

Smart Work Zone Activity App (SWiZAPP)

tech transfer summary

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RESEARCH PROJECT TITLE

Smart Work Zone Activity App (SWiZAPP)

SPONSORS

Smart Work Zone Deployment Initiative (TPF-5(295))
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Iowa, Kansas, Missouri, and Nebraska created the Midwest States Smart Work Zone Deployment Initiative (SWZDI) in 1999 and Wisconsin joined in 2001. Through this pooled-fund study, researchers investigate better ways of controlling traffic through work zones. Their goal is to improve the safety and efficiency of traffic operations and highway work.

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SWiZAPP is a newly developed cross-platform mobile application for collecting real-time work-zone activity information and reporting it to department of transportation staff, traffic management centers, work-zone contractors, and the traveling public.

Objective

The objective of this project was to design, develop, and deploy the Smart Work Zone Activity app (SWiZAPP), a cross-platform mobile application for collecting and reporting real-time work-zone activity information.

Background

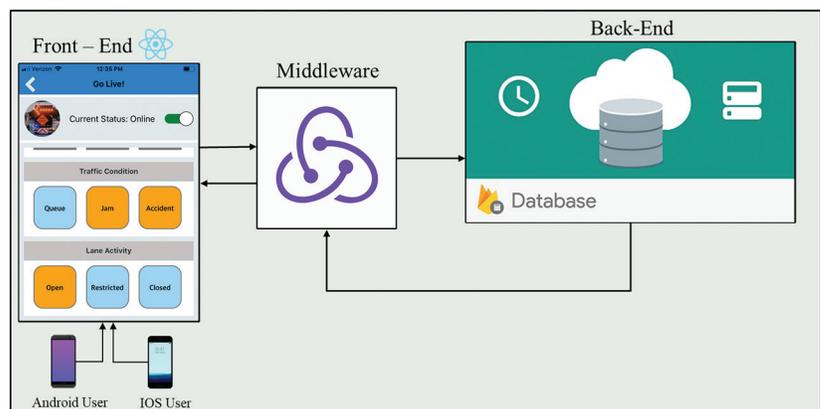
Accurate and timely communication of work-zone activities improves work-zone safety by alerting department of transportation (DOT) staff, traffic management centers (TMCs), contractors, and the traveling public that a work zone has become active or inactive. Such information also facilitates ongoing work-zone safety analysis by enabling the synchronization of work-zone and incident data.

With the increase in the computing power of portable electronic devices such as smartphones, smart work-zone information can be exchanged simply and cost-effectively.

Methodology

SWiZAPP was developed using React Native, currently the most popular open-source, mobile application development framework. The research team followed a modular design approach to enable seamless future expansion of the app by other agencies.

SWiZAPP consists of three main modules: frontend, backend, and middleware.



Frontend, middleware, and backend modules of SWiZAPP

The frontend module allows users to interact with the app via a graphical user interface (GUI). A variety of layouts and user interface (UI) elements, including flatlists, grid and scroll views, buttons, switches, dialog boxes, and notifications, were used to make the app user-friendly.

The backend module stores all work-zone activity information posted by users in a scalable manner. Google's Firebase engine was used to design and deploy a real-time, cloud-based database to support the backend.

The middleware module is managed by Redux, which translates user actions from the frontend to the backend and vice-versa.

A prototype of the app was built and field-tested. To field-test the app, SWiZAPP was compiled and uploaded on both Google Play and the Apple App Store. Four work-zone sites in Columbia, Missouri, were then surveyed using the app. The key metrics used to evaluate SWiZAPP included geolocation accuracy, user-friendliness, and scalability.

Key Outcomes and Findings

The key components of SWiZAPP include a log-in; Projects, which lists all the work zones added by the user; Map View, which displays the locations of the work zones on a map; and Tracker, which reports all work zone-related activities from all users of SWiZAPP.

SWiZAPP currently supports automatic work-zone geolocation and mapping via on-board global positioning system (GPS) sensors and Google Maps, respectively.

In field tests, the accuracy of the app's geolocation module was fairly high overall. However, external factors such as proximity to high-rise buildings and the mobile device operating system (iOS or Android) were found to affect geolocation accuracy.

App users can post live activities from construction sites by capturing and uploading images, using buttons within the app to indicate traffic conditions and lane activities, and/or using text messaging via the app.

The app also enables users to view both real-time and historical activities of all work zones in Smart Work Zone Deployment Initiative (SWZDI) states.

Due to its scalable design, the app is theoretically capable of managing an unlimited number of construction work zones.

The ease of use of SWiZAPP was evaluated via a user-friendliness score based on how many UI components a user was able to navigate without assistance. Swipeable flatlists were found to be the most challenging to navigate, but the remaining components were found to be straightforward.

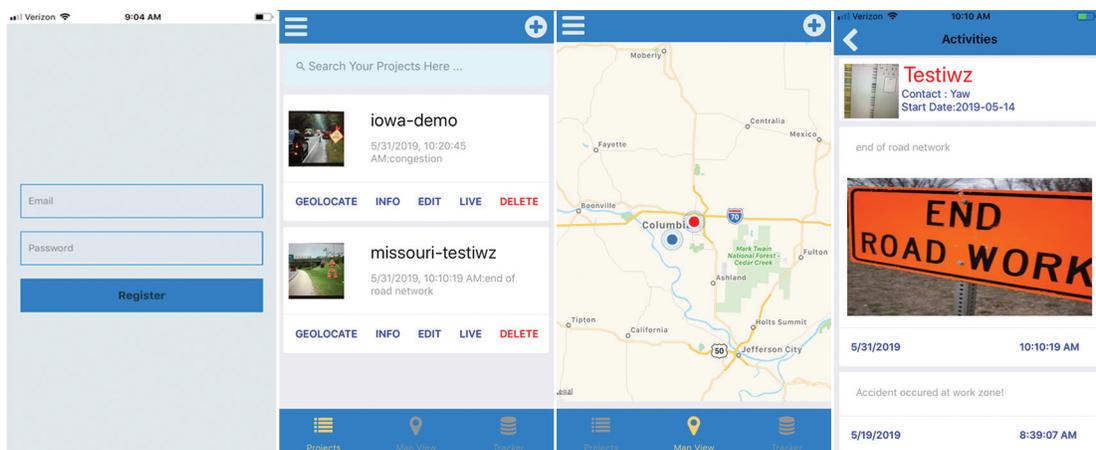
Recommendations for Future Development

A key shortcoming of SWiZAPP is its reliance on internet access. Numerous work zones are in dead zones where internet access is limited and in which SWiZAPP cannot function. In future updates, the app could be designed to store work-zone activity information locally on the phone when there is no internet access and then upload the data when the user regains internet access.

Subsequent releases of the app could support live video streaming and/or archiving of work-zone activities. However, video feeds could exponentially increase the size of the database and require a new database design to enable the app to scale up. SWiZAPP's modular design approach would allow new extensions could be carried out seamlessly.

The app could also be enabled with a chat area, where work-zone and DOT personnel could communicate and seek approval for unplanned activities. All chat messages could be stored to enrich the SWiZAPP database for documenting work-zone activities.

It is also recommended that efforts be made to integrate SWiZAPP with key transportation data management systems, traveler information systems (e.g., 511), and other transportation data archival systems.



Key components of SWiZAPP, from left to right: log-in, Projects, Map View, Tracker

Implementation Readiness and Benefits

The outcome of this project is a fully functioning mobile application for work-zone activity monitoring.

The app could serve as a work-zone-alert management system for TMCs or third-party service providers, such as Waze, Google, and INRIX. Lane closures, crashes, and new work-zone location information can be communicated to users in real time.

Contractors and work-zone managers could use the app for data collection, tracking, and archiving purposes. Application programming interfaces (APIs) could be provided for open data platforms to utilize stored work-zone data.

In scalability tests, the researchers observed notable latencies in image upload speeds as the database size increased over 1 GB. This could be resolved by deploying a cluster of machines instead of a single node to support the backend.