DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

RAJALAKSHMI ENGINEERING COLLEGE
An AUTONOMOUS Institution
Affiliated to ANNA UNIVERSITY, Chennai

A.L.E.R.T.

ANIMAL LOCATION AND EMERGENCY RESPONSE TRACKING

Dr. S. Senthil Pandi
Associate Proffessor

Shaun Paul Moses 220701266
Yuven Senthilkumar 220701330
Shiiv R S 220701331

PROBLEM STATEMENT

Tribal communities living in remote, mountainous regions face frequent and dangerous encounters with wild animals like elephants, tigers, and bears.
Due to lack of mobile networks and early warning systems, these threats often result in:

- Crop destruction
- Livestock loss
- Property damage
- Human injuries or fatalities

MOTIVATION

To empower isolated communities with a smart, autonomous safety system that:

- Detects wildlife in real time using AI and sensors
- Sends early alerts locally and remotely via satellite
- Works off-grid, using solar power
- Promotes self-sustainability and resilience

EXISTING STATEMENT

Traditional Scare Methods
- Drums, firecrackers, shouting
- Reactive and manual
- Animals quickly adapt or become aggressive

Mobile Alert Systems
- SMS alerts used in some areas
- Fails in regions with poor/no mobile network
- Dependent on human input

Manual Surveillance
- Forest guards or villagers patrol on foot
- Limited coverage, prone to human fatigue
- Ineffective during night or bad weather

Electric & Physical Fencing
- Temporary protection using fences or barricades
- High maintenance, easily damaged
- Unsafe for both animals and humans

No Integrated Communication
- No formal system to escalate alerts
- Delayed response from authorities
- Communities left vulnerable in emergencies

OBJECTiVES

Sensor & Detection Layer → Processing & Alert System → Communication Layer → Monitoring and Control → Optional Layer: AI-based Analysis

1. Wildlife Intrusion Detection
Use AI-powered cameras and motion sensors to detect animals like elephants, tigers, and bears in real time.

2. Instant Local Alert System
Trigger sirens, flashing lights, and buzzers to warn villagers immediately upon detection.

3. Emergency Communication via Satellite
Send alerts to authorities using LEO satellite networks (e.g., Starlink) even in no-network zones.

4. Community-Friendly Interfaces
Develop a mobile app and web dashboard with local language support for easy access by both officials and locals.

5. Scalable & Sustainable Deployment
Design the system to be solar-powered, modular, and maintainable by local youth to ensure long-term use.

ABSTRACT

This project presents A.L.E.R.T. – a smart, low-cost, and sustainable safety system tailored for tribal communities in remote, mountainous regions.

Key Features:

- AI-driven detection of wild animals using edge-based cameras and sensors
- Instant alerts via sirens, LEDs, and satellite-based emergency communication
- Real-time monitoring through centralized dashboards for authorities
- Designed to be solar-powered, modular, and locally maintainable

Impact:

Empowers vulnerable communities by providing:

- Early warnings
- Faster emergency response
- Improved safety and autonomy
- Scalability across mobile-dead zones

PROPOSED SYSTEM

Key Components

- AI-Powered Cameras: Detect wild animals using YOLOv5 on edge devices like Raspberry Pi or Jetson Nano
- Motion Sensors (PIR): Trigger detection when movement is sensed
- Edge Processing: Enables local decision-making without internet dependency

Alert Mechanism

- Local Alerts: Sirens and flashing LEDs warn villagers immediately
- Remote Alerts: SMS and satellite communication (Starlink/OneWeb) notify forest officials and rescue teams

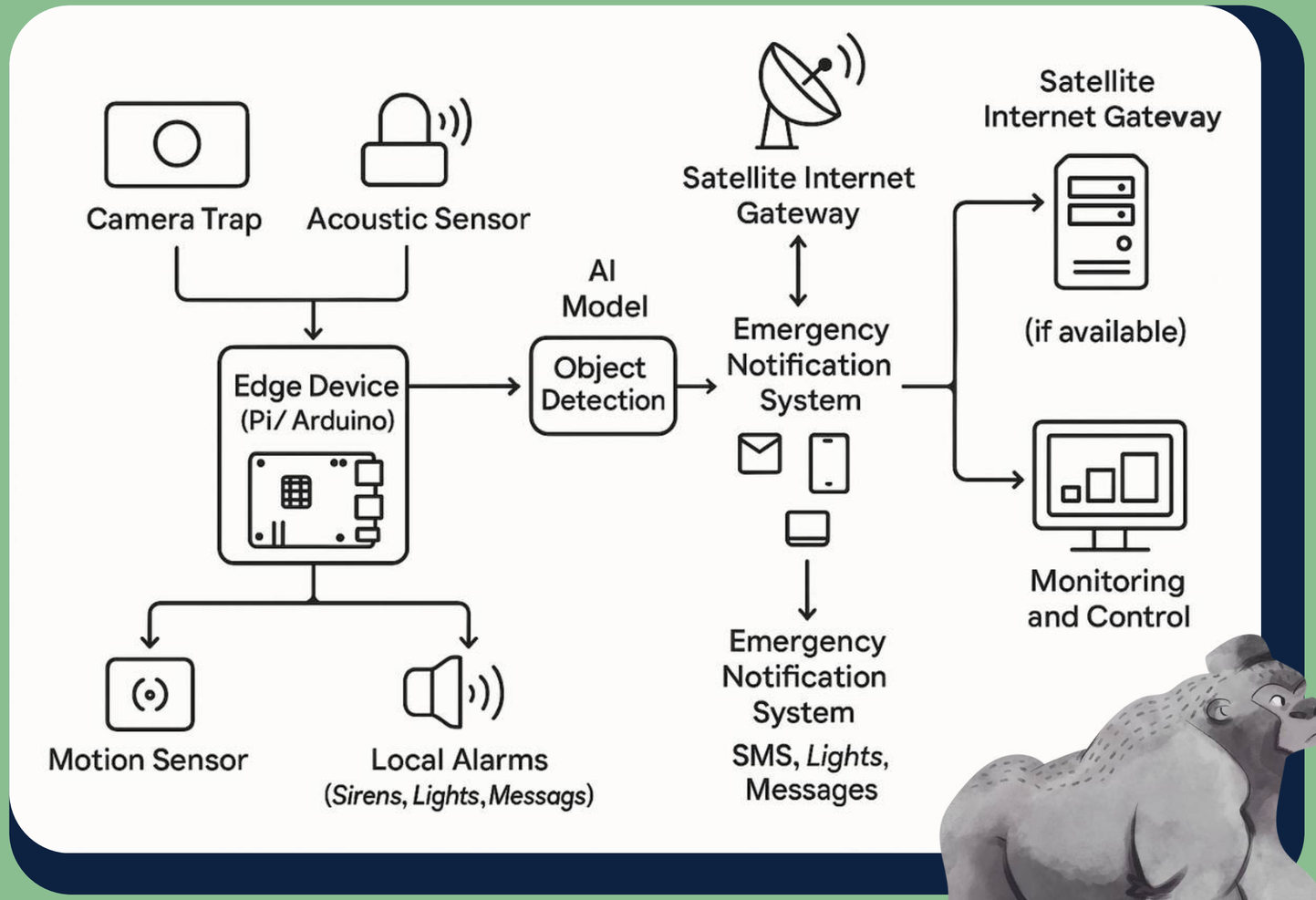
Power & Sustainability

- Solar-powered units ensure 24/7 functionality
- Modular design for easy scalability across multiple villages
- Local maintenance enabled via training tribal youth

Dashboard Interface

- Centralized system to monitor alerts, view live feeds, and access event logs remotely

SYSTEM ARCHiTECTURE



Layered, Solar-Powered System for Wildlife Threat Detection & Emergency Communication

1. Sensing Layer
- Camera modules + PIR motion sensors
- Deployed at village perimeters for continuous wildlife monitoring

2. Edge Processing Layer
- Devices: Raspberry Pi / Jetson Nano
- Runs AI models (e.g., YOLOv5) for real-time detection & classification of wild animals

3. Alert Layer
- Triggers local sirens & LED warnings
- Sends instant alerts via SMS/web dashboard to forest authorities

4. Communication Layer
- Utilizes LEO satellites (e.g., Starlink, OneWeb)
- Ensures coverage even in remote, no-network areas

5. Monitoring & Control Layer
- Centralized dashboard for authorities
- View live alerts, historical logs, and coordinate multi-site responses

6. Power & Maintenance
- Fully solar-powered
- Modular, locally maintainable, scalable for long-term deployment

LiST OF MODULES

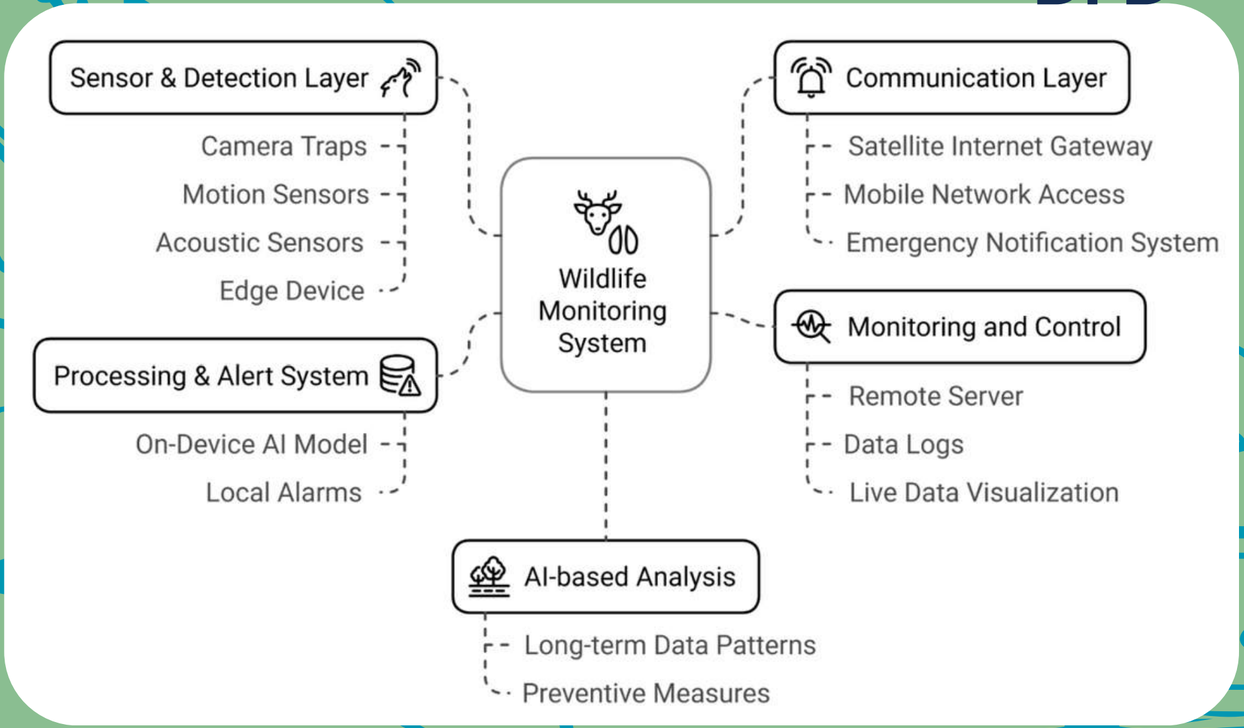
The system consists of six core modules enabling real-time detection and alerts in remote regions:

1. Wildlife Detection Module
   - AI-based detection using YOLOv5 on edge devices (Raspberry Pi/Jetson Nano).
   - Inputs from cameras & PIR sensors.
2. Alerting Module
   - Triggers local sirens, buzzers, and LED flashers when a threat is detected.
3. Communication Module
   - Sends emergency alerts via GSM or LEO satellites to authorities.
4. Dashboard & Mobile Interface
   - Displays alerts, live feeds, and system health.
   - Accessible via browser or SMS in local language.
5. Data & Training Module
   - Collects and labels wildlife image data for continuous model improvement.
6. Cloud & Monitoring Module
   - Logs events, stores image data, and supports long-term analytics.
   -

Modules work together to provide autonomous, solar-powered safety for remote communities.

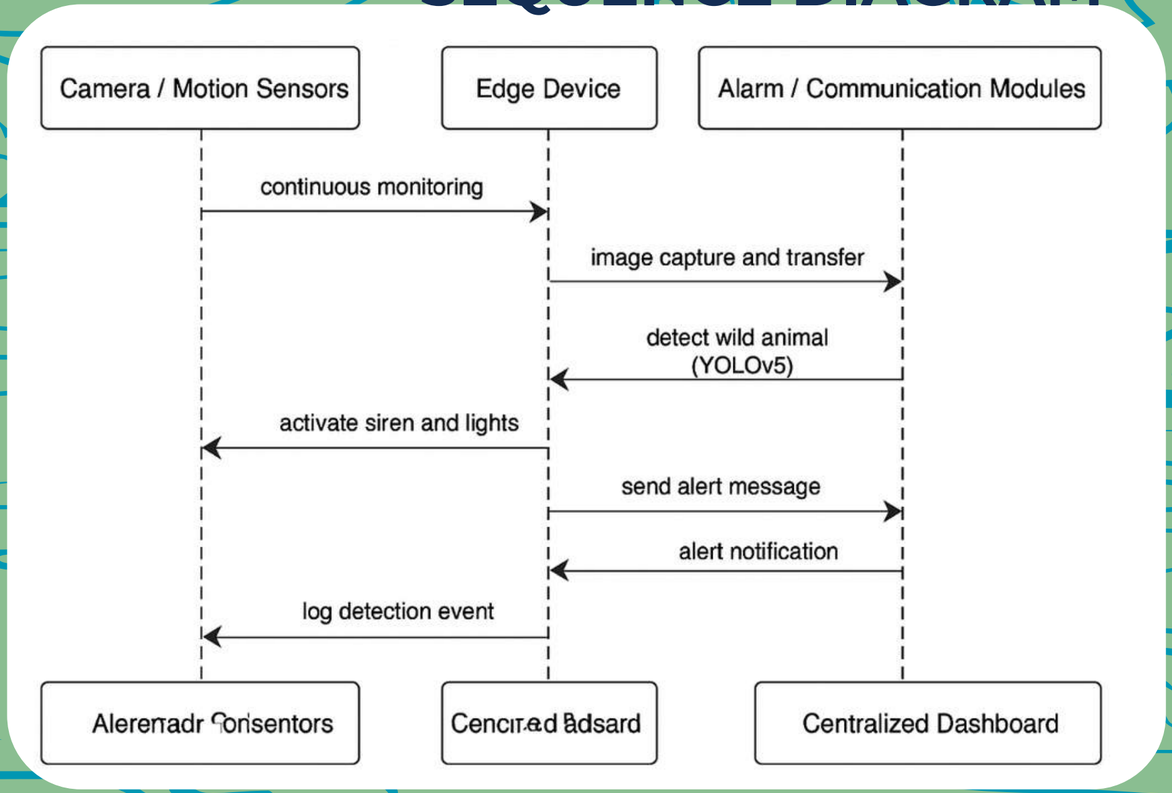
DFD & SEQUENCE DiAGRAM

DFD



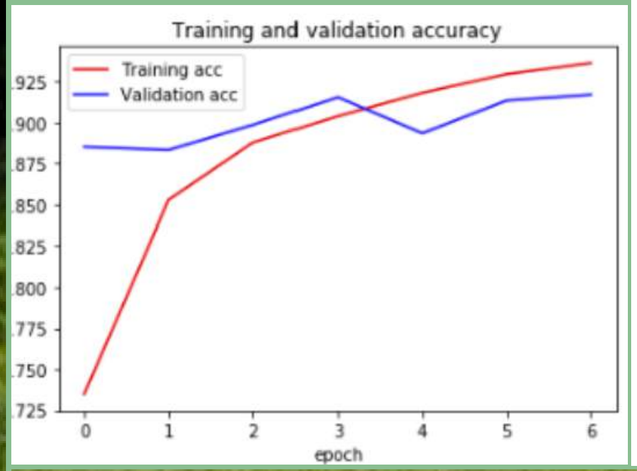
Data from sensors (PIR, cameras) is processed on edge devices using YOLOv5 to detect wild animals.
Detected threats trigger local alerts (sirens, LEDs) and send messages via GSM/LEO satellite to authorities.
All events are logged in a cloud dashboard for real-time monitoring and analysis.

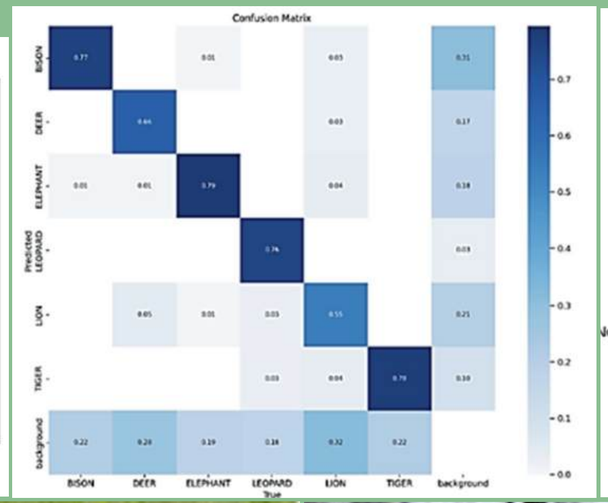
SEQUENCE DIAGRAM

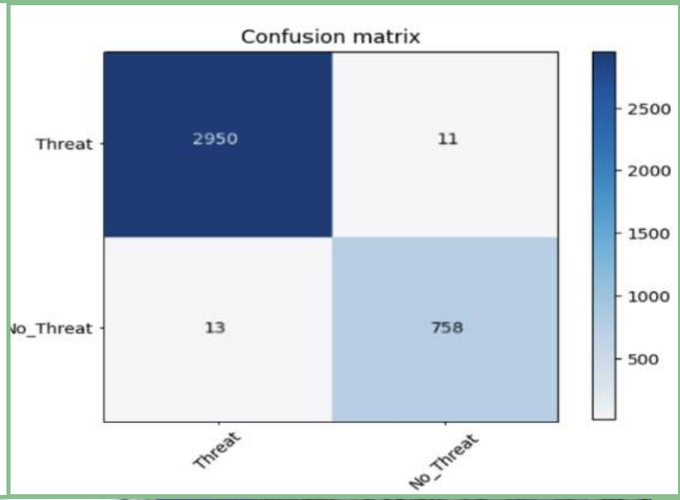


The system begins with continuous monitoring by cameras and PIR sensors placed at village perimeters. When motion is detected, an image is captured and sent to the edge device (Raspberry Pi or Jetson Nano), where the YOLOv5 model identifies whether a wild animal is present. If a threat is detected, the system immediately activates local alerts (sirens, buzzers, flashing LEDs) and sends emergency messages via GSM or LEO satellite to authorities. The event is then logged and displayed on a centralized dashboard for real-time tracking and analysis.

IMPLEMENTATION & RESULT







CONCLUSION

- Successfully implemented a real-time wild animal detection and alert system for remote tribal regions.
- Combines YOLOv5-based object detection, edge computing, and LEO satellite/GSM communication.
- Detects animals like elephants, tigers, and bears; triggers local alarms and sends remote alerts.
- System is solar-powered, modular, locally maintainable, and scalable.
- Field trials show improved safety, reduced response time, and enhanced community protection.

FUTURE WORK

- **Behavioral Detection:** Analyze animal behavior to avoid false alarms.
- **Night Vision:** Add thermal/IR cameras for nighttime accuracy.
- **Mobile App:** Multilingual app for alerts, reports & education.
- **Drone Integration:** Aerial surveillance for extended coverage.
- **Auto-Escalation:** AI-based protocols for critical threats.
- **Predictive Analytics:** Forecast migration patterns and risk periods.
- **Hardware Upgrades:** Faster edge devices with better performance & low power use.

REFERENCES

[1]Zeng, J., Yu, Y., & Tian, B. (Year). Landslide Monitoring based on Computer Vision Technology.

[2]Vasudevan, N., Ramanathan, K., & Ananthapathmanabhan, M. S. (Year). Visual Representation of Slope Stability for Landslide Monitoring Systems.

[3]Li, J. (Year). On Study of Hazards in Tourism Mountainous Regions and Their Relative Prevention.

[4]Shrestha, Y., & Lapeyre, R. (Year). Modern Wildlife Monitoring Technologies: Conservationists versus Communities?

[5]Pu, H., et al. (Year). Concurrent Optimization of Mountain Railway Alignment and Station Locations With a Three-Dimensional Distance Transform Algorithm Incorporating a Perceptual Search Strategy.

[6]Li, R., Xiao, Z., & Zeng, Y. (Year). Toward Seamless Sensing Coverage for Cellular Multi-Static Integrated Sensing and Communication.

[7]Al-Hraishawi, H., Chougrani, H., Kisseleff, S., Lagunas, E., & Chatzinotas, S. (Year). A Survey on Nongeostationary Satellite Systems: The Communication Perspective.

[8]Hong, W., Guo, Z.-J., & Hao, Z.-C. (Year). Seamless Integration Technology for Filtenna Toward 5G/6G Wireless Communications.

[9]Chang, B., Tang, W., Yan, X., Tong, X., & Chen, Z. (Year). Integrated Scheduling of Sensing, Communication, and Control for mmWave/THz Communications in Cellular Connected UAV Networks.

[10]Shi, J., Li, Z., Jia, J., Li, Z., Shen, C., Zhang, J., & Chi, N. (Year). Waveform-to-Waveform End-to-End Learning Framework in a Seamless Fiber-Terahertz Integrated Communication System.

REFERENCES CONT.

11]Zhang, J., et al. (Year). Real-Time Demonstration of 100 GbE THz-Wireless and Fiber Seamless Integration Networks.

[12]Shin, H., Kim, S. M., & Song, Y. (Year). Learning-Aided Joint Beam Divergence Angle and Power Optimization for Seamless and Energy-Efficient Underwater Optical Communication.

[13]Kanno, A. (Year). Seamless Convergence Between Terahertz Radios and Optical Fiber Communication Toward 7G Systems.

[14]Ribeiro, M. V., et al. (Year). Seamless Connectivity: The Power of Integrating Power Line and Wireless Communications.

[15]Lei, M., et al. (Year). Integration of Sensing and Communication in a W-Band Fiber-Wireless Link Enabled by Electromagnetic Polarization Multiplexing.

[16]Kamath, A. N., et al. (Year). Night-Time Animal Recognition System.

[17]Cybersecurity and Infrastructure Security Agency (CISA). (Year). Working with Tribes to Achieve Interoperability.

[18]Verma, A. R. K. (Year). Satellite Communication: Bridging the Gap to the Farthest Places on Earth and Enhancing 911 Emergency Calls.

[19]Dertien, J. S., et al. (Year). Mitigating Human-Wildlife Conflict and Monitoring Endangered Tigers Using a Real-Time Camera-Based Alert System.

[20]Cybersecurity and Infrastructure Security Agency (CISA), USA. (2020). The Tribal Emergency Communications Resources Fact Sheet.

THANK YOU