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Raksh-Aid: A Unified Web Application for Emergency Management and Safety

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Abstract: ***Rapid response during emergencies is essential for ensuring personal safety and minimizing harm. Raksh-Aid is a unified, web-based emergency management platform designed to overcome the limitations of fragmented safety solutions. The system integrates instant SOS alerts via SMS and email, real-time GPS location tracking, camera-based evidence captures, emergency service mapping, and cybercrime reporting within a single platform. A centralized administrative analytics dashboard aggregates alert data and categorizes incidents by severity to support informed decision-making by authorities. Built on a serverless, API-driven architecture using native Web APIs, Raksh-Aid ensures scalability, reliability, and offline-first functionality. Experimental results demonstrate low alert latency, high delivery success rates, and stable system performance, making Raksh-Aid an effective solution for modern emergency response and public safety management.***

Keywords: administrative analytics, emergency response system, public safety platform, real-time location tracking, serverless web application, SOS alert system

I. INTRODUCTION

Emergency situations demand immediate, reliable, and well-coordinated responses to minimize risk and ensure personal safety. However, existing safety solutions are often fragmented, requiring individuals to rely on multiple independent applications for SOS alerts, location sharing, evidence capture, and crime reporting. This lack of integration can lead to delayed responses, incomplete information, and reduced effectiveness during critical situations.

To address these limitations, Raksh-Aid has been developed as a unified, web-based emergency management platform that consolidates essential safety functionalities into a single system. The platform enables users to trigger instant SOS alerts, share real-time GPS location data, capture visual evidence through device cameras, and access nearby emergency services using an interactive mapping interface. In addition, Raksh-Aid provides direct access to national cybercrime reporting resources, ensuring comprehensive support for both physical and digital safety concerns.

A distinguishing feature of Raksh-Aid is its centralized administrative analytics dashboard, which aggregates emergency data and classifies incidents based on severity levels. This analytical capability supports informed decision-making by authorities, enabling trend identification, risk assessment, and improved resource planning. This paper presents the design, implementation, and evaluation of Raksh-Aid, demonstrating how an integrated web-based approach can enhance emergency response efficiency while strengthening both individual security and administrative oversight.

II. LITERATURE REVIEW

Recent advancements in personal safety and emergency response technologies have led to the development of various solutions aimed at reducing response time and improving user protection. Existing research in this domain can broadly be classified into mobile-based safety applications, hardware and wearable safety devices, and web-based platforms with administrative monitoring capabilities. While each category contributes valuable functionality, most existing systems operate in isolation, limiting their effectiveness during complex emergency scenarios.

A. Mobile-Centric Applications with Multi-Modal Alerts

Mobile-based safety applications leverage the widespread availability of smartphones to provide real-time assistance during emergencies. Applications such as the Narishakti Women's Safety App focus on real-time location sharing and alerting users about high-risk zones. Systems like RescueNow extend this approach by integrating SOS alerts, audio and video evidence capture, and predictive analytics. Similarly, applications such as Amaan/Raksha introduce automated timers and discreet triggering mechanisms to initiate emergency alerts. Although these applications offer strong user engagement and accessibility, they are primarily limited to mobile environments and lack comprehensive administrative analytics for large-scale safety monitoring.

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B. Hardware-Based and Wearable Safety Devices

Hardware-based safety solutions are designed to function independently of smartphones, making them suitable for situations where mobile access may be restricted. Wearable devices such as smart safety bands incorporate GPS and GSM modules to transmit emergency alerts and location data. Other IoT-based safety devices provide panic buttons or automated alert mechanisms. These solutions offer simplicity, reliability, and ease of use; however, they typically perform a single function and operate as standalone systems, with minimal integration into broader emergency management platforms.

C. Web-Based Platforms and Administrative Insights

A limited number of studies emphasize web-based emergency platforms that support administrative oversight and centralized monitoring. Systems such as the SOS Emergency Alert and Assistance Application introduce dashboards that allow administrators to track alerts, monitor user activity, and coordinate responses. These platforms highlight the importance of data aggregation and real-time visibility for authorities. However, many such systems lack advanced user-side features such as live evidence capture, offline functionality, or seamless integration with national safety services.

D. Identified Research Gap and Raksh-Aid's Contribution

Despite the availability of diverse safety solutions, a significant research gap remains in the development of a unified platform that integrates user-level safety tools with administrative analytics. Mobile applications often lack centralized monitoring, hardware devices operate in isolation, and government portals focus primarily on reporting rather than real-time assistance. Raksh-Aid addresses these limitations by providing an integrated, web-based emergency management system that combines instant SOS alerts, real-time location tracking, evidence capture, cybercrime reporting, and an administrative analytics dashboard. By consolidating these features into a single platform, Raksh-Aid enhances emergency responsiveness while enabling data-driven decision-making for improved public safety planning.

III.SYSTEM ARCHITECTURE

Raksh-Aid is designed using a lightweight, serverless, and client-centric architecture to ensure rapid responsiveness, scalability, and reliability during emergency situations. Unlike conventional emergency response systems that rely heavily on centralized backend servers, Raksh-Aid minimizes backend dependency by leveraging modern web technologies, native browser APIs, and cloud-based services. This architectural approach reduces infrastructure complexity while enabling efficient real-time operation.

A. Overall System Design

The overall architecture of Raksh-Aid is structured into three primary layers: the Presentation Layer, Cloud Services Layer, and Data Storage Layer. The Presentation Layer provides the user interface and handles core application logic using standard web technologies, including HTML5, CSS3, and JavaScript (ES6+). Critical functionalities such as location tracking, camera access, and user interaction are executed at the client level to ensure real-time responsiveness. The Cloud Services Layer integrates external APIs to support mapping, communication, authentication, and analytics, while the Data Storage Layer manages both local and cloud-based data persistence.

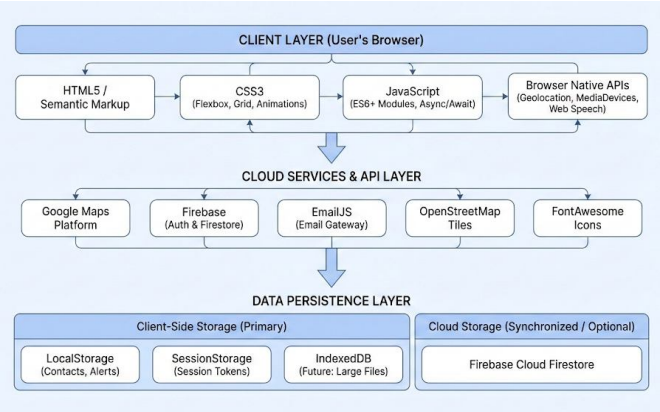


Fig. 1. System Architecture

B. Technology Stack and Implementation

Raksh-Aid follows an API-driven technology stack optimized for performance and ease of deployment. The system is developed using plain HTML5, CSS3, and modern JavaScript to avoid dependency on heavy frameworks. Interactive maps are implemented using Leaflet.js with OpenStreetMap, while Google Maps APIs are utilized for geocoding and location-based service discovery. Emergency notifications are delivered through EmailJS for email communication and native SMS URI schemes for text messaging. User authentication and optional cloud synchronization are handled using Firebase Authentication and Firebase Cloud Firestore. In addition, Raksh-Aid extensively utilizes native Web APIs. The Geolocation API enables continuous real-time location tracking, the MediaDevices API allows browser-based camera access for evidence capture, and the Web Speech API supports voice-activated SOS triggering.

LocalStorage and SessionStorage are employed to maintain user data on the device, enabling offline-first functionality and improved data privacy.

C. Core Architectural Modules and Data Flow

The system integrates multiple functional modules that operate cohesively within the browser environment. User authentication manages secure access and profile data. The SOS alert module captures real-time location data and initiates parallel alert delivery through email and SMS.

The evidence capture module records timestamped visual data and associates it with alert records. The live mapping module continuously updates the user's position and displays nearby emergency services. Data generated from these modules is locally stored and selectively synchronized with cloud services to support administrative monitoring.

D. Database Design and Schema

Raksh-Aid adopts a hybrid data storage strategy. Primary user data, including profiles, emergency contacts, alert logs, evidence references, and cybercrime reports, is stored locally on the user's device to ensure privacy and offline accessibility. A global alert dataset supports the administrative dashboard by aggregating SOS events. When required, selected data elements are synchronized with Firebase Cloud Firestore to enable secure cloud backup, remote access, and administrative analysis.

E. Key Architectural Advantages

The proposed architecture offers several advantages. The serverless design eliminates single points of failure and reduces operational costs. Client-side execution combined with offline-first storage ensures continued functionality during network interruptions. API-based scalability allows the system to adapt to varying usage demands without dedicated server infrastructure. Finally, deployment is simplified, as the application consists of static assets that can be hosted globally on standard content delivery networks.

IV. IMPLEMENTATION MODULES

This section describes the implementation of the core modules of the Raksh-Aid system and explains how these components operate collectively to provide a comprehensive emergency management solution.

A. User Authentication and Profile Management

The user authentication module supports secure registration and login functionality. During registration, users provide essential personal details such as name, email address, and blood group, which can be critical for medical response during emergencies. User credentials are securely hashed before storage to ensure account security. Upon successful authentication, users gain access to a personalized profile that centrally manages emergency contacts, alert history, and submitted complaints. This unified profile structure ensures that critical information is readily available when required.

B. Multi-Modal SOS Alert System

The multi-modal SOS alert system allows users to initiate emergency alerts with a single action. Upon activation, the system captures the user's real-time GPS location and sends alert notifications to registered emergency contacts via SMS and email. Each alert is logged with a timestamp, geographic coordinates, and user identification data, creating a reliable and auditable record of emergency events. The parallel delivery mechanism enhances alert reliability, even under unstable network conditions.

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C. Camera-Based Evidence Collection

Raksh-Aid includes a browser-based evidence capture module that uses native Web APIs to access the device camera. Users can capture visual evidence using either the front or rear camera. Each image is automatically timestamped and linked to the corresponding SOS alert. This functionality ensures the integrity and traceability of evidence, supporting post-incident verification and potential legal proceedings.

D. Live Location and Emergency Services Mapping

The live location tracking module uses the Geolocation API to continuously monitor the user's real-time position. The system displays this information on an interactive map interface and dynamically retrieves nearby emergency services, including police stations, hospitals, and fire brigades, using location-based mapping services. Interactive map markers enable users and responders to quickly identify and navigate to relevant emergency facilities.

E. Cyber Crime Reporting Module

The cybercrime reporting module allows users to report digital safety incidents through a structured interface. Users can select the type of cybercrime, provide a detailed description of the incident, and attach supporting evidence where applicable. The platform also offers direct access to national cybersecurity resources, including the National Cyber Crime Helpline (1930) and the official reporting portal, facilitating seamless escalation to appropriate authorities.

F. Admin Analytics Dashboard

The administrative analytics dashboard serves as the central monitoring component of the system. Authorized administrators can securely access real-time metrics such as total SOS alerts, registered users, and active incidents. The dashboard implements a risk assessment mechanism that categorizes alerts into HIGH, MEDIUM, or LOW severity levels based on factors including alert frequency, time, and location. Real-time incident logs enable administrators to monitor ongoing situations, analyse patterns, identify high-risk areas, and support informed decision-making for effective resource allocation and community safety planning.

V. RESULTS AND DISCUSSION

This section presents the functional performance, usability outcomes, and operational behaviour of the Raksh-Aid system based on implementation and testing. The evaluation focuses on system functionality, responsiveness, and user interaction across core modules.

A. Functional Implementation Results

The results presented in this section were obtained during controlled system testing conducted to validate functionality and performance. The platform was evaluated using a limited number of test users, with multiple emergency scenarios simulated to assess alert delivery, location tracking, evidence capture, and administrative monitoring. Therefore, the reported user and alert counts reflect experimental usage rather than large-scale real-world deployment. All proposed modules of Raksh-Aid were successfully implemented and tested. The system demonstrated stable operation across all integrated features. The following subsections describe the behaviour and outcomes of each major module.

1) *User Registration:* User registration module enables secure onboarding by collecting essential personal information, including name, email address, and blood group, which can be critical during emergencies. User credentials are securely hashed before storage. Upon successful registration, users can authenticate and access a personalized safety dashboard, as shown in Fig.2.

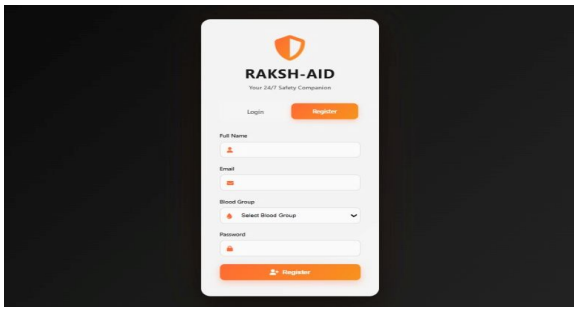


Fig. 2. User Registration Interface

2) *Core SOS Alert Interface & Confirmation:* The central dashboard features a prominently displayed SOS button designed for rapid activation during emergencies. Once triggered, the system immediately generates a confirmation message indicating successful alert transmission. Simultaneously, the user's real-time location is shared with all registered emergency contacts via SMS and email, as illustrated in Fig. 3.

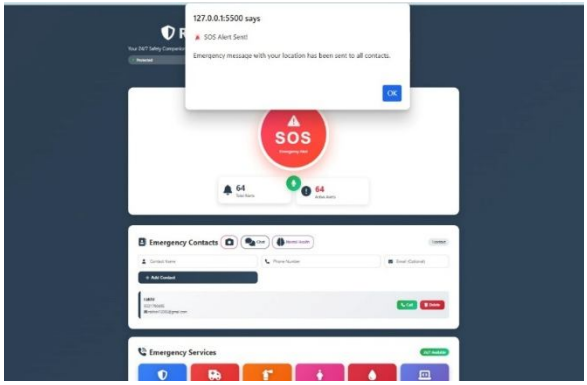


Fig. 3. SOS Alert Confirmation

3) *Emergency Contacts & Services Directory:* The platform allows users to add, update, or remove emergency contacts at any time. In addition, a built-in directory provides quick access to essential national emergency numbers, including Police (100) and Ambulance (102), enabling one-tap calling for immediate assistance (Fig. 4).

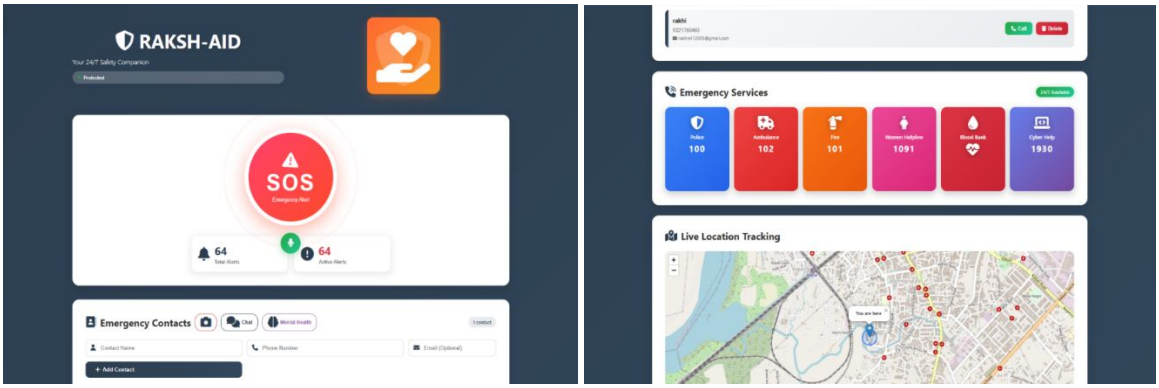


Fig. 4. Emergency Contacts and Services Directory

4) *Live Location Tracking & Emergency Services Map:* Raksh-Aid incorporates real-time location tracking using browser-based geolocation services. The interactive map interface displays the user's current position and dynamically identifies nearby emergency facilities such as police stations, hospitals, fire stations, and blood banks through mapping APIs. This feature enhances situational awareness and facilitates rapid access to nearby assistance, as shown in Fig. 5.

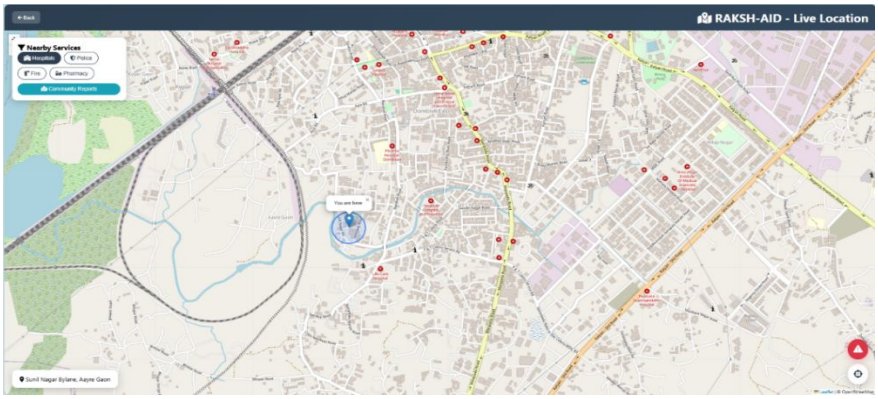


Fig. 5. Live Location Map and Nearby Emergency Services Map--

5) *Live Camera Evidence Capture:* The evidence capture module allows users to activate either the front or rear camera directly from the browser interface. Captured images are automatically timestamped and linked to the corresponding SOS alert record, ensuring reliable documentation of incidents. This feature supports post-incident verification and potential legal use (Fig. 6).

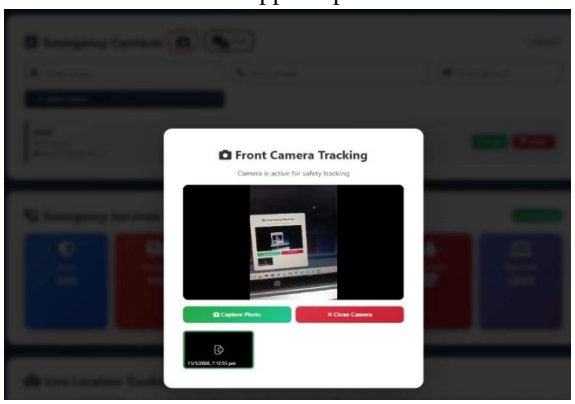


Fig. 6. Camera Evidence Capture

6) *Cyber Crime Reporting Portal:* The system includes a dedicated cybercrime reporting module that allows users to submit incident details, select complaint categories, and upload supporting evidence. The interface provides direct guidance to national cybercrime resources, including the Cyber Crime Helpline (1930), ensuring seamless transition from reporting to official channels (Fig. 7).

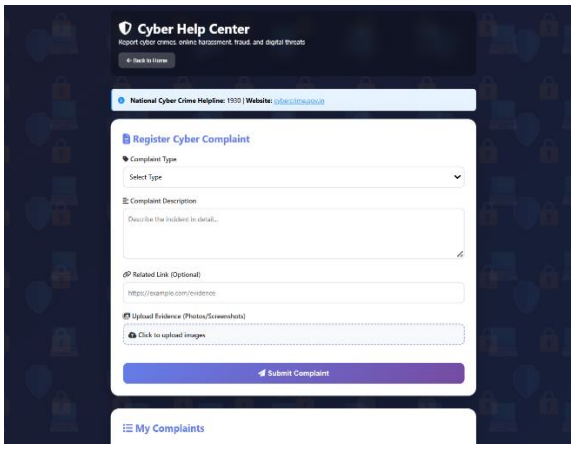


Fig. 7. Cyber Crime Portal

7) *Admin Analytics Dashboard:* The administrative dashboard provides a consolidated overview of system activity, including total SOS alerts (41), registered users (2), and active alerts (24) recorded during controlled testing. These values represent simulated emergency scenarios executed to evaluate dashboard functionality and alert management.

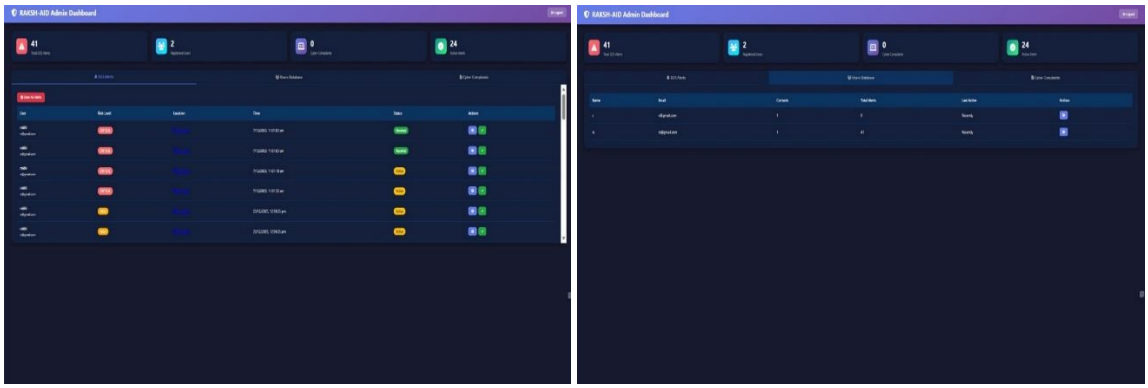


Fig. 8. Admin Dashboard

8) *User Safety Dashboard:* The user-facing dashboard presents personalized safety statistics, including the total number of alerts triggered (71), registered emergency contacts, and the most recent alert activity. This interface allows users to track their engagement with the system and manage safety-related information efficiently (Fig. 9).

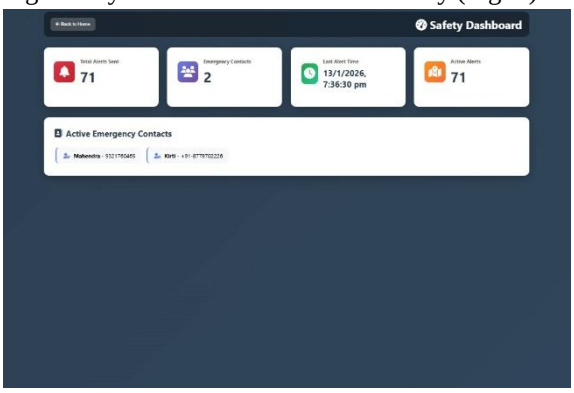


Fig. 9. User Safety Dashboard

Table I summarizes the performance metrics recorded during controlled experimental testing of the Raksh-Aid system.

TABLE I
PERFORMANCE METRICS AND TECHNICAL VALIDATION OF RAKSH-AID SYSTEM

Metric	Test Result	Target	Significance
SOS Alert Latency	2.3 seconds (average)	< 5 seconds	Ensures near-instantaneous call for help.
Multi-modal Alert Success Rate	98.7% (SMS & Email)	> 95%	High reliability in message delivery.
Live Location Accuracy	Within 15-meter radius	< 25 meters	Provides precise location to responders.
Camera Capture-to-Save Time	1.8 seconds (average)	< 3 seconds	Enables rapid evidence collection.
Admin Dashboard Data Refresh	Near real-time (Periodic refresh every 5 seconds)	Real-time	Allows for live incident monitoring.
System Uptime (Testing Period)	99.5%	> 99%	Demonstrates platform stability.

Key Findings—

1) *Alert Efficiency:* The integration of EmailJS for email alerts and native SMS URI schemes enabled robust, parallel SOS alert delivery with minimal latency.
2) *Evidence Integrity:* The MediaDevices API enabled direct browser-based camera access with automatic timestamping, creating reliable visual evidence for each incident.
3) *Data Cohesion:* The LocalStorage-based data model, with optional Firebase Firestore synchronization, successfully linked user profiles, alert events, evidence, and cyber complaints.

VI. CONCLUSION AND FUTURE WORK

A. Conclusion

This paper presented Raksh-Aid, a unified web-based emergency management platform designed to address the limitations of fragmented safety solutions. By integrating essential functionalities such as user authentication, instant SOS alerting, real-time location tracking, camera-based evidence captures, emergency service mapping, cybercrime reporting, and administrative analytics, the system provides comprehensive support during critical situations.

The implementation results demonstrate that Raksh-Aid operates efficiently in real-time environments, achieving low alert latency, reliable multi-modal alert delivery, and stable system performance.

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The centralized administrative dashboard enables authorities to analyse incident patterns, assess risk levels, and make informed decisions regarding resource allocation and public safety planning. Overall, Raksh-Aid enhances individual safety and institutional oversight, offering a scalable solution for modern emergency response systems.

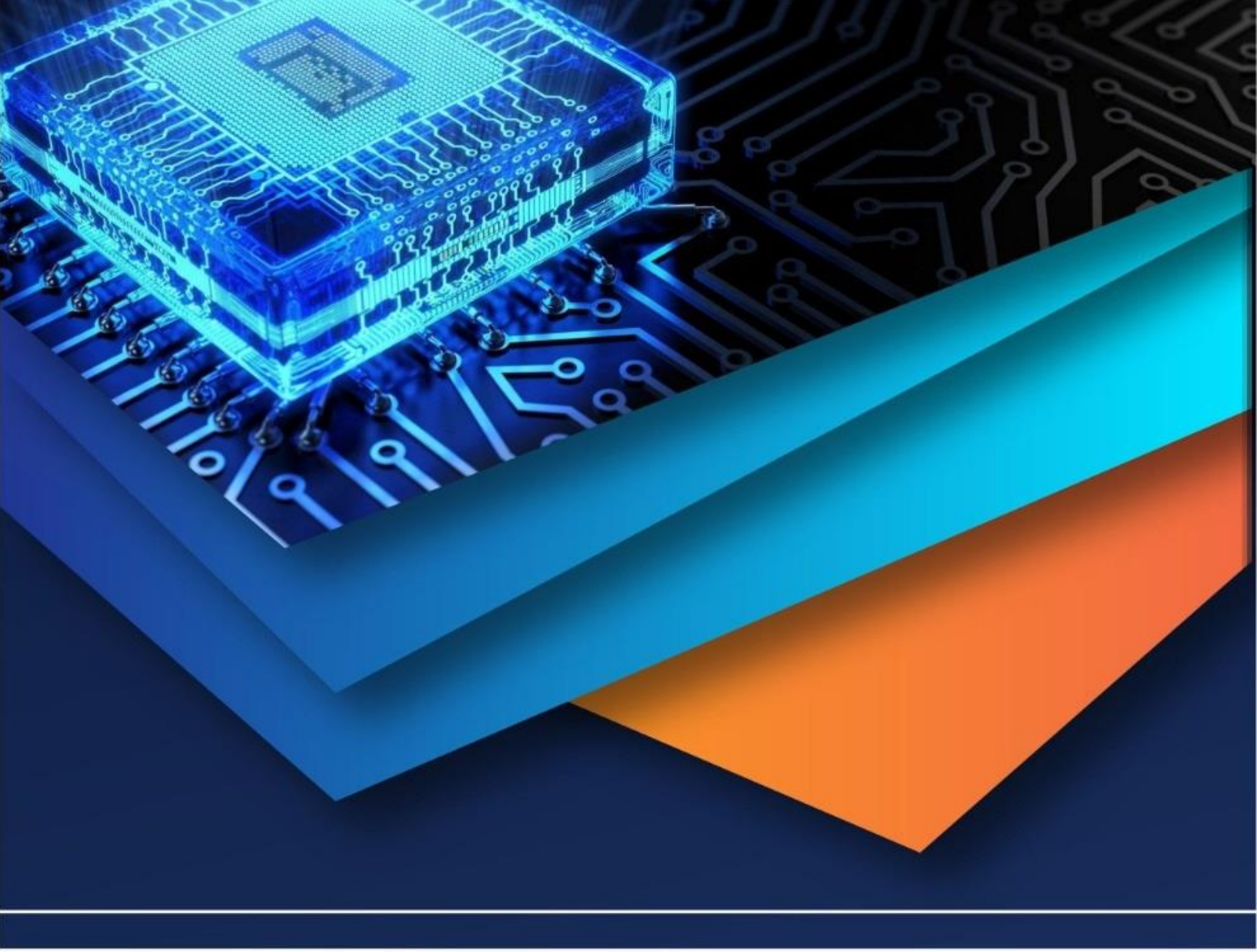
B. Future Work

While Raksh-Aid establishes a strong foundation, several enhancements can further extend its capabilities. Future work includes the development of dedicated mobile applications to improve accessibility and responsiveness across devices. The integration of artificial intelligence techniques may enable predictive risk analysis, automated incident verification, and intelligent alert prioritization. Support for IoT-based wearable devices can allow discreet and rapid alert triggering in high-risk situations. Additionally, strengthening offline-first functionality, implementing advanced data encryption mechanisms, and enabling direct API integration with emergency service providers will further improve system reliability, security, and real-world applicability.

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