DESIGN AND DEVELOPMENT OF AN INTELLIGENT EMERGENCY STATE REPORTING SYSTEM FOR PUERTO RICO

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Secure Mobile Application Development

INTRODUCTION

Puerto Rico currently faces a critical shortfall in its emergency response framework—the absence of a comprehensive Emergency Management Application managed by government agencies. The government could leverage this widespread connectivity to crowdsource real-time emergency reporting but currently does not. This research project is predicated on the conviction that citizens, armed only with a smartphone, constitute the most immediate — and often underutilized — layer of emergency response capability. The core of creating an emergency reporting system is civilians. There are no reports if civilians don't have a practical way to send them. Therefore, it is necessary to provide a simple way for emergency reports to be made via a mobile application. This mobile application will serve as a centralized service for Puerto Rican civilians to report various types of emergencies. The app strengthens both community preparedness and institutional responsiveness. Moreover, it empowers residents to become active participants in safety networks. This approach not only accelerates communication but also improves transparency, situational awareness, and trust between communities and response agencies.

OBJECTIVE

The objective of this research is to determine if it is feasible to create a mobile application for Puerto Rico where civilians can easily report a variety of emergencies. The application should serve as a centralized emergency reporting service that categorizes the reported emergency and sends it to the appropriate government response team. This project involves 3 databases named:

1) Highway
2) Citadel
3) Orbiter

This research focuses on the Orbiter database. The Orbiter database contains the mobile application's user's information.

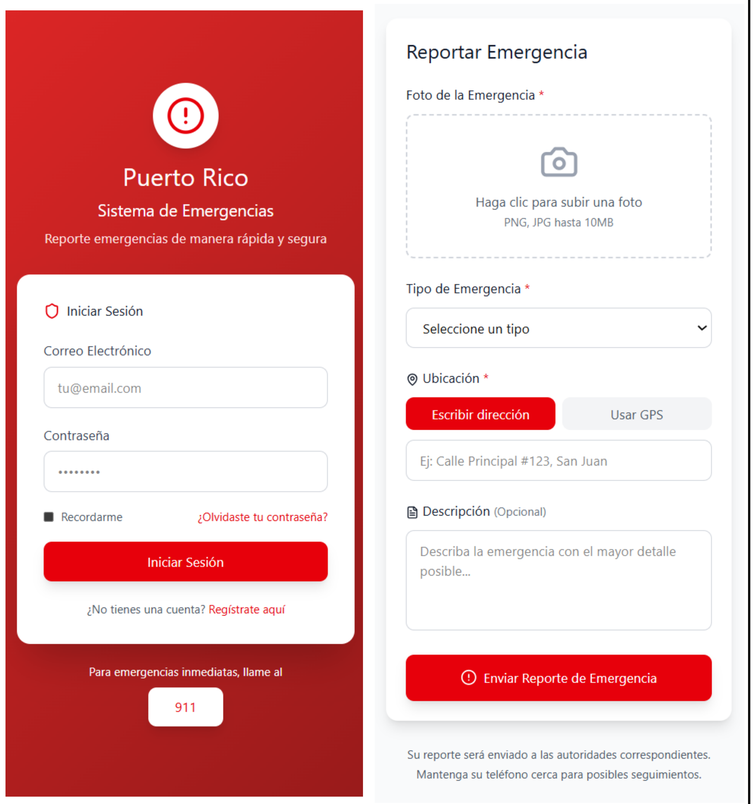
METHODOLOGY

Advantages of using Flutter SDK

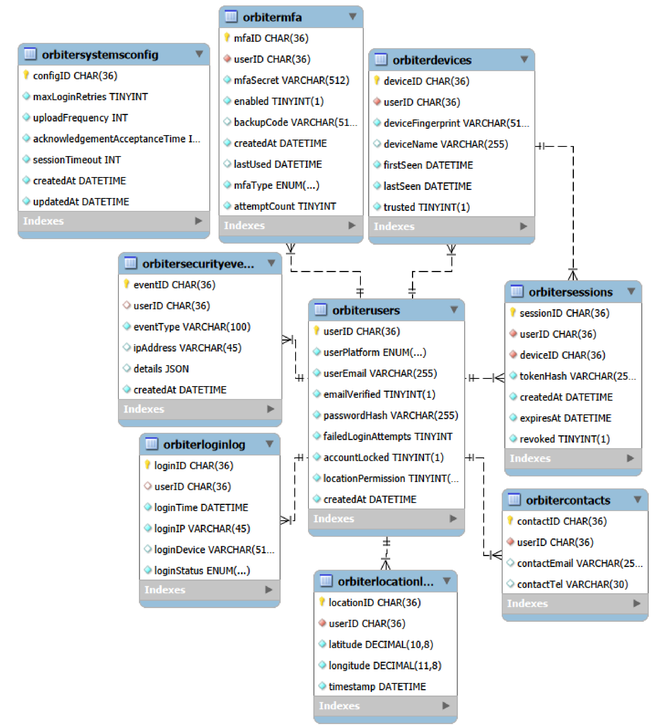
- Multiplatform Codebase
- Modular Development
- Adaptation to Platform
- Dart Programming

Orbiter Database

- Mobile Users
- Authentication
- Password Hashing



User Interface



Database Structure

CONCLUSION AND FUTURE WORK

A mobile application used for reporting emergencies in Puerto Rico is feasible. Users can securely create an account and use the report emergency page to send emergency reports by uploading a picture of said emergency. From a cybersecurity standpoint, it was concluded that strong security practices can be integrated into a mobile application without compromising usability. The implementation of bcrypt password hashing, JWT session management, rate limiting, and a structured audit log through orbiterLoginLog and orbiterSecurityEvents demonstrates that a civilian-facing emergency application can be built with a security-first mindset. It was further concluded that a relational database schema can be designed to serve both operational and forensic purposes simultaneously. The Orbiter database does not solely store the data needed to run the application — it also preserves a detailed record of user behavior, device activity, and security events that could assist authorities or system administrators in reconstructing the circumstances surrounding an emergency report. This dual purpose adds investigative value to the application beyond its primary reporting function. It was also concluded that Flutter is a suitable framework for this type of civic application. Its cross-platform nature means the same codebase can serve both Android and iOS users, which is particularly relevant in Puerto Rico where both platforms maintain significant user bases. The framework's widget system allowed for a consistent visual identity across all pages of the application. Future work for this investigation can be further developing the user interface.

Appwrk. (2025, June 8). 15 best mobile app security threats and how to prevent them. https://appwrk.com/insights/mobile-app-security
Hispanic Federation. (2022, September 19). Building a stronger and more resilient Puerto Rico. https://www.hispanicfederation.org/advocacy/reports/HFconPR_5YearUpdate_Final.pdf
ZDNet. (2023, October 16). Why multi-factor authentication is absolutely essential in 2025. https://www.zdnet.com/article/whymulti-factor-authentication-is-absolutely-essential-in-2025/