scalable wearable collar system designed to provide real-time health and location monitoring of animals.

2. Materials and Methods

2.1 Hardware Components

The system is built using the following hardware modules:

Microcontroller (ESP32/Arduino): Responsible for sensor data processing and wireless data transmission.

MAX30102 Sensor: Used for measuring heart rate based on photoplethysmography principles.

DS18B20 Temperature Sensor: Measures body surface temperature of the animal.

Accelerometer (ADXL345 / MPU6050): Captures motion data to analyze activity and posture.

GPS Module: Provides real-time location and movement tracking.

Rechargeable Battery Pack: Supplies power for continuous system operation.

Wearable Collar Housing: Ensures secure placement of components with animal comfort.

2.2 Software Components

Embedded programming using C/C++

Firebase Realtime Database for cloud-based data storage

Web or mobile dashboard for data visualization

Rule-based logic for abnormal condition detection

2.3 Data Acquisition and Communication

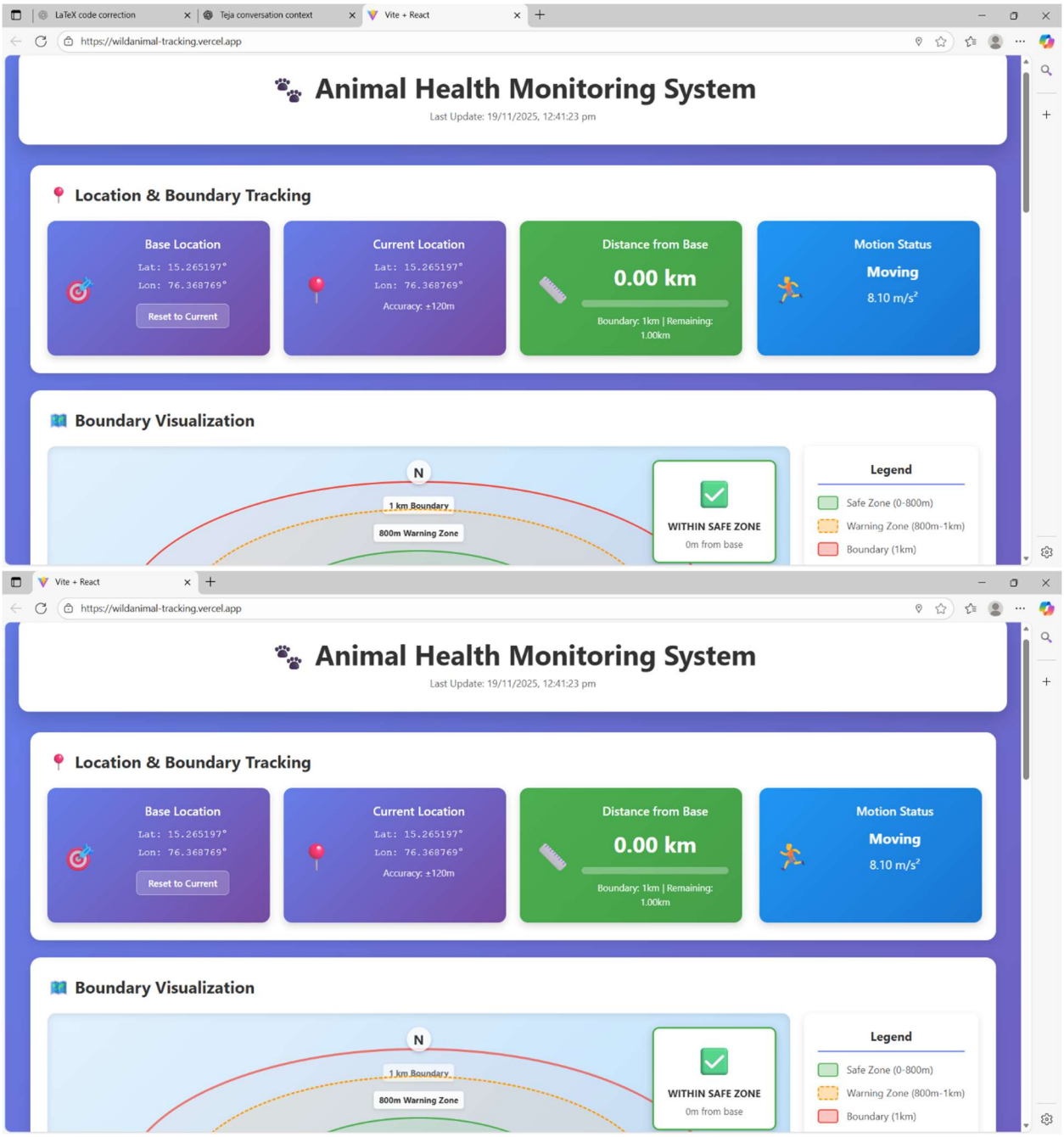
Physiological and activity-related data are continuously captured through onboard sensors. The microcontroller processes the collected data and uploads it to the Firebase cloud using a Wi-Fi connection. In situations where internet access is unavailable, GSM-based alert mechanisms can be employed to maintain communication reliability.

3. Results and Discussion

The developed system effectively tracks animal heart rate, temperature, physical activity, and geographical position in real time. Heart rate readings obtained from the MAX30102 sensor provide meaningful indicators of animal stress and health conditions. Temperature monitoring assists in identifying early symptoms of fever or infection.

Motion data collected through the accelerometer enables classification of animal behavior, such as resting, walking, or prolonged inactivity, which may indicate potential health issues. GPS tracking ensures continuous location monitoring, offering significant benefits for wildlife observation, anti-theft measures, and migration analysis.

The cloud-based dashboard allows remote access to both real-time and historical data. Automated alerts notify users when sensor values exceed predefined thresholds. Overall, the system demonstrates superior efficiency and reliability compared to traditional monitoring approaches.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https://wildanimal-tracking.vercel.app
Animal Health Monitoring System
Last Update: 19/11/2025, 12:41:23 pm
Location & Boundary Tracking
Base Location
Lat: 15.265197°
Lon: 76.368769°
Reset to Current
Current Location
Lat: 15.265197°
Lon: 76.368769°
Accuracy: ±120m
Distance from Base
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Boundary: 1km | Remaining: 1.00km
Motion Status
Moving
8.10 m/s²
Boundary Visualization
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1 km Boundary
800m Warning Zone
WITHIN SAFE ZONE
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Safe Zone (0-800m)
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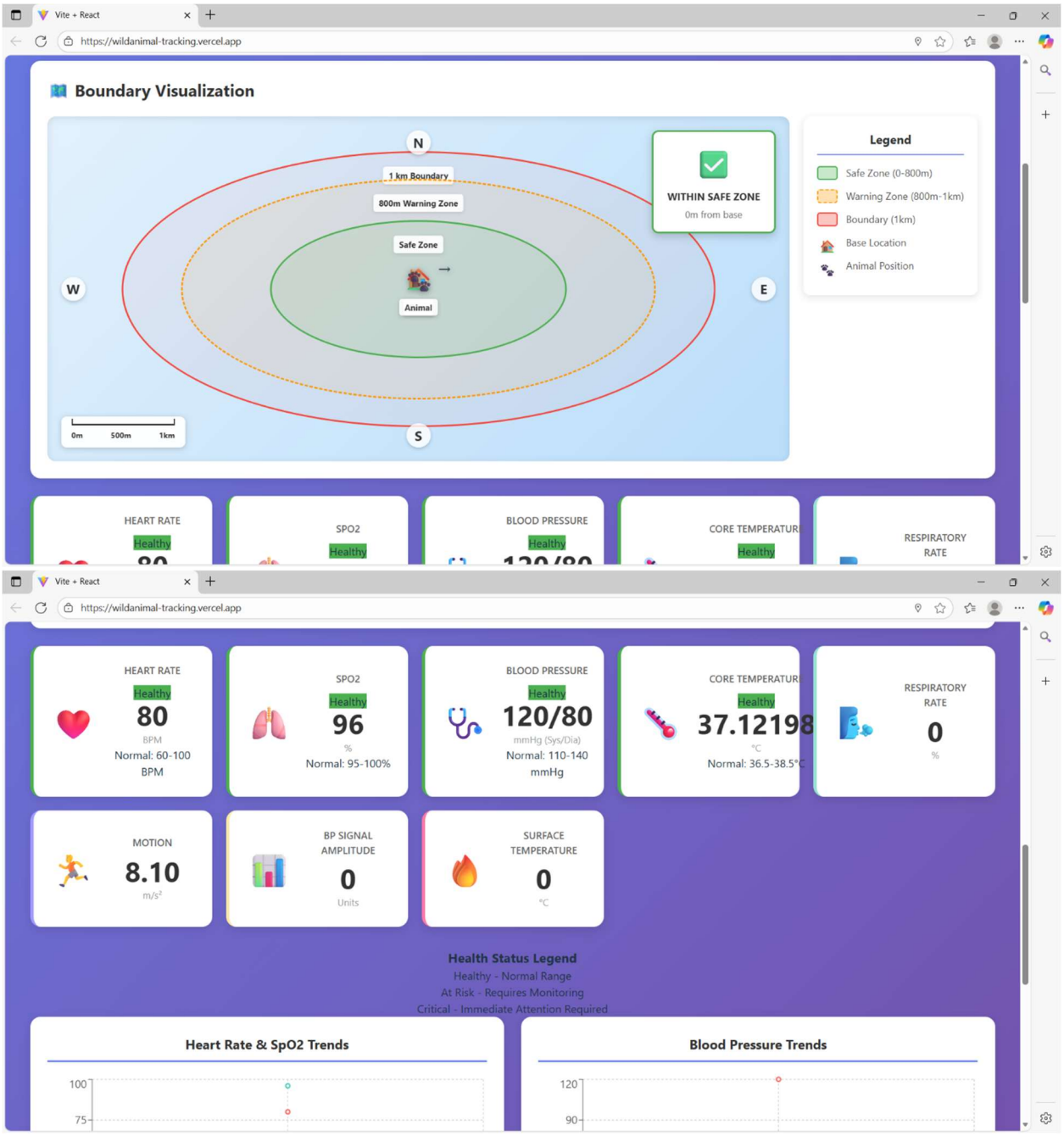
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Boundary Visualization
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WITHIN SAFE ZONE
0m from base
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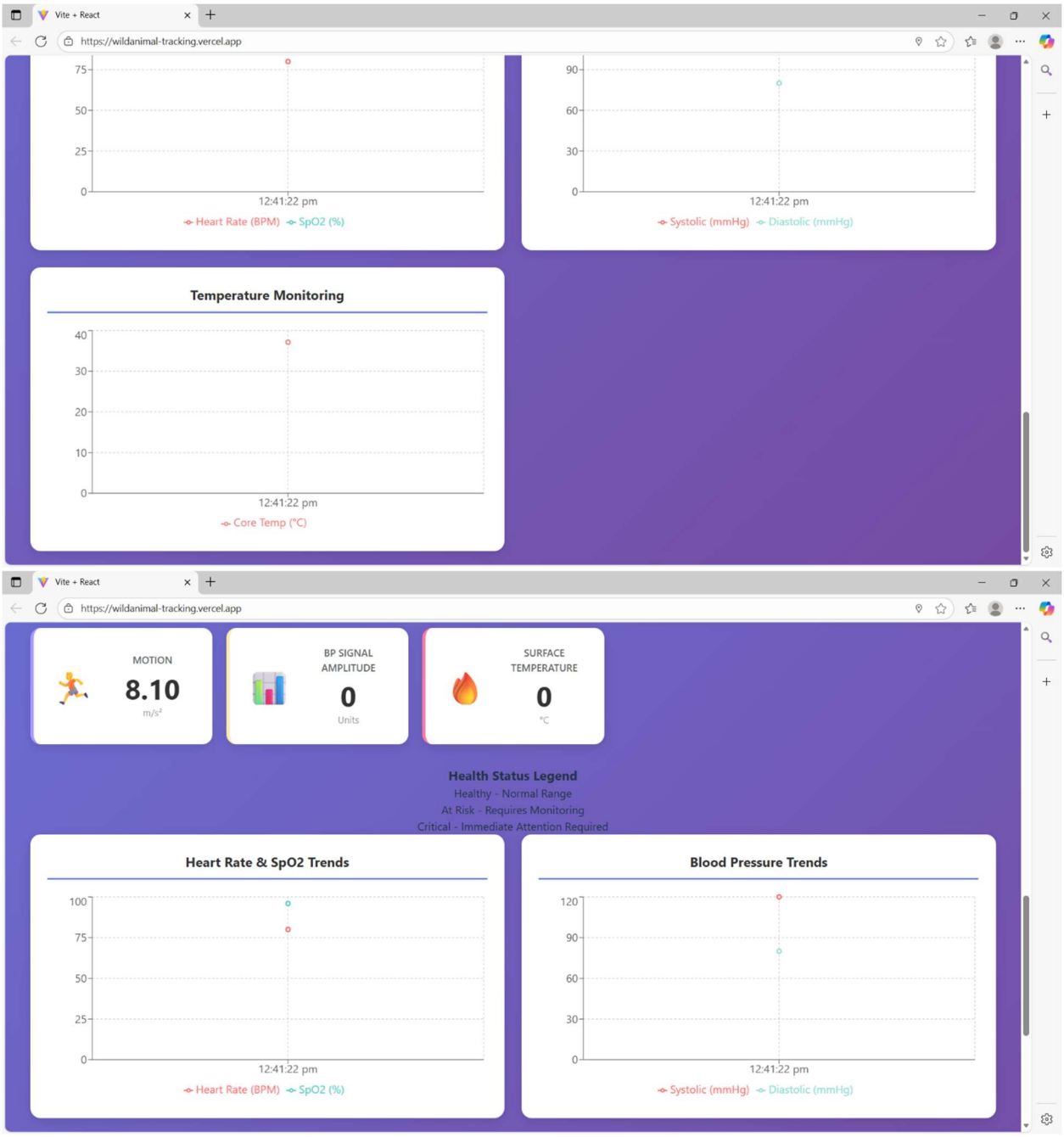
Safe Zone (0-800m)
Warning Zone (800m-1km)
Boundary (1km)
Base Location
Animal Position
HEART RATE
Healthy
SPO2
Healthy
BLOOD PRESSURE
Healthy
CORE TEMPERATURE
Healthy
RESPIRATORY RATE
Vite + React
https://wildanimal-tracking.vercel.app
HEART RATE
Healthy
80
BPM
Normal: 60-100 BPM
SPO2
Healthy
96
%
Normal: 95-100%
BLOOD PRESSURE
Healthy
120/80
mmHg (Sys/Dia)
Normal: 110-140 mmHg
CORE TEMPERATURE
Healthy
37.12198
°C
Normal: 36.5-38.5°C
RESPIRATORY RATE
0
%
MOTION
8.10
m/s²
BP SIGNAL AMPLITUDE
0
Units
SURFACE TEMPERATURE
0
°C
Health Status Legend
Healthy - Normal Range
At Risk - Requires Monitoring
Critical - Immediate Attention Required
Heart Rate & SpO2 Trends
100
75
Blood Pressure Trends
120
90



4. Conclusion

This research introduced an IoT-based wearable collar system for real-time animal health and activity monitoring. By combining physiological sensors, motion analysis, GPS tracking, and cloud technologies, the system enables early detection of health abnormalities and informed decision-making. The solution reduces dependency on manual monitoring while supporting scalable deployment in livestock farming and wildlife conservation. Future improvements may include machine learning-based prediction models, solar-powered operation, and long-range communication technologies such as LoRaWAN.

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Competing Interest Declaration

The authors declare that there are no competing interests related to this research work.

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