SURA – Smart Unmanned Response Alarm for Gunshot Detection in Border Zones

AIM

To develop and deploy a portable, AI-powered, LoRa-based gunshot detection and real-time alert system specifically designed for remote, border, and conflict-prone regions of India. The system will ensure rapid response, improve security intelligence, and enhance both civilian and defense safety through automated sound detection and alarm triggering.

OBJECTIVES

- Detect gunfire events using edge-AI audio classification models.
- Transmit real-time alerts via LoRa to nearby military posts or command stations.
- Activate smart sirens and visual alerts for civilian areas.
- Deploy a low-cost, solar-powered, internet-free system suitable for Indian terrain.
- Enhance defense forces' ability to localize threats with multi-node triangulation.

INNOVATION DESCRIPTION

- AI-based sound classification of gunshots using pre-trained lightweight ML models.
- LoRa-based long-range, low-power wireless communication for remote alerts.
- Optional integration with low-power cameras for snapshot recording during incidents.
- Smart siren logic with varying alert levels based on type and frequency of gunshots.
- Advanced encryption for secure transmission and anti-tamper triggers in each device.
- Health monitoring via heartbeat packets and remote diagnostic capabilities

POTENTIAL AREAS OF APPLICATION

- Border Security: Indo-Pak, Indo-Bangladesh, and Indo-Myanmar borders.
- Rural Law Enforcement: Maoist regions and low-infrastructure districts.
- Civilian Safety: Villages, schools, and public centers in conflict-prone areas.
- Disaster Management: Panic alerts during armed violence or riots.
- Vehicle and Drone Surveillance Units: Mobile detection in patrol operations.

TECHNOLOGY

- MEMS microphones + ESP32/STM32 microcontrollers.
- AI detection models built with TinyML or TensorFlow Lite.
- SX1276/SX1278 LoRa modules with GPS for triangulation.
- Solar charging units and lithium-ion battery packs.
- IP65 enclosures and tamper detection switches.
- Relay-triggered sirens and LED alert mechanisms.

STRATEGIES

- Pilot deployment in one high-risk border village per region.
- Collaborate with BSF/ITBP units for feedback and optimization.
- Partner with Indian electronics MSMEs for low-cost manufacturing.
- Develop training manuals for deployment by rural defense volunteers.
- Seek inclusion under DRDO TDF, BADP, and iDEX for funding and trials.

IMPLEMENTATION PLAN

Phase 1: Prototype Development (1-2 months)

- Design PCB and housing.
- Train AI model on real Indian firearm sounds.
- Test LoRa range and signal encryption.

Phase 2: Pilot Trials (3 months)

- Deploy 10-15 nodes + gateway in selected area.
- Collect data, fine-tune ML model, and improve reliability.

Phase 3: Defense Integration (3-4 months)

- ➤ Interface with military dashboards.
- ➤ Add remote diagnostics and alert history logs.

Phase 4: Scaling (6-12 months)

- ➤ Partner with DRDO/MSME units for 100+ units.
- ➤ Expand to 2-3 border states.

CHALLENGES AND SOLUTIONS

Challenge	Solution
Terrain and weather	Use IP-rated enclosures, mesh network repeaters
Sound misclassification	Train with real gun data, use multi-node validation
Tampering or hacking	Tamper switch + AES encryption on LoRa packets
Power limitations	Solar with smart sleep-wake cycle design
Deployment scale	Modular kits for field units to self-install

ALIGNMENT WITH NATIONAL GOALS

- BharatNet & Digital India: Leverages decentralized, digital-first surveillance.
- Atmanirbhar Bharat: Enables indigenous defense tech innovation.
- Smart Border Management (MHA): Supports mission for real-time situational awareness.
- Startup India: Ideal for defense or safety-focused startup development.
- MSME Empowerment: Encourages local manufacturing and employment.

KEY OUTCOMES

1. Enables real-time detection of gunfire in sensitive zones.

2. Enhances civilian safety through automatic sirens and alert beacons.

3. Assists military in pinpointing attack origin using triangulation.

4. Empowers MSMEs in electronic manufacturing.

5. Reduces dependency on manual patrol detection.

6. Saves lives and improves national internal security preparedness.

CONCLUSION

SURA is a smart, scalable, and indigenous innovation designed to secure India's most vulnerable areas using modern AI and IoT technologies. With minimal infrastructure and high adaptability, it can transform how threats are detected and addressed in real time. Through government support and defense adoption, SURA can become a cornerstone in India's smart security and border safety strategy.