# Development of a Scalable IoT-Based Emergency Alarm and Response System for Smart Cities in Nigeria

## Applicant Information

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Institution: Bayero University, Kano
Project Duration: 24 Months
Budget: ₦
Focus Area: Construction and Smart City Development

## Executive Summary

This project proposes the development of a scalable, IoT-enabled emergency alarm and response system designed for Nigerian cities under the thematic focus area of Construction and Smart City Development. Building on a proof-of-concept already piloted at Bayero University Kano, the system integrates Active Boards (central monitoring units), mobile applications, IoT-enabled devices, and a dedicated Security Response Team (SRT) to connect households, campuses, and public institutions to centralized emergency hubs. The proposed solution is innovative, locally adaptable, cost-effective, and commercially viable, providing a foundation for Smart City development in Nigeria. By reducing emergency response times and enhancing community safety, this project aligns strongly with NASENI's objectives and the Renewed Hope Agenda.

## Problem Statement

Nigeria faces pressing challenges in urban safety and security. Emergency response systems are fragmented, and imported solutions are expensive and not well-suited to local infrastructure. Communities, estates, universities, and city centers lack affordable, reliable, and scalable alarm technologies. The absence of an integrated, locally designed system leads to delayed responses in cases of burglary, fire, or medical emergencies. This project addresses these gaps with a home-grown IoT-based emergency alarm system coupled with a trained response team tailored for Nigerian conditions. Its relevance lies squarely within NASENI's call theme of Construction and Smart City Development, as it provides a technology-driven infrastructure for safer, smarter urban living.

## Project Objectives

1. To design and develop IoT-enabled Active Boards integrated with GSM, Wi-Fi, and AI-based incident prioritization.
2. To prototype and pilot the system across Bayero University Kano campuses and selected communities in Kano.
3. To develop a cloud-based dashboard and mobile app for centralized monitoring and response.
4. To establish and train a dedicated Security Response Team (SRT) to react to alarms promptly.
5. To create a framework for commercial rollout with Nigerian manufacturing partners.

6. To contribute to Nigeria's Smart City and Security Infrastructure Development Agenda under NASENI.

**Patent Credentials:**

- Registration Number: RP: NG/P/2022/77
- Date of Patent: 11/12/2021
- Date of Sealing: 05/06/2022

This patent demonstrates originality, legal protection, and commercial potential of the innovation, providing a strong foundation for scaling and attracting industry partnerships.

Proposed Innovation

- IoT-enabled alarm devices for homes, schools, hospitals, and offices.
- Active Boards in centralized monitoring hubs linked via GSM.
- Cloud-based dashboards for security offices.
- Locally designed for affordability and sustainability.
- Integration with a Security Response Team (SRT) to ensure that every alarm triggers real action.

Security Response Team (SRT)

The SRT ensures that the emergency alarm system translates into practical, real-time protection for communities. It bridges the gap between electronic alerts and human intervention.

Structure of the SRT

1. Team Leader (Shift Supervisor): Oversees daily operations, assigns tasks, and reports incidents.
2. Control Room Operators: Monitor Active Boards and dashboards, verify alarms, and dispatch responders.
3. Field Response Officers (Rapid Responders): Mobile officers trained to respond quickly, equipped with motorcycles/vehicles, and able to provide first aid or secure scenes.
4. Technical Support Officer: Maintains the alarm system hardware and software, coordinates troubleshooting.
5. Liaison Officer: Ensures effective coordination with external agencies such as the police, fire service, and medical services.

Workflow

1. Alarm triggered via mobile phone, portable trigger unit, or IoT sensor.
2. Control room logs and verifies the alert.
3. Rapid responders dispatched to the site.
4. Responders secure the area, assist victims, or escalate cases.
5. Liaison Officer coordinates with government emergency services if needed.
6. Incident documented for continuous improvement.

Training and Capacity Building

- First aid and basic life support.
- Firefighting and evacuation drills.
- Use of IoT dashboards and monitoring systems.
- Conflict management and collaboration with law enforcement.

Equipment and Resources

- Patrol motorcycles/vehicles for rapid mobility.
- Portable radios and secure communication devices.
- First aid kits and firefighting tools.
- Protective equipment for field officers.

Performance Indicators

- Average response time.
- Resolution success rates.
- Community satisfaction levels.
- Frequency of drills and preparedness exercises.

Methodology

1. System Design: Development of IoT-based Active Boards and sensor integration.
2. Software Development: Creation of mobile application and centralized monitoring dashboard.
3. Pilot Testing: Deployment at BUK campuses and selected urban estates.
4. Establishment of SRT: Recruitment, training, and equipping of Security Response Team members.
5. Evaluation: Measurement of response times, reliability, adoption rates, and scalability.
6. Commercialization Framework: Engagement with industry partners, including telecoms and security companies, to support large-scale deployment.

Commercial Viability and Market Analysis

- Market Demand: Universities, hospitals, residential estates, and local governments are key customers.
- Potential Users: Private security firms, housing developers, and public safety agencies.
- Competitive Advantage: Locally produced, affordable, scalable, and customizable compared to expensive imported solutions.
- Business Model: Off-take agreements with real estate developers, licensing of technology, and partnership with SMEs for local manufacturing and distribution.

Alignment with NASENI and Renewed Hope Agenda

- NASENI Objectives: Industrial growth, import substitution, job creation, and promotion of indigenous technology.

- Renewed Hope Agenda: Enhanced security, digital transformation, local content development, and inclusive growth.
- National Policy Linkages: Smart City Development, Digital Economy, and National Security Strategy.

Scalability and Sustainability

The system will start with a campus/community pilot, expand to Kano estates, and then scale nationwide. Sustainability is ensured through:

- Local content integration (Nigerian components and technicians).
- Partnerships with state governments and housing developers.
- Affordable subscription-based service models for long-term revenue.
- Solar-powered backup to ensure reliability despite power outages.

Expected Outcomes

- Fully functional prototype system.
- Operational Security Response Team integrated with the alarm system.
- Patents, research publications, and technical manuals.
- Commercial product ready for adoption in Nigerian cities.
- Training and capacity building for students and SMEs in IoT and Smart City technologies.
- Enhanced public safety and reduced emergency response time in pilot communities.

Work Plan and Timeline

Year 1:

- Hardware and software design.
- Development of IoT-enabled Active Boards and mobile app.
- Initial pilot deployment at BUK.
- Recruitment and training of Security Response Team.

Year 2:

- Expansion to urban estates in Kano.
- Full integration of SRT with the system.
- System optimization and field testing.
- Commercialization framework development.
- Final reporting, dissemination, and stakeholder workshops.

Team Composition

- PI: Prof. M. H. Ali (Physics, IoT, and Electronics).
- Co-PIs: Computer Science (software/app development), Electrical Engineering (IoT hardware), Security Studies (policy and safety framework).
- Industry Partners: Telecom providers, security companies, real estate developers.

- Security Response Team: Dedicated operational staff trained to respond to alarms.

Budget and Justification

- Personnel and research assistants.
- Hardware prototyping (boards, sensors, IoT modules).
- Software/app development costs.
- Pilot deployment expenses (BUK + estates).
- Training workshops and dissemination.
- Security Response Team recruitment, training, and equipment.

Risk Analysis and Mitigation

- Technical Risks: Power outages → Mitigation: solar backup.
- Adoption Risks: Reluctance from users → Mitigation: awareness campaigns and user training.
- Commercial Risks: Competition from imported systems → Mitigation: focus on low-cost local adaptation.
- Policy Risks: Data/privacy concerns → Mitigation: compliance with NCC and NITDA regulations.

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Annexes

- CVs of key team members.
- Patent Certificate: RP: NG/P/2022/77 (Date of Patent: 11/12/2021; Date of Sealing: 05/06/2022).

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