International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 12 Issue: 11 | Nov 2025 www.irjet.net p-ISSN: 2395-0072

Wildlife Tracker & Alert System using GPS & BLE Technology

Ajit.V.Pawar , Yashraj.S.Tayde , Vaibhav.R.Thaware

[1]Student , Dept , of E&TC Engineering, KK Wagh collage of engineering Nashik, India
[2]Student , Dept , of E&TC Engineering, KK Wagh collage of engineering Nashik, India
[3]Student , Dept , of E&TC Engineering, KK Wagh collage of engineering Nashik, india
Under the guidance of Prof. S.S. Dongare Sir

Abstract - *With the increasing number of wildlife tourism activities, there is a growing need for technologies that enhance tourist safety while also supporting animal conservation. This project introduces a wildlife tracker using GPS & BLE technology that uses (BLE) and GPS to monitor wild animals and alert tourists in real time. The system involves compact tags attached to animals, integrating a GPS module for location tracking and a BLE chip for short-range communication. When a tagged animal approaches within a predefined range, nearby smartphones (with the app) detect the BLE signal and generate alert notifications, including warning sounds and animal information. The GPS data is also logged for use by forest departments to study animal movement patterns. This solution operates with BLE & GPS technologies , making it suitable for remote forest areas. It increases tourist awareness, reduces human animal conflicts, and animal monitoring .The proposed system combines safety, technology, and conservation into a practical solution .*

Key Words: **Alerts, Location Tracking, GPS, BLE, Animals**

1.INTRODUCTION

Wildlife plays a vital role in maintaining the balance of our ecosystem. However, with increasing human interference and habitat loss, many wild animals are at risk, leading to frequent human animal conflicts and difficulties in monitoring their movements. Traditional tracking methods are often limited by range, high cost, and poor connectivity in remote forest regions. To address these challenges, this project proposes a **Wildlife Tracker & Alert System** using **GPS and Bluetooth Low Energy (BLE)** technologies. The GPS module continuously provides the animal's location coordinates, while the BLE module enables short-range communication with nearby smartphones or monitoring devices, even in areas without internet access. The system also integrates **health monitoring sensors** such as temperature and heart rate sensors to track the animal's condition. If any abnormal readings or risky proximity are detected, the system sends alerts to forest officials and nearby tourists for quick action. This solution enhances wildlife safety, supports behavioral study through stored data on an SD card, and helps reduce human–animal conflicts. By combining GPS precision with BLE efficiency, the project offers a **cost-effective, low-power, and scalable** approach to modern wildlife monitoring.

1.1 LITERATURE REVIEW

It focuses on developing a low-cost and efficient tracking system for farm animals using an Arduino microcontroller integrated with a GPS and GSM module. The GPS module continuously records the animal's position, while GSM transmits this data to the farmer's mobile phone through SMS. The proposed system helps farmers locate missing animals, monitor grazing boundaries, and detect unusual movements. The system also ensures better animal safety and management. The hardware is lightweight, easy to mount, and powered by a rechargeable battery. Overall, it demonstrates how IoT technology can reduce livestock loss and improve farm automation.[1]

It presents a real-time tracking system that uses Bluetooth Low Energy (BLE) beacons to monitor asset location. BLE tags periodically send location data to a mobile application or gateway device within a defined range. Compared to traditional Bluetooth or Wi-Fi systems, BLE consumes very little power and supports longer battery life. The paper explains data transfer mechanisms, signal strength-based localization, and the use of smartphones as receivers. The proposed technique ensures real-time data visualization on a dashboard and supports multiple nodes simultaneously. It's adaptable not only for industrial asset management but also for tracking animals or equipment in forest zones.[2]

Introduces a BLE-based wireless sensor node designed to monitor animal health and location efficiently. The node includes sensors for temperature, motion, and heart rate, enabling health diagnostics in addition to tracking. It communicates data to a base station or smartphone using Bluetooth Low Energy technology, which significantly reduces energy consumption. The device is built for remote field operation and optimized for compactness and long battery life. The authors discuss the firmware structure, energy optimization, and data transmission protocols. The solution demonstrates how BLE can replace costly long-range systems for short-range animal management tasks.[3]

The pepper focuses on detecting and tracking wild animals near forest boundaries using sensors and image processing techniques. It integrates GPS for location tracking and wireless communication to send alerts when an animal crosses a geofenced area. The system uses infrared (IR) and motion sensors to detect movement even at night. Alerts are

automatically sent to forest rangers or nearby residents to prevent human–animal conflict. The authors also propose a mobile alert interface for real-time updates. This system helps in improving wildlife monitoring, preventing poaching, and ensuring both human and animal safety[4]

It proposes a multi-object tracking framework for simultaneously monitoring several animals in a given area. Using computer vision and machine learning algorithms, the system identifies individual animals from video feeds and tracks their paths. The technique applies feature extraction and motion prediction to maintain unique IDs for each animal. It helps researchers analyze animal behavior, migration patterns, and herd movement. The paper also highlights the use of IoT-enabled cameras and wireless networks for real-time transmission. The proposed method can be used for wildlife studies, ecological research, and smart forest management systems.[5]

The paper presents a GPS and GSM-based system that helps forest departments monitor wild animals' movement in real time. Each animal is equipped with a GPS collar that sends its coordinates to a control unit through GSM communication. When animals enter danger zones or approach human settlements, automatic alerts are generated. The system helps prevent animal poaching and reduce human–wildlife conflict. It includes a web interface for displaying location maps and movement history. The authors emphasize the reliability and coverage range of GSM networks for effective data transfer. The model is scalable and suitable for large forest reserves.[6]

This paper combines GNSS (Global Navigation Satellite System) and LoRa (Long Range) communication to develop a low-power, long-range wildlife tracking solution. LoRa enables data transmission over several kilometers with minimal energy consumption, making it ideal for forest or mountain environments. The paper discusses optimization algorithms to reduce GNSS power draw and extend battery life. The tracking unit sends periodic updates to a base station for analysis. The system design balances accuracy, power efficiency, and communication cost. It demonstrates how hybrid GNSS–LoRa networks can overcome the limitations of GPS-only or GSM-based systems in wildlife research.[7]
This review paper explores the evolution and applications of miniature radio tags used for animal tracking. It compares technologies like GPS, LoRa, BLE, ZigBee, and RFID based on energy use, range, weight, and data capacity. The authors analyze their suitability for tracking different species — from large mammals to small birds or reptiles. It also discusses design trade-offs between tag size, antenna performance, and battery life. The paper highlights the trend toward integrating multi-sensor capabilities (like temperature, acceleration, and heart rate) in modern tags. It concludes with recommendations for future energy-efficient and miniaturized wildlife tracking devices.[8]

1.2 METHODOLOGY

The wildlife tracking and safety system begins with tagging each animal using a compact device equipped with GPS, ESP32 microcontroller, BLE, and an SD card. Once activated, the tag acquires precise GPS coordinates and timestamps, which are saved locally for data integrity. The device periodically broadcasts this tracking data via Bluetooth Low Energy (BLE). Rangers' mobile phones or strategically placed gateways receive these BLE transmissions, ensuring data capture even in areas with limited connectivity. The collected data is then visualized on a mobile application utilizing Google Maps, allowing real-time tracking of animal movements. Rangers can monitor these locations, set custom alerts for boundary crossings or unusual activity, and respond proactively to enhance wildlife safety and reduce human-animal conflict. This integrated approach enables efficient field monitoring, data-driven patrol planning, and improved conservation outcomes through the seamless application of IoT technology.

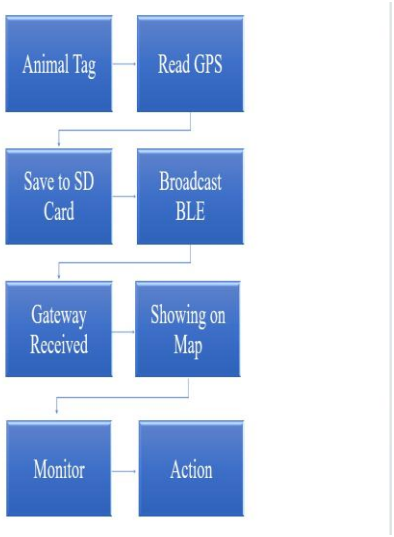


Fig.1 basic flow of Project

Data collection summery: Most of the studies used GPS modules for animal location tracking because of their high accuracy, but they often faced signal loss in dense forest areas. To overcome this, some papers integrated IoT and GSM-based systems, allowing data to be transferred to cloud platforms for monitoring through mobile apps or dashboards.

A few recent studies (especially after 2022) focused on BLE (Bluetooth Low Energy) and LoRa communication to reduce power consumption and improve range in remote zones. These systems were found more suitable for long-term use since they required less battery power compared to Wi-Fi or GSM-based trackers.Many papers also emphasized solar energy and low-power circuit design to make the devices sustainable in wildlife conditions. However, only a limited

number of works included real-time alert systems for nearby humans or AI-based animal behavior prediction, which are still emerging areas of research.In summary, the overall analysis shows a clear shift from traditional GPS-only systems toward hybrid IoT-based and BLE-powered models. The combination of GPS + BLE + IoT cloud dashboard appears to be the most promising setup for accurate, energy-efficient, and continuous wildlife tracking directly aligning with the objectives of our proposed project.

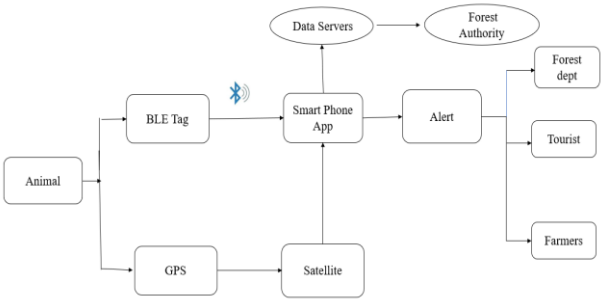


Fig. 2 Block Diagram

2. Results

This Fig. shows the How the tag is register and get real time location of animal in mobile app with using the BLE and GPS , so we can track the animal , and we also get some basic information of that that animal like temperature, signal strength of BLE tag, Battery percentage of tag and distance of that animal we can see the all the information of that animal in Advance info. Tab in mobile application section.

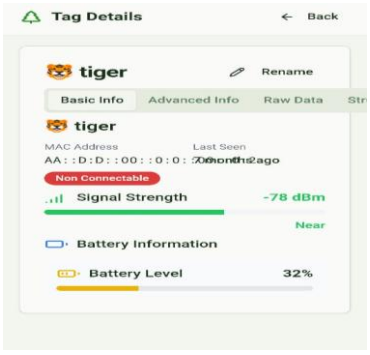
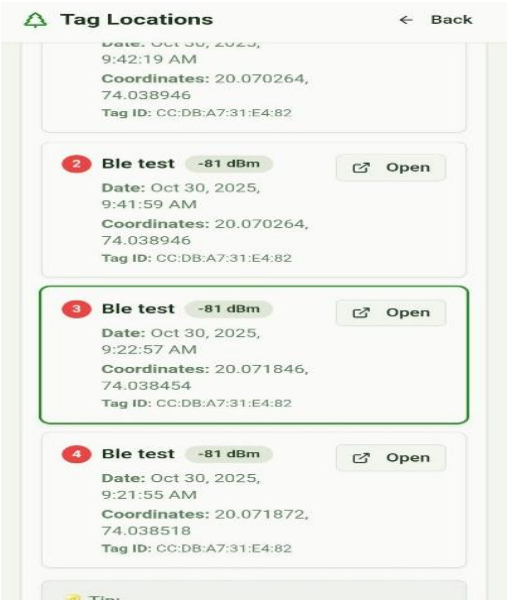
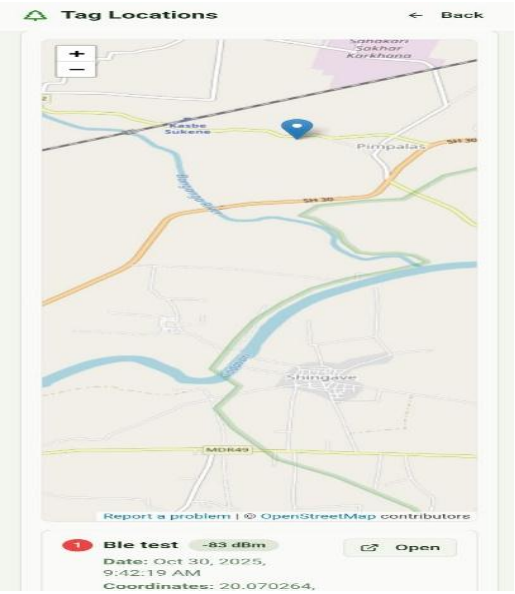
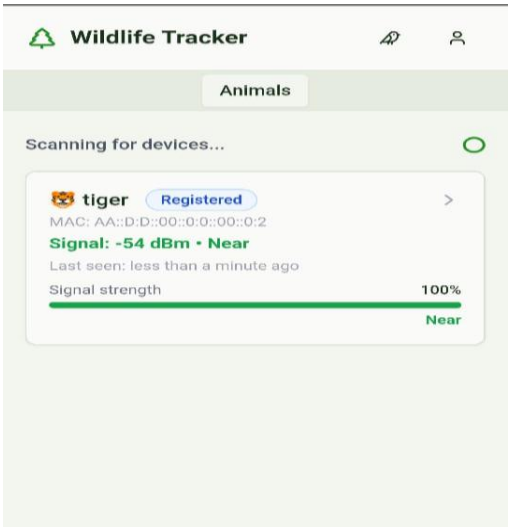


Fig. 3-6shows the result







3.DISCUSSION

The implementation of the proposed Wildlife Tracker & Alert System demonstrates how GPS and BLE technologies can be effectively combined to provide real-time location tracking and alerting in wildlife areas. Compared to previous approaches that relied only on GPS and GSM, the integration of BLE significantly reduces power consumption and allows communication even in remote regions with limited network connectivity.

The results indicate that BLE-based alerts are reliable for short-range detection between the tagged animal and the mobile device, while GPS provides continuous positional data for long-range monitoring. This hybrid model ensures both safety and efficiency, allowing tourists and forest officers to receive immediate notifications when an animal approaches a restricted or tourist zone.

The addition of health monitoring parameters such as temperature and battery level enhances the practicality of the system. This feature supports forest officials in tracking animal well-being and detecting unusual behavior patterns. Furthermore, storing data on an SD card provides a valuable resource for long-term studies on animal movement and habitat usage.

However, some limitations were identified, including possible GPS signal loss in dense forest areas and reduced BLE range depending on terrain or environmental interference. Future improvements could involve integrating LoRa or mesh network support to extend range, and adding solar-based charging to increase device lifetime. Overall, the discussion confirms that the proposed system offers a balanced, low-cost, and sustainable approach for both wildlife conservation and tourist safety. It bridges the gap between traditional GPS tracking and modern IoT-based smart monitoring systems, supporting both ecological research and real-time protection efforts

3. CONCLUSIONS

Wildlife monitoring is important for effective protection, sustainable use and scientific management of wildlife resources. Although there is currently a lot of work on building real sensor systems, very few attempts have been made to deploy them in the field and then maintain and develop them. The study of the animals through this system or their conservation. Proposed system is the best possible way to keep track of the animal's location and their health 24 hours-a-day. Proposed new system can find the animal over large, dense forest areas with the help of a Node MCU. It also gives a live update of their health through the temperature and pulse sensors.

The app in the mobile phones of forest officers will allow them to keep track of the wildlife from anywhere and at all times. The notification system will alert them immediately. if anything is wrong with the species,the caretaker can reach the exact location immediately. Proposed system does not require any human attention as this is a completely selfindependent and automated system. Proposed project will help us save wildlife at a much better rate

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to all those who have supported and guided us throughout the successful completion of our project titled "Wildlife Tracker using GPS and BLE Technology."First and foremost, we extend our deepest thanks to our project guide, Prof. S. S. Dongare, for their constant guidance, valuable feedback, and technical support. Their encouragement and expertise greatly helped us in shaping our project and understanding every stage of its development.

We are also profoundly thankful to Dr. K. N. Nandurkar, our respected Principal, for his continuous support and motivation, which provided us with the resources and environment needed for successful project execution. Our sincere thanks to Dr. S. A. Patil, Head of the Department of Electronics and Telecommunication, for his constant inspiration, insightful suggestions, and encouragement throughout this journey.

We also wish to extend our appreciation to all faculty members of our department for their assistance and moral support whenever required. A heartfelt thanks to our team members for their dedication, teamwork, and consistent efforts in research, design, and implementation of this project.

We are grateful to our college management for providing the necessary infrastructure and technical facilities that enabled us to complete this work successfully. We would also like to express our deepest gratitude to our parents, whose constant encouragement, patience, and blessings have been our greatest source of strength.

Lastly, we are inspired by the efforts of forest officers, farmers, and wildlife researchers, whose real-world challenges motivated us to design a system that enhances both human and animal safety. We hope our work will contribute in a small way to the conservation of wildlife and the prevention of human-animal conflicts.

REFERENCES

[1] G. Ramesh et al., 'Farm Animal Location Tracking System Using Arduino and GPS Module,' IEEE ,2021.

[2] D. Thamizhselvi et al., 'Real-Time Asset Tracking Using BLE Technology,' IEEE 2025.

[3] K. S. Burman et al., 'Low Energy Bluetooth Sensor Node for Animal Monitoring,' Research Gate, 2021.

[4] V. R. Viji et al., 'Detection and Tracking of Wild Animal,' IEEE, 2023.
[5] M. P. Banavath et al., 'Multi-Object Tracking for Animals,' IEEE, 2023.
[6] K. Dhivya et al., 'GPS based Tracking System for Wildlife Safety,' IEEE ,2022
[7] Kerle-Malcharek et al., "GNSS and LoRa-Based Wildlife Tracking with Energy Optimization," IEEE, 2025.
[8] Toledo et al., "Review of Miniature Radio Tags for Wildlife Tracking," IEEE, 2025.

BIOGRAPHIES

1. Yashraj S. Tayde
Final Year Student of E&TC
At K K Wagh Institute of Engineering Education and research Nashik

2. Ajit V. Pawar
Final Year Student of E&TC
At K K Wagh Institute of Engineering Education and research Nashik

3. Vaibhav R. Thaware
Final Year Student of E&TC
At K K Wagh Institute of Engineering Education and research Nashik