Open Source Mobile Software for Distributed Studies of Hearing

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Overview

In collaboration with the Hearing Center of Excellence and the Walter Reed National Military Medical Center (WRNMMC), Creare has developed an open source mobile application and software framework (Open TabSINT) that enables researchers to administer customized tests and questionnaires on mobile devices located across multiple sites. The system is designed to provide researchers flexibility in deploying human research study protocols while minimizing the effort required to administer the study.

TabSINT System

Design Protocol → **Deploy** → **Administer** → **Review**
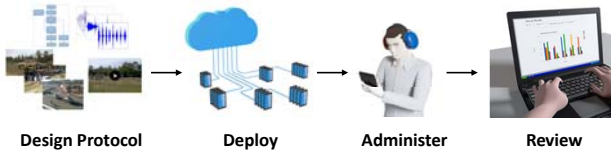
Design Protocol: Researchers create and modify study protocols by editing a text-based (JSON) template. The application includes templates for multiple speech-in-noise tests and over 25 questionnaire types.

Deploy: The protocol is uploaded to a cloud-based webserver, remote git repository, or the local SD card of a device.

Administer: The application processes and renders the text protocol into a set of interactive pages. The user steps through the protocol while the application records test data and results.

Review: Test results are automatically uploaded or exported to the back-end data store and immediately available for analysis.

Three Data Storage Options

TabSINT can interface with three different back-end data stores:

(1) **TabSINT Webserver**: Custom SQL database with extended services including sound card specific calibration of media files

(2) **Git Repository**: Deploy protocols and store results using easily accessible git repositories on Gitlab

(3) **SD Card**: Load protocols and store results on the SD card of the tablet completely offline

Software Architecture

TabSINT is implemented using standard web technologies so that it can be easily deployed on a variety of platforms. The app uses HTML for structure and content, CSS style sheets for look and feel, and Javascript for control and logic. The app is developed in the Apache Cordova environment for cross-platform compatibility. The native utilities on each platform (android, iOS, etc.) can be accessed by using Cordova Plugins.
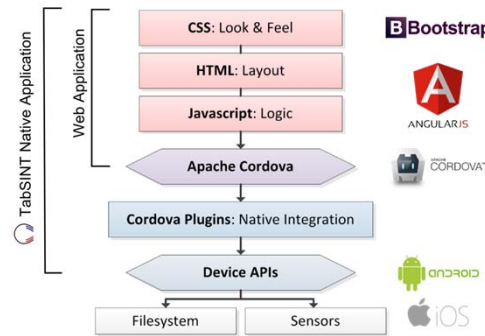
Integration with External Hardware or Apps

TabSINT includes an application programming interface for **plugins**, allowing external contributors to build hardware and software that can interface directly with TabSINT, leveraging the existing user interface and data management framework.
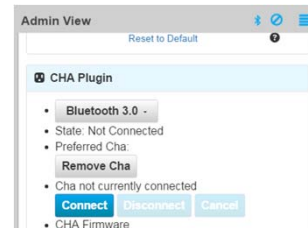
To date, several TabSINT plugins have been built and deployed, most notably:

- Bluetooth connection to the highly attenuating, wireless, audiometric headset developed by Creare
- Ambient noise measurement through the sound level meter app developed by Sensimetrics and WRNMMC

Deployment

Currently, Open TabSINT is in use by WRNMMC in a study of functional hearing performance with active military subjects, and by Creare in several other hearing studies to evaluate the performance of the Creare headset. To date, this system has collected over 9000 individual results across more than 70 study sites.

Creare

- *Singapore*: 120 participants in 1 week
- *University of Northern Colorado*: 100 participants
- *House Clinic: 60 participants*

WRNMMC

- *Fit*: 9 sites, about 1000 subjects collected since 08/2014
- *CAPD*: 3 sites, more than 500 subjects collected since 11/2014
- *Prevelance*: 3 sites, more than 2000 subjects collected since 6/2015
- *3D*: DiLorenzo TRICARE Health Clinic, over 700 subjects since 06/2015
- *HCE Climate Survey*: 30 surveys

Open Source

Now housed on GitHub, this software is available to researchers across the world to use and adapt to their specific needs. Researchers with engineering resources can also contribute to the repository to further improve the features and robustness of this software.
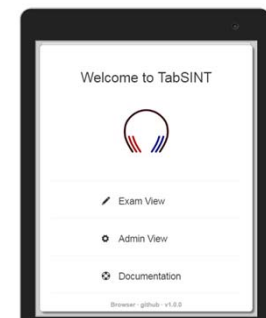
Visit the TabSINT website for user documentation, developer documentation, and a live demo of the application in the browser: https://creare-com.github.io/tabsint