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Android Bluetooth-Based Women Safety in Cab

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Abstract - Ensuring women's safety in cab rides remains a major concern, especially during late hours and in remote areas. This paper proposes a Bluetooth-enabled Android application designed to enhance women's security in cabs by enabling continuous monitoring and emergency alerts. The system leverages Bluetooth connectivity with embedded systems in cabs to detect anomalies, trigger alerts, and share real-time location with trusted contacts.

Introduction

In recent years, the safety and security of women, particularly during transit, have become pressing issues worldwide. With the rapid expansion of ride-hailing services and cab transportation, instances of violence, harassment, and abuse against women while commuting have significantly raised concerns among the public, authorities, and researchers. Despite the availability of GPS tracking, SOS buttons, and driver verification mechanisms, there are still gaps in ensuring real-time responsiveness and trustworthiness of these systems. This has led to the development of alternative solutions that leverage the pervasive presence of mobile devices and embedded systems.

One such approach is the integration of Bluetooth-based Android applications that can function even in low-network zones and provide immediate connectivity with embedded modules in cabs. Bluetooth, being a short-range communication technology, offers the advantage of low latency and stable device pairing in proximity. When integrated with an Android mobile application and embedded devices, it can play a significant role in enhancing the safety of women by monitoring cab environments and detecting unusual events like disconnection, route deviation, or lack of driver-passenger communication.

The proposed system introduces a Bluetooth-based women safety mechanism in cabs, designed to automatically track and monitor travel, alert emergency contacts in critical situations, and assist authorities with real-time data such as location, timestamps, and vehicle information. A key advantage of this model is its ability to function independently of the cab driver's interaction. Unlike existing systems that are integrated solely into the cab app or rely on mobile networks, this system introduces a dual-layer of safety using Bluetooth connectivity and mobile app triggers.

Background and Motivation

India, along with several other countries, has witnessed increasing cases of crimes against women in transit. Despite advancements in smart transportation systems, many of these crimes go unreported or are not addressed swiftly due to lack of immediate communication and tracking. Many safety applications depend heavily on mobile data, which may be unreliable in remote areas or inside vehicle cabins with low signal strength. Furthermore, panic buttons or emergency calls are not always accessible or feasible during distress.

The proposed solution aims to provide a preemptive and automatic safety system that doesn't depend solely on manual activation. By leveraging Bluetooth's loss of connection as a safety trigger, the system assumes that if a woman is forcibly removed or leaves the vehicle unexpectedly, the connection breaks and the app automatically sends an SOS alert with GPS location and time. Similarly, if a panic button within the app is pressed, it immediately communicates with registered emergency contacts, law enforcement, or the backend server.

B. System Features Overview

This Android Bluetooth-based safety system incorporates several key components:

- Bluetooth Connectivity: A secure pairing between the Android device and an in-cab hardware module (e.g., Arduino with Bluetooth HC-05) ensures constant monitoring of the passenger's presence in the cab.
- Real-Time GPS Tracking: The application uses built-in GPS to track the route and share it continuously or upon a triggered alert.
- Emergency Alert Mechanism: Upon loss of Bluetooth connection or pressing the panic button, an alert containing location, timestamp, and identity is sent to predefined contacts.

- User Interface: A minimal and user-friendly UI allows users to select emergency contacts, start trips, view travel status, and access emergency services.
- Offline Functionality: The core functionality works even without internet access, leveraging Bluetooth and SMS for communication when possible.

C. Existing Work and Limitations

Several existing applications like "Raksha", "bSafe", "VithU", and others provide emergency alert functionality. However, these systems are often dependent on manual activation, continuous internet connectivity, or do not integrate with external hardware for additional safety verification. Moreover, many apps do not respond to sudden disconnections or unanticipated events like power loss, network jamming, or user disorientation.

Bluetooth technology offers a unique advantage in this space. As it operates independently of internet access and maintains stable connections in confined environments like car cabins, it becomes a practical tool to detect disturbances in user-device relationships. An abrupt disconnection while the trip is in progress can act as a vital signal for potential threats.

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E. Contribution and Scope

This paper presents the development and implementation of an Android Bluetooth-based Women Safety in Cab system using Android Studio for app development and embedded modules for vehicle integration. The work contributes to:

- Designing a secure, responsive, and autonomous emergency alert system.
- Using Bluetooth disconnection as a smart trigger for suspicious activity.
- Ensuring offline operability and low-power consumption.
- Providing an open-source base for future enhancements like AI surveillance, audio recording, and driver authentication.

IV. SOME COMMON MISTAKES

When developing or evaluating Android Bluetooth-based women safety systems, the following common mistakes are often observed:

- Overdependence on Internet Connectivity: Many applications rely heavily on mobile data for alerts, ignoring scenarios where network coverage is poor or unavailable. A safety system should be capable of working offline.
- Unsecured Bluetooth Communication: Failing to secure the Bluetooth pairing process can lead to spoofing or unauthorized access, compromising the system's integrity.
- Battery Drain and Resource Mismanagement: Improper handling of background services and continuous Bluetooth scanning can lead to significant battery consumption, reducing usability.
- Inadequate Testing in Real-World Scenarios: Applications are often tested only in ideal conditions. Failure to simulate real emergencies (e.g., disconnection events, false positives) may result in untrustworthy operation during actual use.
- Lack of Privacy Protection: Sending sensitive location or identity data without proper encryption or user consent can violate privacy regulations and user trust.
- Complex User Interfaces: Safety apps must be quick and intuitive. If the panic button or alert mechanism is hidden behind multiple screens, it defeats the purpose in emergencies.
- Ignoring Hardware Integration Failures: Many systems fail to handle scenarios where the in-cab hardware is non-functional or improperly configured, resulting in app malfunction or false negatives.

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