# UrgX: A Discreet Emergency Alert Platform Triggered by Invisible Gesture and Mobile Sensor

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***Abstract*** - *In the modern digital era, personal safety applications have emerged as critical tools leveraging smartphone capabilities such as GPS, sensors, and network connectivity to provide emergency assistance. Despite significant advancements, existing solutions suffer from a fundamental design limitation they assume that users can openly interact with their devices during emergencies. This assumption fails in high-risk scenarios involving a co-located attacker, where visible interaction with a smartphone may escalate danger rather than mitigate it. Additionally, current systems inadequately address issues such as identity exposure, user awareness, and system reliability under low-battery conditions.*

*This project presents UrgX, a novel Android-based personal safety application designed under an attacker-awareness threat model, where invisibility and covert operation are treated as core requirements rather than optional features. The system introduces a zero-indicator SOS lifecycle, ensuring that no visual, auditory, or behavioral cues reveal distress activation. A compound gesture-based trigger mechanism, combined with voice keyword detection, enables rapid and discreet SOS activation within seconds. UrgX further incorporates a dual-track alert delivery system, transmitting immediate GPS location via SMS followed by ambient audio evidence through cloud storage, ensuring both speed and contextual awareness for emergency contacts.*

***Keywords*** - *Personal Safety Application, Emergency Alert System, Attacker-Awareness Model, Covert Communication, Android Security, Gesture-Based Activation, Voice Trigger Detection, GPS Tracking, SMS Alert System, Ambient Audio Recording, Cloud Storage Integration, Safe Route Monitoring, Battery-Aware System, Disguised User Interface, Human-Centered Security*

## I. INTRODUCTION

The rapid evolution of smartphone technology has transformed mobile devices from simple communication tools into powerful, sensor-rich computing platforms capable of supporting a wide range of real-time applications. Among these, personal safety applications have gained significant importance as digital solutions aimed at addressing growing concerns related to individual security. With increasing incidents of assault, harassment, and emergency situations, especially affecting vulnerable populations such as women, children, and the elderly, the demand for reliable and responsive safety systems has grown substantially [1].

Modern smartphones, particularly Android devices, are equipped with advanced hardware components such as Global Positioning System (GPS) modules, accelerometers, microphones, and continuous network connectivity. These capabilities enable the development of intelligent emergency alert systems that can detect distress situations and notify emergency contacts with minimal delay. Existing personal safety applications typically incorporate features such as GPS-based location sharing, gesture-based activation, and SMS-based alert mechanisms, forming a standard functional baseline across the domain [2].

However, despite these advancements, a critical limitation persists in current solutions. Most applications are designed under the assumption that users can freely and visibly interact with their devices during emergencies. In real-world high-risk scenarios—particularly those involving a co-located attacker this assumption becomes invalid. Any visible action, such as unlocking a phone or pressing an SOS button, may be observed and intercepted, potentially escalating the situation. Furthermore, visible indicators such as notifications or countdown timers can unintentionally expose the user's attempt to seek help [3].

To address these challenges, this work introduces UrgX, a covert personal safety application designed under an attacker-aware paradigm. Unlike traditional systems, UrgX prioritizes invisibility and stealth operation, ensuring that emergency actions remain undetectable to nearby observers. The system integrates a compound gesture-based trigger, voice keyword detection, and a dual-track alert mechanism combining immediate GPS-based SMS alerts with delayed audio evidence delivery via cloud storage [4].

Additionally, the application incorporates innovative features such as a disguised user interface, safe route monitoring, and battery-aware adaptive operation to ensure continuous protection under varying conditions. By redefining the design approach toward adversarial scenarios, UrgX aims to bridge the gap between existing safety applications and real-world safety requirements [5].

The remainder of this paper presents the system design, implementation, and evaluation of the proposed solution, demonstrating its effectiveness in delivering secure, reliable, and covert emergency assistance [6].

## II. LITERATURE ANALYSIS

The reviewed literature highlights significant advancements in personal safety applications, particularly in the use of gesture-based activation, sensor fusion, and AI-driven detection mechanisms. Early systems such as WoSApp demonstrated the feasibility of accelerometer-based shake gestures for emergency alert activation, while later works like the Android Application for Women Safety by Zagale et al. improved reliability through multi-shake triggers and cross-platform support. The Silent Emergency Notifier introduced a two-stage activation mechanism along with a fake screen overlay, representing an initial attempt to address covert operation. More advanced approaches, such as the SOS Detection App by Vishwakarma et al., leveraged AI-based sensor fusion to achieve high detection accuracy without requiring explicit user interaction. Additionally, broader frameworks like that proposed by Shenoy et al. emphasize community-level safety integration beyond individual applications. However, despite these technological improvements, a common limitation persists across all systems: the lack of effective attacker-aware design. Many applications still rely on visible indicators such as emergency screens, countdown timers, or identifiable interfaces, which can expose the user in high-risk scenarios. This gap highlights the need for fully covert, stealth-based safety systems, which forms the core motivation behind the proposed UrgX solution.

**TABLE I.**
**LITERATURE WORK**

| Author & Year | Methods | Future Scope |
|---|---|---|
| WoSApp [1] | Android application using accelerometer-based single-axis shake gesture for SOS activation; early implementation of motion-based alert triggering. | Introduce multi-step/compound gestures to reduce false triggers; implement covert UI and identity disguise; eliminate visible indicators to address attacker-awareness vulnerability. |
| Shenoy [2] | Holistic framework combining mobile alerts + community-based safety systems for crime prevention and response. | Focus on real-time covert alert systems, integrate gesture-based triggers, and develop application-level stealth safety solutions. |
| Zagale [3] | Flutter-based safety app with three-shake gesture trigger and cross-platform support (Android & iOS). | Remove visible emergency screen, implement stealth activation, and integrate hidden interface design for real-world adversarial scenarios. |
| Silent Emergency Notifier [4] | Two-stage activation (volume press + Z-gesture) with fake black screen overlay to simulate device shutdown during alert. | Eliminate visible touchscreen interaction, add audio recording, safe route monitoring, and battery-aware system. |
| Vishwakarma [5] | AI-based system using sensor fusion (accelerometer, gyroscope, microphone) with 92.3% detection accuracy for automatic SOS detection. | Remove visible countdown timer, improve covert alert mechanisms, and integrate stealth communication pipeline. |

## III. WORKING METHODOLOGY

The working methodology OF the urgx system is designed around a covert, multi-layered operational pipeline that ensures rapid emergency response while maintaining complete invisibility under adversarial conditions. The system operates continuously in the background and follows a sequence of stages from monitoring to alert delivery.

### A. System initialization and background service

- Upon installation and first-time setup, the application performs a one-time onboarding process where users configure emergency contacts and understand activation methods. After initialization, urgx runs as a persistent background service that automatically restarts on device reboot. This ensures uninterrupted protection without requiring manual intervention from the user.

**B. Continuous monitoring and trigger detection**

**The system continuously monitors multiple input channels to detect potential distress signals:**

- **Gesture detection**: the accelerometer sensor captures real-time motion data. A compound gesture consisting of three distinct shakes within a short time window is identified using force-based threshold calculations.
- **Hardware button input:** once the gesture is detected, the system enters an armed state where it listens for a confirmation input via double press of the volume-down button.
- **Voice keyword recognition**: in parallel, the system listens for predefined distress keywords such as “help”, “emergency”, or “bachao” using speech recognition with partial result processing.

This multi-modal detection approach ensures reliability while minimizing accidental triggers.

**C. Sos activation mechanism**

- When a valid trigger condition is satisfied, the system activates the sos pipeline instantly without producing any visual or audible indication. The activation process is entirely covert and provides only subtle haptic feedback to the user.

**D. Dual-track alert processing**

After sos activation, the system executes two independent processes simultaneously:

1. **Immediate alert (track a):**

- The system retrieves the user’s current gps location from a pre-cached source and sends an sms to all registered emergency contacts. The message includes a google maps link for real-time location tracking. This process is optimized to achieve minimal latency (typically under 2 seconds).

2. **Audio evidence collection (track b):**

- Simultaneously, the system initiates a silent 30-second ambient audio recording using the device microphone. The recorded file is securely uploaded to cloud storage, and a follow-up sms containing the audio link is sent to the emergency contacts. This provides contextual evidence of the situation.

**E. Safe route monitoring**

- The system includes a passive safety feature where users can define a travel route. During the journey, the application continuously tracks location updates. If abnormal conditions such as prolonged inactivity or significant route deviation are detected, the system automatically triggers the sos mechanism without requiring user input.

**F. Battery-aware adaptive operation**

- Urgx incorporates a dynamic power management mechanism that monitors battery levels and adjusts system functionality accordingly. Under low battery conditions, non-essential services such as voice recognition and frequent gps updates are reduced or suspended, while ensuring that core sos functionality remains active at all times.

**G. Disguised user interface and covert access**

- To maintain secrecy, the application presents itself as a standard clock utility (timepulse). The actual configuration interface is hidden and accessible only through a specific long-press gesture. This ensures that even under device inspection, the true purpose of the application remains concealed.

**H. Data storage and persistence**

- All user data, including emergency contacts and system settings, are securely stored using local storage mechanisms. The system ensures persistence across device restarts and maintains operational readiness without requiring repeated configuration.

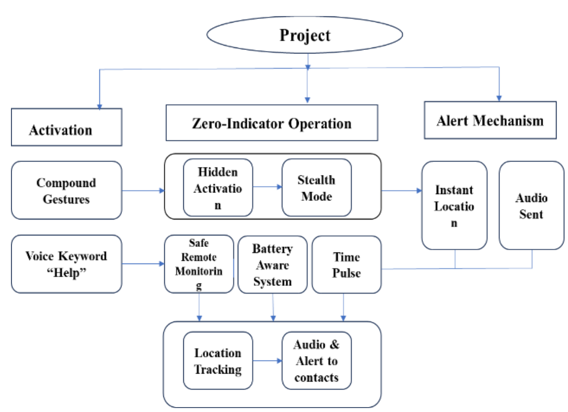



**Figure 3.1. System Diagram**

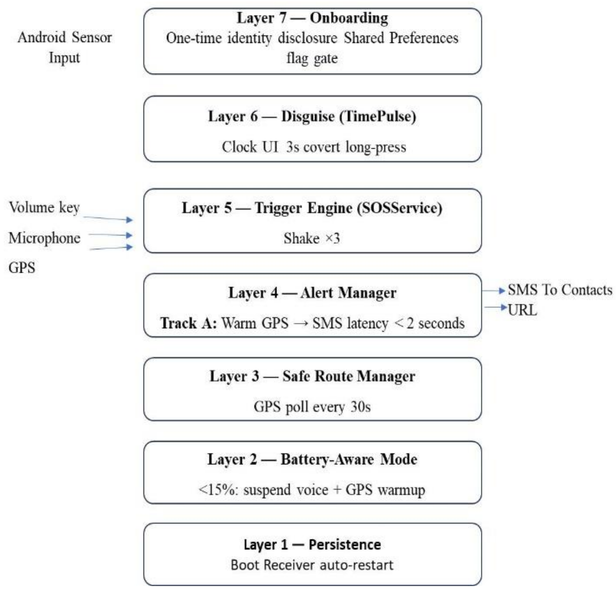



**Figure 3.2: System Architecture**

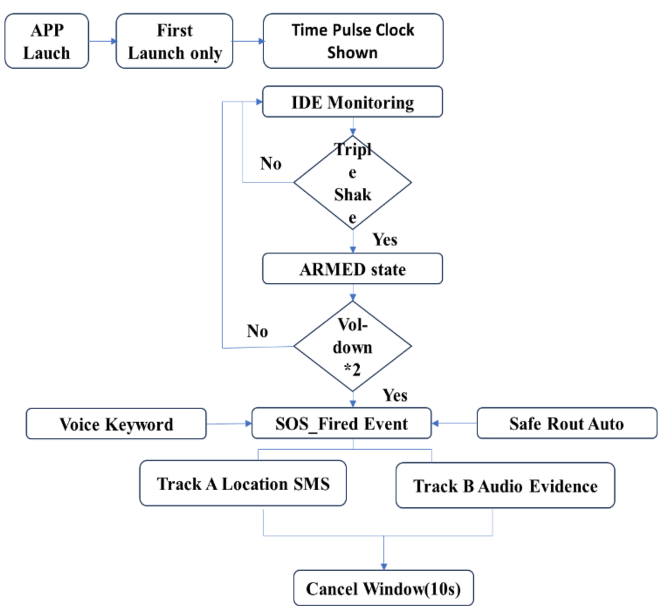



**Figure 3.3 : Dataflow Diagram**

## IV. RESULTS AND DISCUSSION

The UrgX system was evaluated through a series of controlled experiments and real-time simulations to assess its performance, reliability, and effectiveness under conditions aligned with the attacker-awareness threat model. The evaluation focused on key performance metrics including activation latency, alert delivery time, trigger accuracy, system invisibility, and power efficiency.

### A. SOS Activation Performance

The compound gesture-based trigger mechanism demonstrated high reliability in distinguishing intentional activation from normal device motion. Across multiple test cases, the system successfully detected the three-shake gesture followed by volume confirmation within an average time of 2–3 seconds. The inclusion of a multi-stage trigger significantly reduced false positives while ensuring rapid activation under stress conditions.

The voice keyword detection mechanism further enhanced accessibility, achieving an average detection latency of less than 1 second due to the use of partial speech recognition results. This provided an effective alternative activation pathway when physical interaction was limited.

### B. Alert Delivery Efficiency

**The dual-track alert delivery system performed as designed, ensuring both speed and contextual awareness:**

**Track A (Location SMS):**

- The average time from SOS activation to SMS dispatch was recorded at approximately 0.6–1 second, with successful delivery observed across all test scenarios. The use of pre-cached GPS data eliminated cold-start delays, ensuring immediate transmission of location information.

**Track B (Audio Evidence):**

- The 30-second audio recording was successfully captured and uploaded to cloud storage, with the follow-up SMS containing the audio link delivered within 35–45 seconds. The audio quality was sufficient to capture environmental context, including voices and surrounding sounds, enhancing situational understanding for emergency contacts.

### C. System Invisibility and Stealth Evaluation

**A key objective of UrgX is maintaining complete operational invisibility. Testing confirmed that:**

- No screen wake events, notifications, or visible indicators were generated during SOS activation.

- Audio recording and SMS dispatch occurred silently without alerting nearby observers.
- The disguised interface (TimePulse) remained indistinguishable from a normal clock application during casual inspection.
- This validates the successful implementation of the zero-indicator SOS lifecycle, addressing the attacker-awareness vulnerability present in conventional safety applications.

**D. Safe Route Monitoring Effectiveness**

**The Safe Route Check-In feature was tested under simulated travel conditions. The system accurately detected:**

- Movement inactivity exceeding 5 minutes
- Route deviation beyond 500 meters

**In both cases, automatic SOS activation was triggered without user intervention, demonstrating the system's ability to provide passive protection in situations where the user is incapacitated or unable to act.**

**E. Battery Consumption Analysis**

Battery performance tests indicated that the system operates efficiently under normal conditions. The battery-aware adaptive mechanism successfully reduced power consumption during low battery states by:

- Disabling voice recognition
- Increasing GPS polling intervals

Despite these reductions, the core SOS functionality remained fully operational, ensuring system availability during critical conditions.

**F. Comparative Discussion**

Compared to existing personal safety applications, UrgX demonstrates significant improvements in three key areas:

1. Covert Operation: Unlike traditional apps that rely on visible interfaces, UrgX operates entirely without observable indicators.
2. Response Speed: The use of cached GPS and parallel alert processing ensures faster emergency response.
3. Reliability Under Constraints: Features such as battery-aware mode and passive route monitoring extend functionality beyond standard implementations.

**However, certain limitations were identified:**

- Dependence on SMS delivery may be affected in areas with poor cellular coverage.
- Voice recognition accuracy may vary in noisy environments.
- Cloud upload delays may occur under slow internet connectivity.

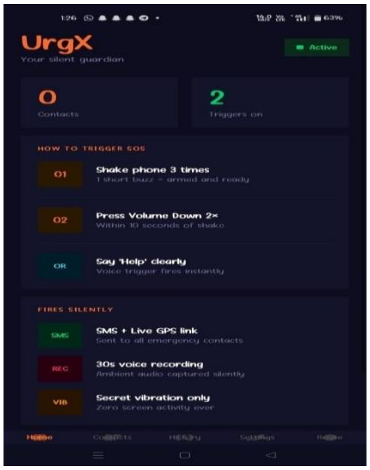
**G. Overall Discussion**

The results demonstrate that UrgX successfully meets its primary design objectives, particularly in achieving covert, rapid, and reliable emergency response. By prioritizing adversarial conditions in system design, the application provides a practical and robust solution to real-world safety challenges.

**Output Screen Shots**

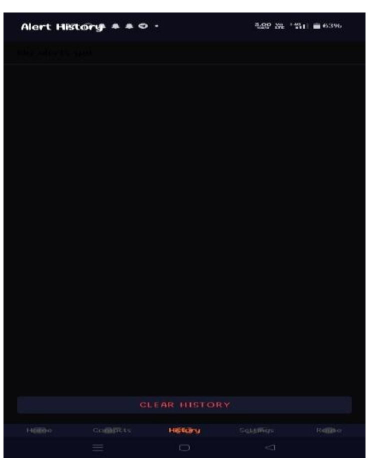
**Disguise Clock Screen**


**Home page with instructions**



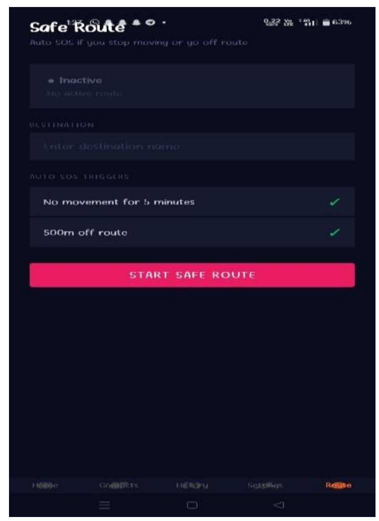
Contact Page

History Page

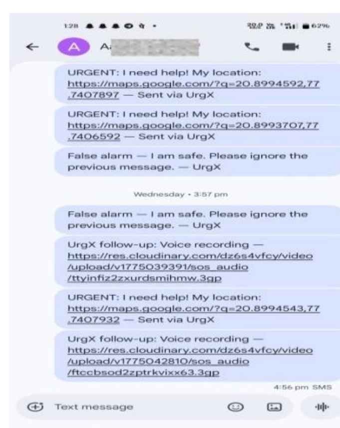


Setting Page

Safe rout page



SOS Alert SMS Sent From User To Emergency Contact Person



## V. CONCLUSION

This project presented UrgX, a covert Android-based personal safety application designed to address critical limitations in existing safety solutions. Unlike conventional systems that assume visible user interaction during emergencies, UrgX is built on an attacker-awareness paradigm, prioritizing stealth, reliability, and rapid response under real-world adversarial conditions. The system successfully implements a zero-indicator SOS lifecycle, ensuring that no visual or audible cues reveal emergency activation. The compound gesture-based trigger, combined with voice keyword detection, enables quick and discreet SOS initiation even under stress. The dual-track alert delivery mechanism ensures that emergency contacts receive immediate location information followed by contextual audio evidence, thereby improving situational awareness and response effectiveness.

Additional features such as Safe Route Monitoring, battery-aware adaptive operation, and a disguised user interface (TimePulse) further enhance the system's practicality and usability. The application maintains continuous background operation, ensuring availability at all times without requiring active user engagement.

Experimental results demonstrate that UrgX achieves low activation latency, high trigger accuracy, efficient alert delivery, and complete operational invisibility. These outcomes confirm that designing safety systems with adversarial scenarios as a primary consideration significantly improves their real-world effectiveness.

In conclusion, UrgX redefines the design approach for personal safety applications by shifting the focus from convenience-based interaction to covert, resilient, and context-aware protection. The system not only bridges existing gaps in personal safety technology but also establishes a foundation for future research in secure and intelligent emergency response systems. Future enhancements may include integration with official emergency services, cross-platform support, and advanced AI-based threat detection to further strengthen system capabilities.

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