University of Missouri

TigerAware Dashboard: An Improved Survey Generation and Response Visualization Dashboard

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Outline

- Introduction
- TigerAware Platform Design
- Background & Related Work
- New TigerAware Dashboard
- TigerAware Applications
- Conclusion

Outline

- Introduction
  - Problem Background
  - TigerAware Platform
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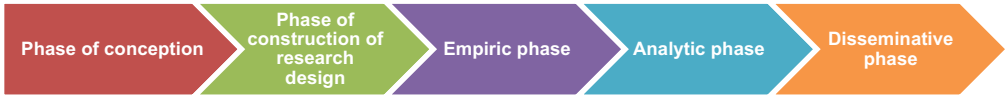
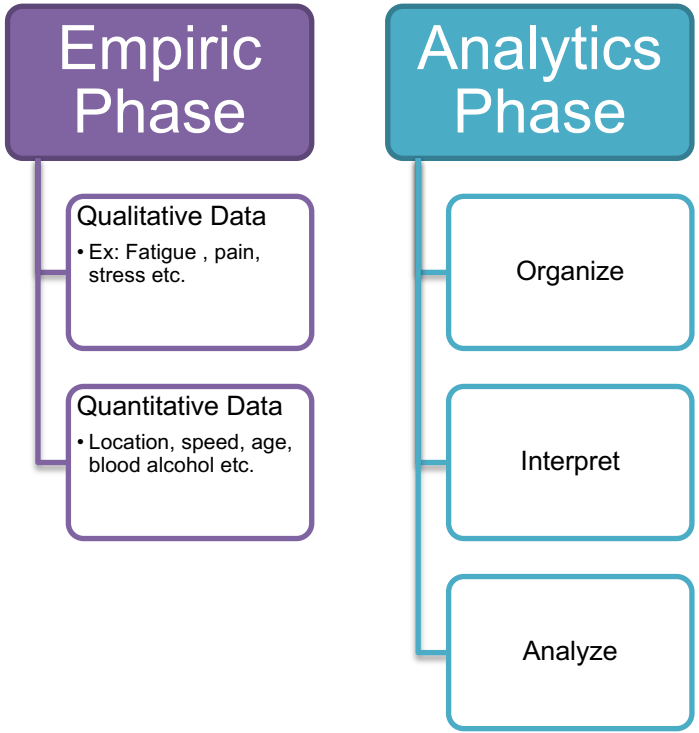
Introduction

- Researchers across any discipline follow these five phases to conduct effective research .
  - Phase of conception
  - Phase of construction of research design
  - Empiric phase
  - Analytic phase
  - Disseminative phase



Introduction

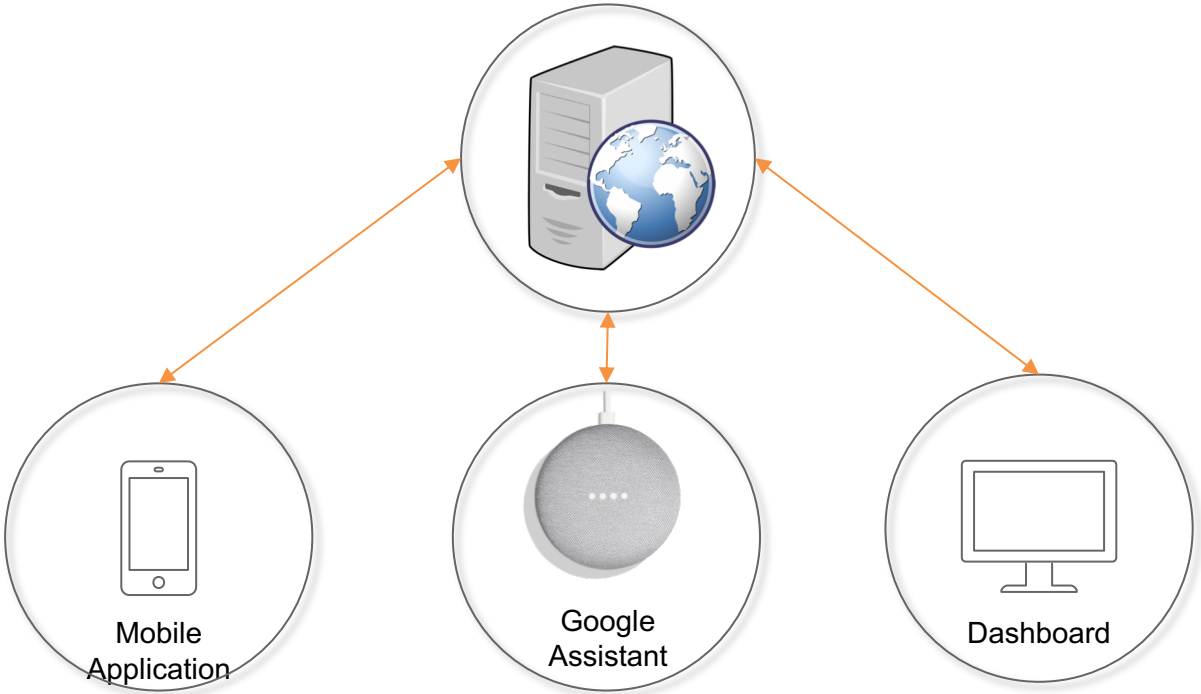
- Empiric Phase
  - Highly time consuming.
  - Collect Qualitative and Quantitative Data.
- Analytics Phase
  - Systematic processing of data.
  - Comparison of data.
  - Finding correlation between data points.



Problem Background

- Custom Standalone Platform
  - Turn around time
    - New features require rework and redeployment
  - Infrastructure requirements
    - Server setup and maintenance
  - Development Costs
- Off-the shelf Applications
  - Limitations on type of data collected
    - Quantitative data types are limited
  - Costs increases with number of participants.
  - Paid services like branching, randomized/scheduled notifications etc.

TigerAware Platform



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- Introduction
- TigerAware Platform Design
  - Survey Grammar
  - TigerAware Architecture
- Background & Related Work
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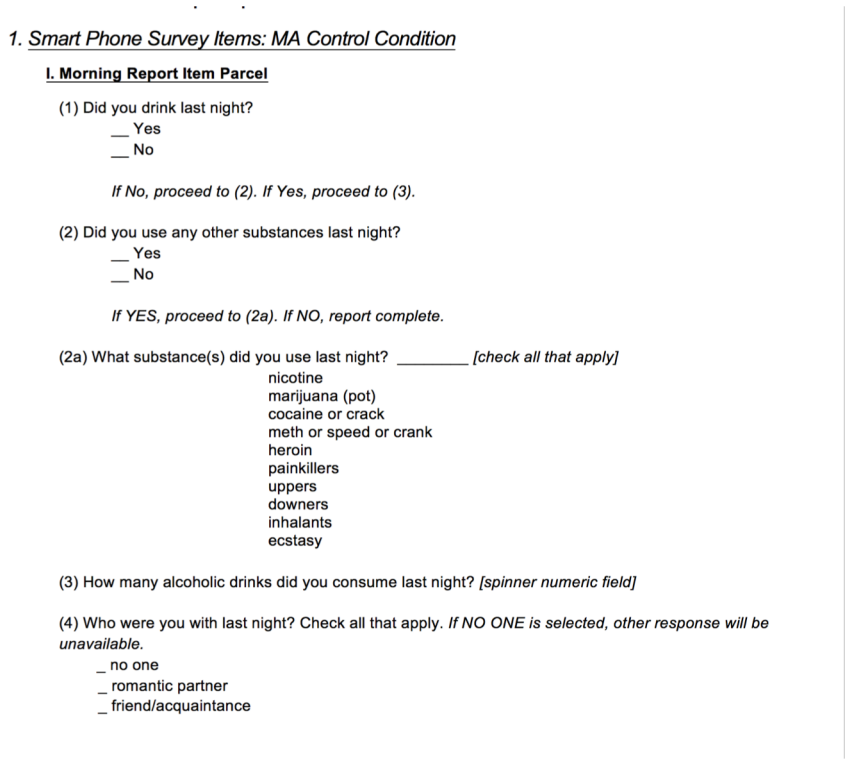
What is a Survey?

- Survey is a collection of questions.
- Based on response of each question you have follow up question.
  - Continue with main questions
  - Continue to other section of questions



1. Smart Phone Survey Items: MA Control Condition

I. Morning Report Item Parcel

(1) Did you drink last night?
__ Yes
__ No

If No, proceed to (2). If Yes, proceed to (3).

(2) Did you use any other substances last night?
__ Yes
__ No

If YES, proceed to (2a). If NO, report complete.

(2a) What substance(s) did you use last night? _____ *[check all that apply]*
nicotine
marijuana (pot)
cocaine or crack
meth or speed or crank
heroin
painkillers
uppers
downers
inhalants
ecstasy

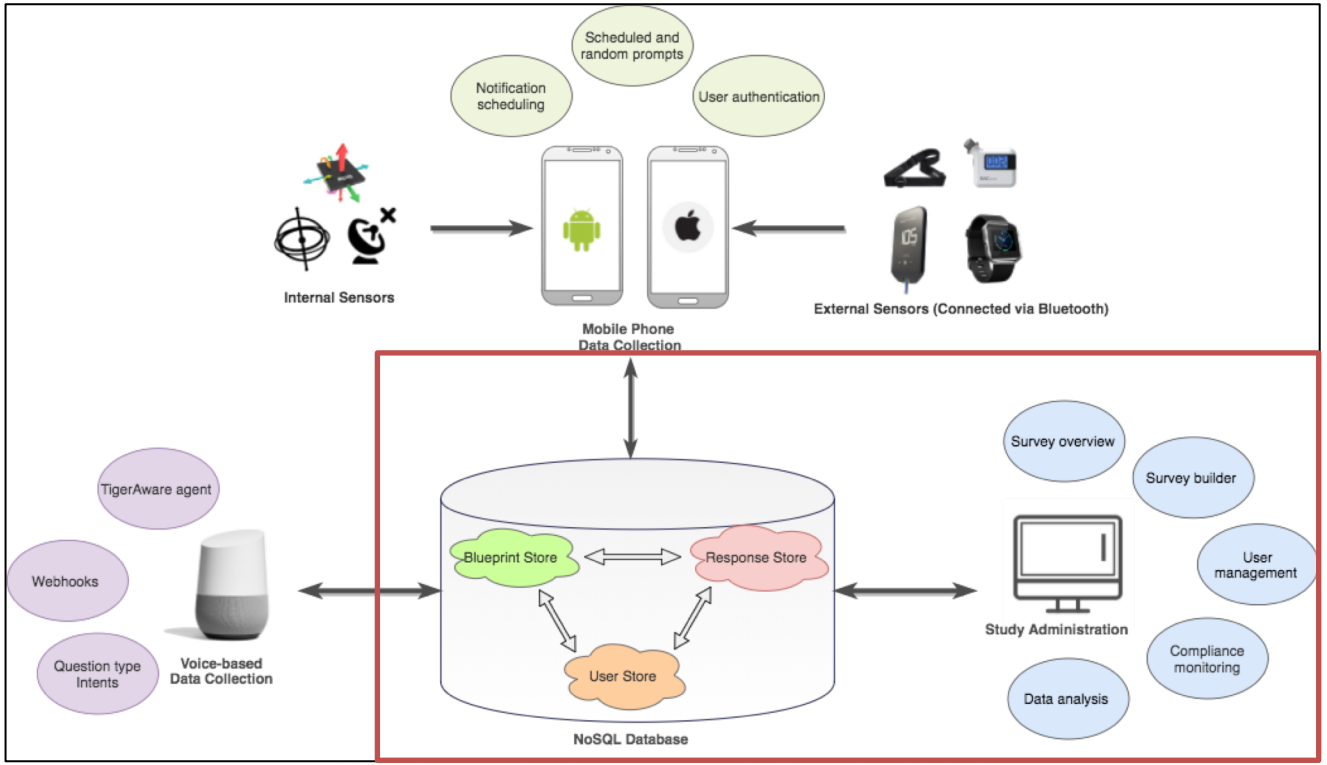
(3) How many alcoholic drinks did you consume last night? *[spinner numeric field]*

(4) Who were you with last night? Check all that apply. *If NO ONE is selected, other response will be unavailable.*
_ no one
_ romantic partner
_ friend/acquaintance

Survey Grammar.

survey	[steps]
steps	conditional-step step step, steps conditional-step, steps
conditional-step	{ conditional-step-attributes }
conditional-step-attributes	conditional-pairs, conditional-step-attributes
conditional-pairs	‘title’: string ‘id’: string ‘subtitle’: string ‘type’: conditional-types ‘choices’: choices-value ‘conditions’: conditions-value ‘conditionalDefault’: string

TigerAware Architecture



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Related Work

[1] P. Harris, R. Taylor, R. Thielke, J. Payne, N. Gonzalez, J. Conde, " Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support " in *Journal of Biomedical Informatics* , July, 2008.

- Emphasis on rapid deployment and flexible informatics systems
- Export data in R/SAS/CSV formats
- Flat file database.
- LAMP based server architecture

Limitations:

- Limited ways a participant can take a survey.

Related Work

[2] Ruiqi Shi, "An Enhanced Mobile Ambulatory Assessment System for Alcohol Craving Studies“, in *University of Missouri, Department of CS in Master’s Thesis* , April, 2015

- Flat file system
- LAMP based server architecture

Limitations:

- Single Survey – Alcohol Craving Study
- Single external source for data collection from sensors

Related Work

[3]D. Srivatsav, "MTD: MOOD TOOLKIT DASHBOARD - A Data Analytical Web Application for Psychological Research Studies“, in *University of Missouri, Department of CS in Master’s Thesis*, 2017.

- Web dashboard implementation
  - Simple and Intuitive to use
- LAMP Based Architecture
- Visualization Capabilities
- Only a limited number of studies can be supported.

Related Work

DEMONS	AndWellness	SurveyMonkey
• Passive and Active Sensor Integration Framework. • Device based survey notifications. • Lacks cross platform support	• Manual survey authoring using XML. • Device based survey notifications. • Lack of cross platform support.	• Commercially available system. • Features hidden behind pay walls. • Email based survey notifications.

Related Work Summary

- Collecting data in form of question accompanied by data from mobile device's internal sensors or external wirelessly connected sensors
- Managing multiple participants and their data across time
- Visualizing and organizing collected data on a Web dashboard
- Data Exportation
- Largely based on LAMP Architecture

Existing Dashboard

Survey Platforms / Functionalities	REDCap	DEMONS	AndWellness	Survey Monkey	Existing TigerAware Dashboard
Quiz	X	X	X	✓	X
Survey	✓	✓	✓	✓	✓
Response based Branching	✓	X	✓	✓	X
Notification Scheduler	X	Localized Triggers	User Created Triggers	Email Based Notifications	X
Survey Visualization	X	✓	✓	✓	Limited
External Data Sources	X	Mobile	Mobile	Mobile	Mobile
Survey Templates	✓	X	X	X	X

New Design Choices

LINUX + APACHE + MySQL + PHP STACK	Firebase + Express + AngularJS + Node.js STACK
Multi-tasking performance dependent on Web servers. No true language support for multi-tasking	Node.js uses non-blocking event loop. Language level support for multi-tasking
Slower runtime due to Interpreted compilation	Faster at runtime due to just in time compilation
MySQL suited for predefined schema	NoSQL based as it allows for easy modification of information schema
Lack of first party libraries for connecting to Firebase	Open source community support and first party support for Firebase

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  - Web Modules
  - Server Modules
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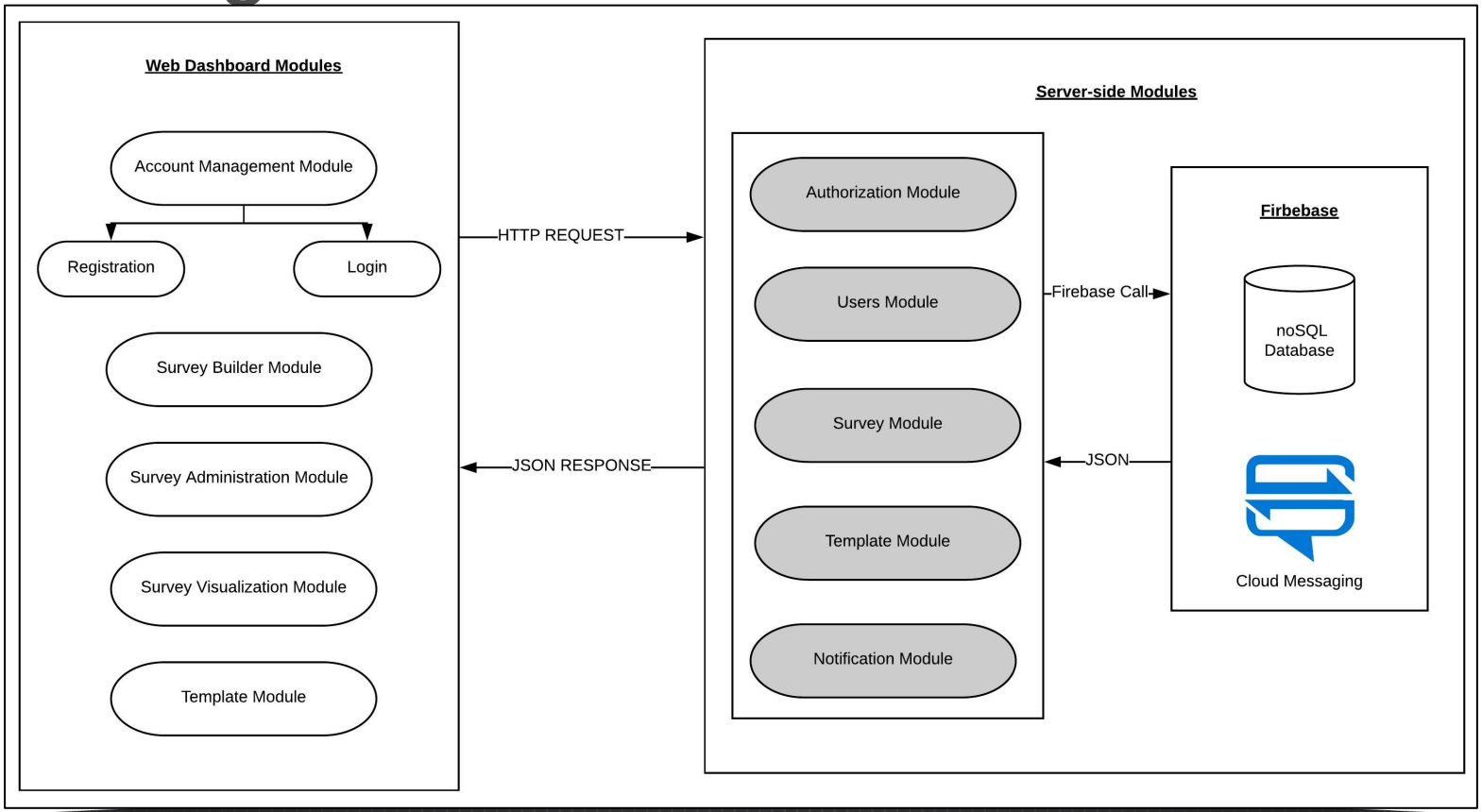
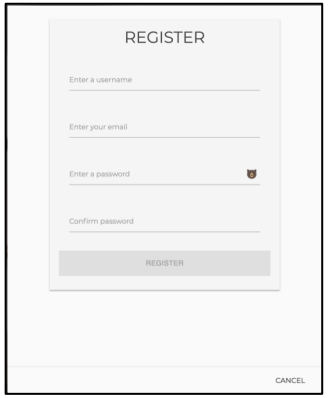
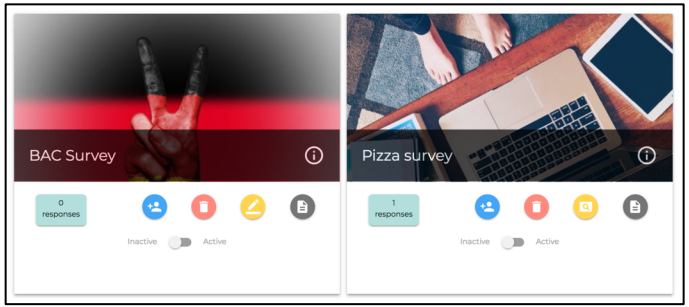
New TigerAware Dashboard

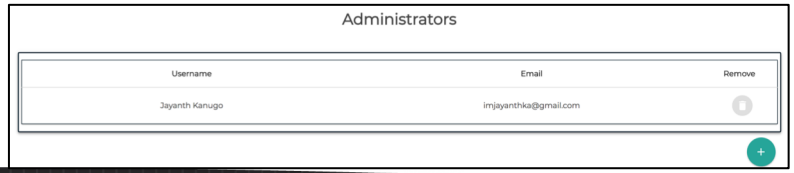


Web Modules

- Account Management Module:
  - Registration and login management.
- Survey Administration Module:
  - Assign administrative roles to user
  - Add and Remove participants
  - Enable and disable a survey
  - Restrict access

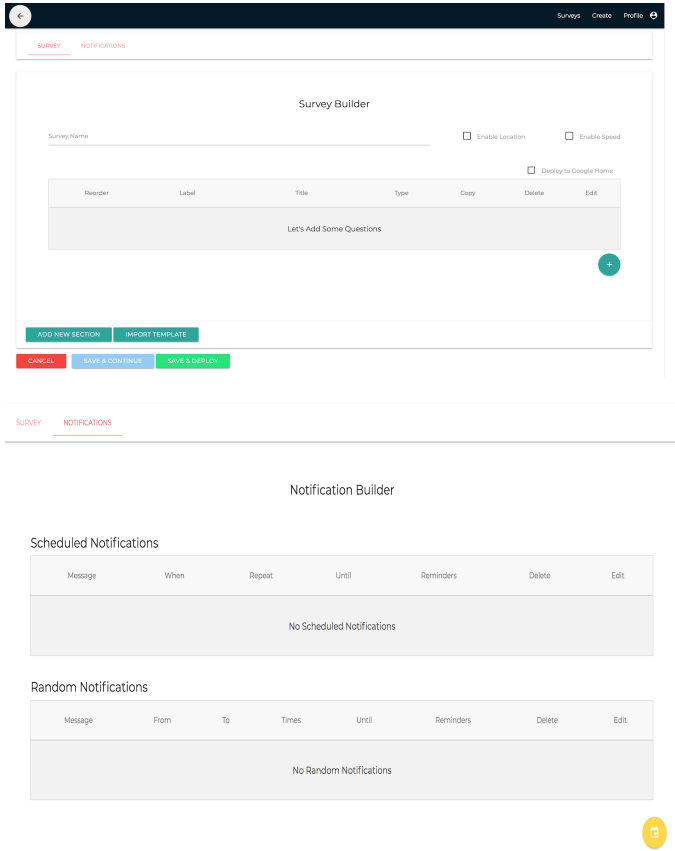






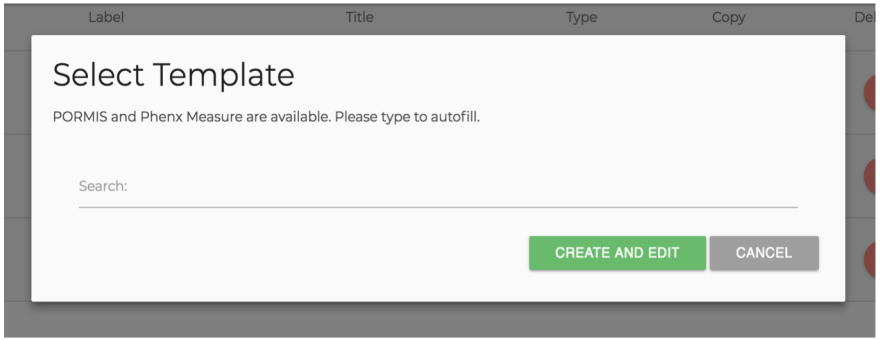
Web Modules.

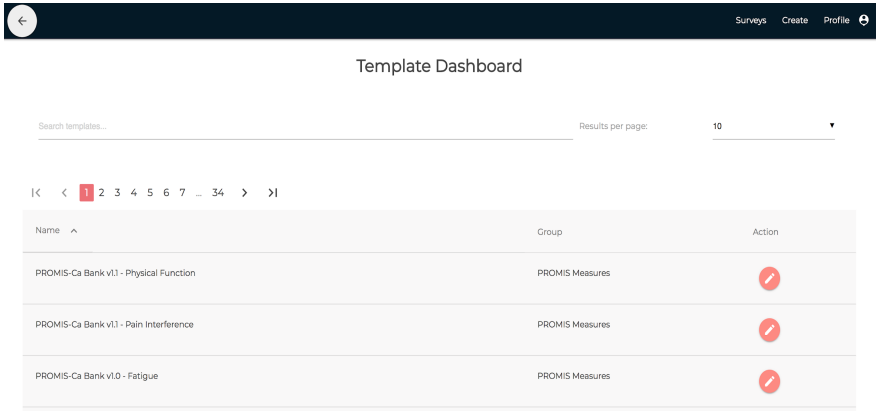
- Survey Builder Module:
  - Create surveys
  - Currently support 10 different question types
  - Branching based on survey responses
  - Create survey for virtual assistant.
  - Ability to import from 900+ preexisting surveys
- Notifications Builder Module:
  - Scheduled notification
  - Random notifications



Web Modules..

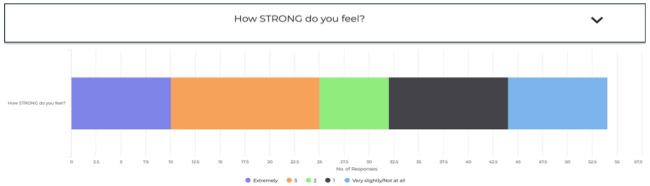
- Template Module
  - Consists of PhenX Toolkit and PROMIS Measures
  - Paginated, Sortable and Searchable list of over 900+ preexisting surveys
  - Ability to combine multiple surveys to create a custom surveys

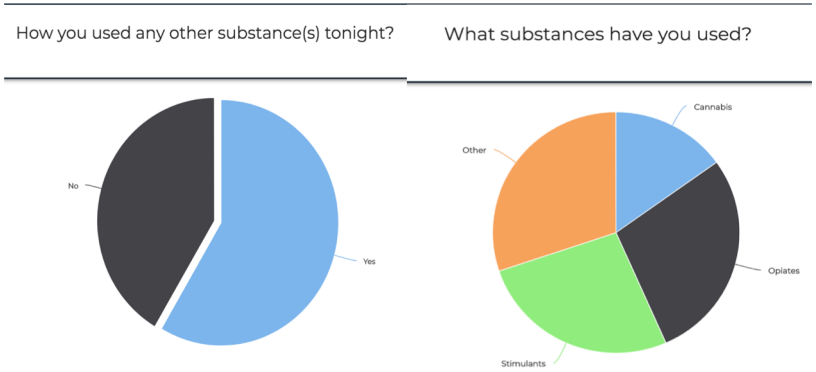


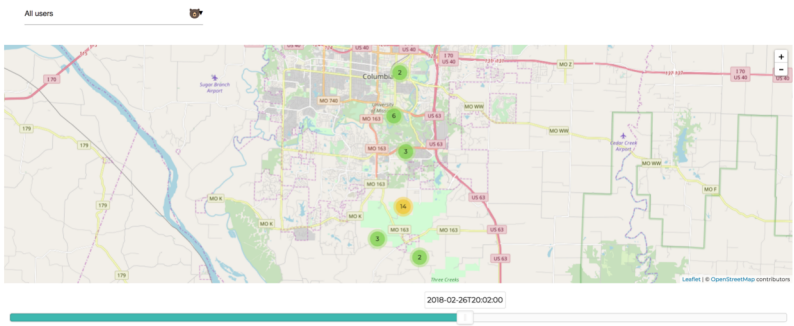


Web Modules…

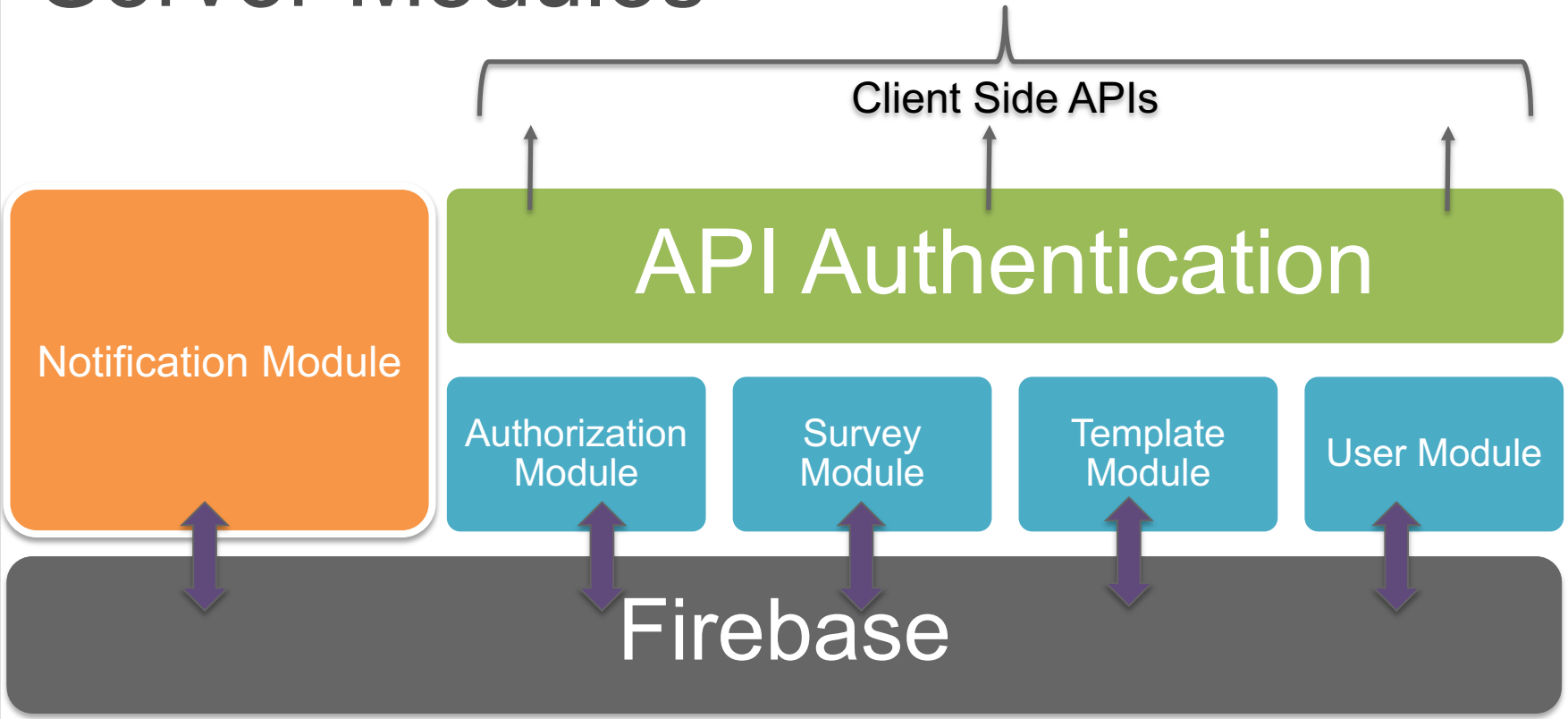
- Survey Visualization Module
  - Map showing location metadata associated with the survey response per user over time.
  - Response information visualized based on each user and their compliance Information
  - Works by using factory design pattern to return a JSON response corresponding to each question type in responses





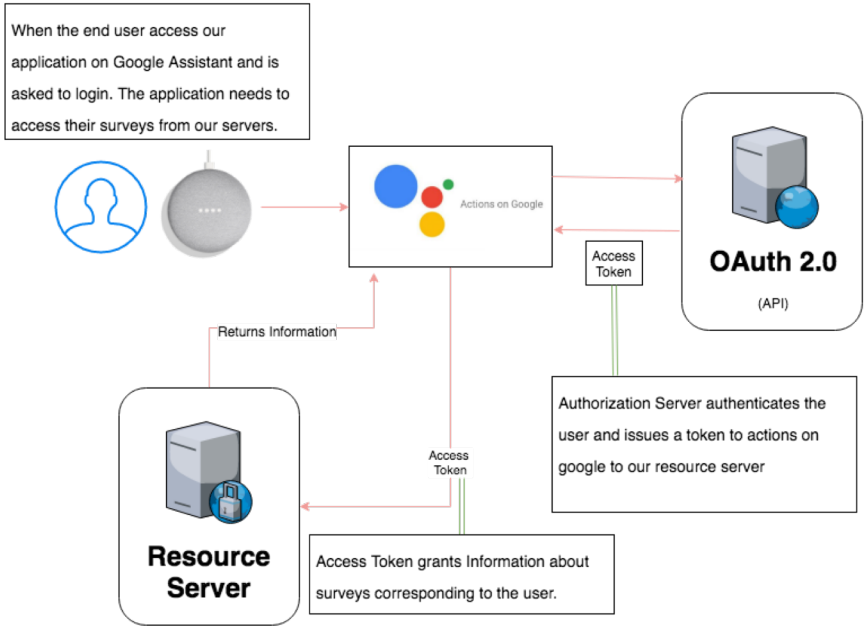


Server Modules



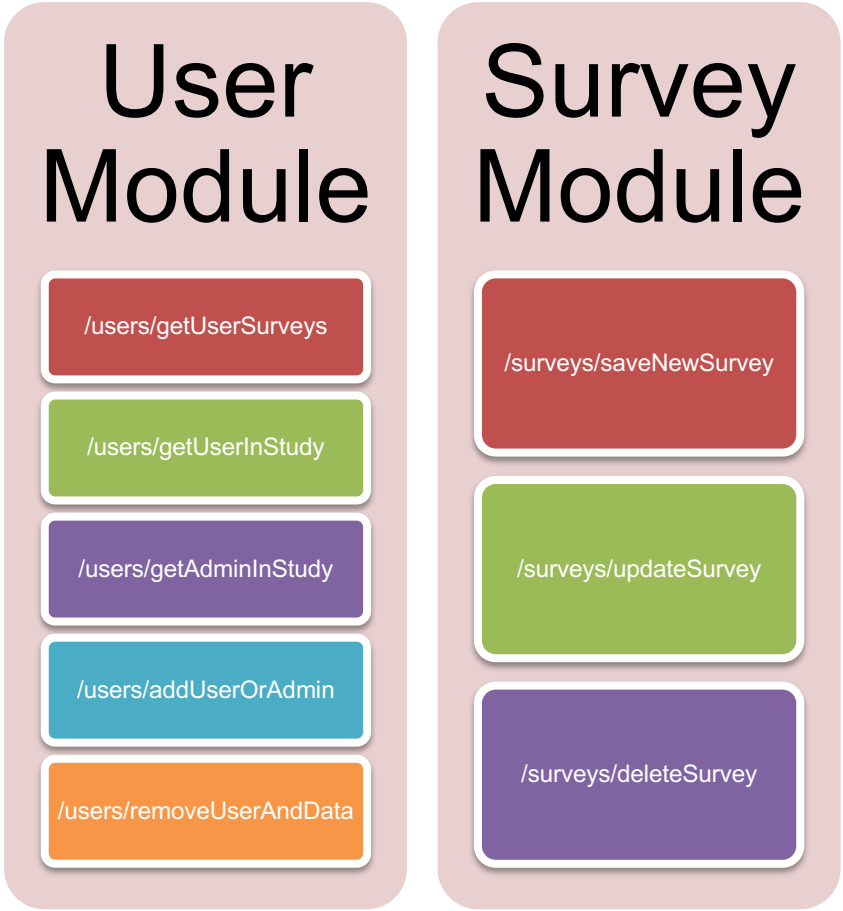
Server Modules.

- Authorization Module
  - Implements OAuth 2.0 End Point
  - Industry standard protocol for authentication
  - Server holds a copy of all the necessary tokens
    - authorization codes
    - access tokens
    - refresh tokens
  - Enables integration to any third party chat client to authenticate using TigerAware like Facebook Messenger, Twitter, Amazon Alexa Google Assistant



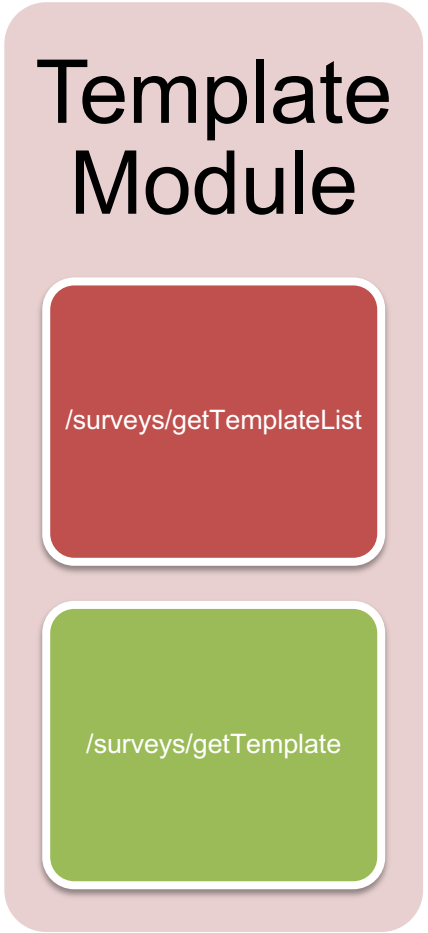
Server Modules..

- User module
  - Provides access privileges.
    - Add/Remove User to be a participant survey
    - Add Admins to the study.
- Survey Module
  - An abstraction of survey level operation.
    - Create/Update/Delete Surveys
    - Get template information.

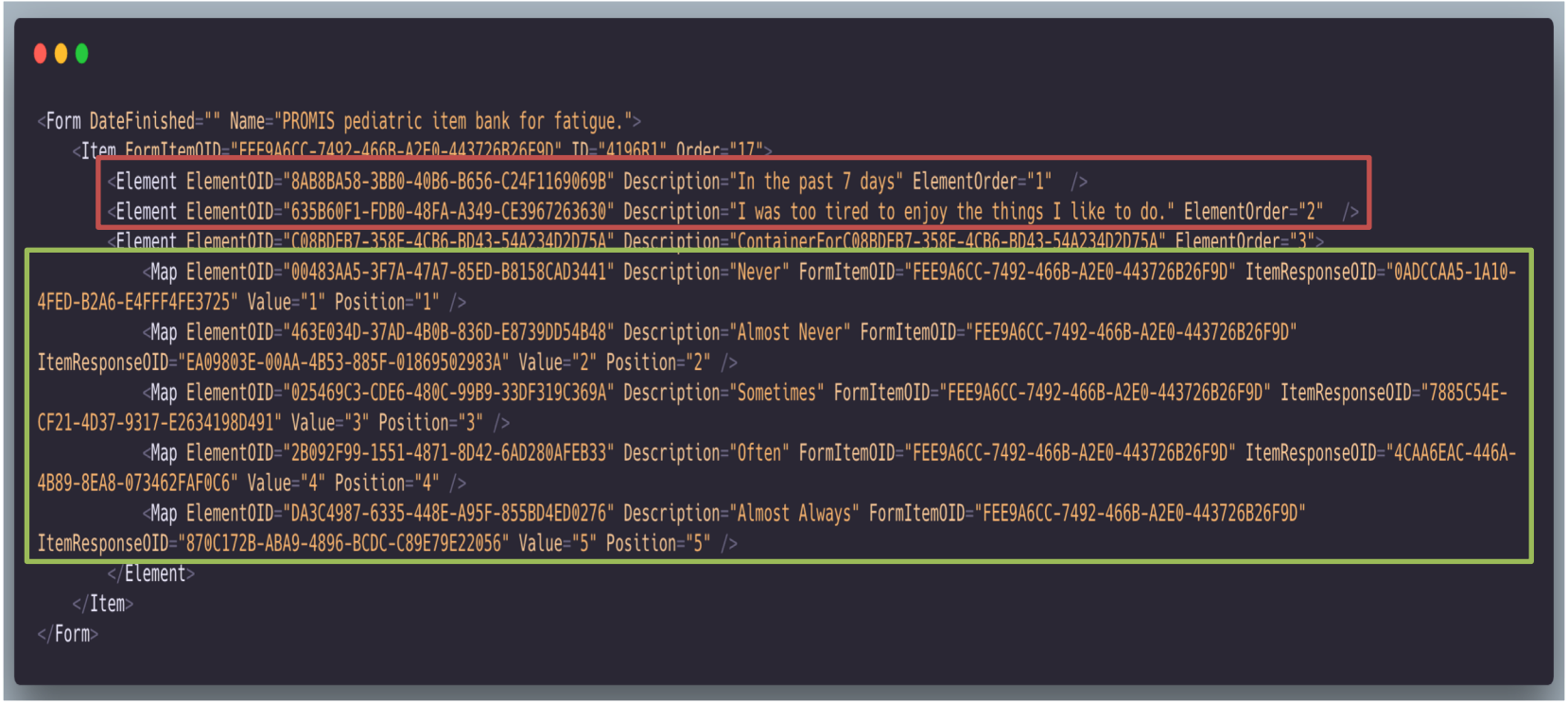


Server Modules…

- Template Modules
  - PROMIS Measures
    - 300+ Surveys
    - XML Format
  - PhenX Toolkit
    - 600+ Surveys
    - CSV Format



PROMIS Measures



```
<Form DateFinished="" Name="PROMIS pediatric item bank for fatigue.">
    <Item FormItemOID="FEE9A6CC-7492-466B-A2E0-443726B26F9D" ID="4196B1" Order="17">
        <Element ElementOID="8AB8BA58-3BB0-40B6-B656-C24F1169069B" Description="In the past 7 days" ElementOrder="1"  />
        <Element ElementOID="635B60F1-FDB0-48FA-A349-CE3967263630" Description="I was too tired to enjoy the things I like to do." ElementOrder="2"  />
        <Element ElementOID="C08BDEB7-358E-4CB6-BD43-54A234D2D75A" Description="ContainerForC08BDEB7-358E-4CB6-BD43-54A234D2D75A" ElementOrder="3">
            <Map ElementOID="00483AA5-3F7A-47A7-85ED-B8158CAD3441" Description="Never" FormItemOID="FEE9A6CC-7492-466B-A2E0-443726B26F9D" ItemResponseOID="0ADCCAA5-1A10-
4FED-B2A6-E4FFF4FE3725" Value="1" Position="1" />
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ItemResponseOID="EA09803E-00AA-4B53-885F-01869502983A" Value="2" Position="2" />
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CF21-4D37-9317-E2634198D491" Value="3" Position="3" />
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ItemResponseOID="870C172B-ABA9-4896-BCDC-C89E79E22056" Value="5" Position="5" />
        </Element>
    </Item>
</Form>
```

Fig: XML Response from PROMIS Measures API

PhenX Toolkit

- Steps involved
  - Parsing step id
  - Parsing step type
  - Parsing any choices and constraints
  - Parsing conditions

CSV HEADERS	TIGERAWARE STEP ATTRIBUTES
Variable / Field Name	id
Form Name	Survey Name
Section Header	-
Field Type	type
Field Label	title
Choices, Calculations, OR Slider Labels	choices
Field Note	subtitle
Text Validation Type OR Show Slider Number	type
Text Validation Min	constraints
Text Validation Max	constraints
Identifier?	-
Branching Logic (Show field only if...)	conditions
Required Field?	-
Custom Alignment	-
Question Number (surveys only)	-
Matrix Group Name	-
Matrix Ranking?	-

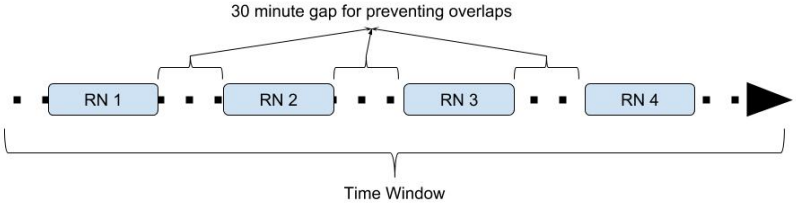
Notification Module

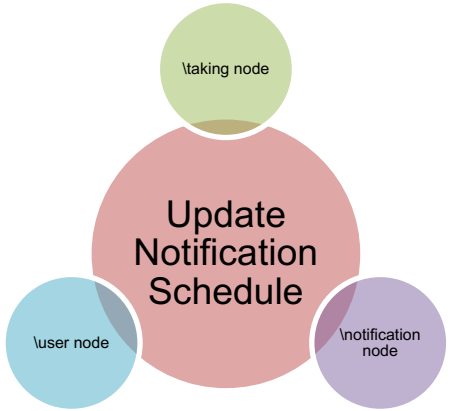
Requirements:

- Survey level Requirements
  - Participant needs to be randomly notified
    - In specified time window
    - With sufficient buffer between each notification
  - Need to track if user has been notified for compliance information
- Platform Requirements
  - Real-time scheduling of any new participant added to a survey
  - Real-time scheduling for any modified notification
  - Real-time updating of change in user notifications tokens

Notification Module

- Survey level implementation
  - Predefined buffer of 30 minutes between notifications was set
  - Number of notifications is restricted to 4
  - Size of the window has lower bound of 2hrs.
- Platform level implementation
  - Background process looking for database modification.
    - Taking node
    - Notification node
    - User node
  - Rescheduling each day
  - Time zone management





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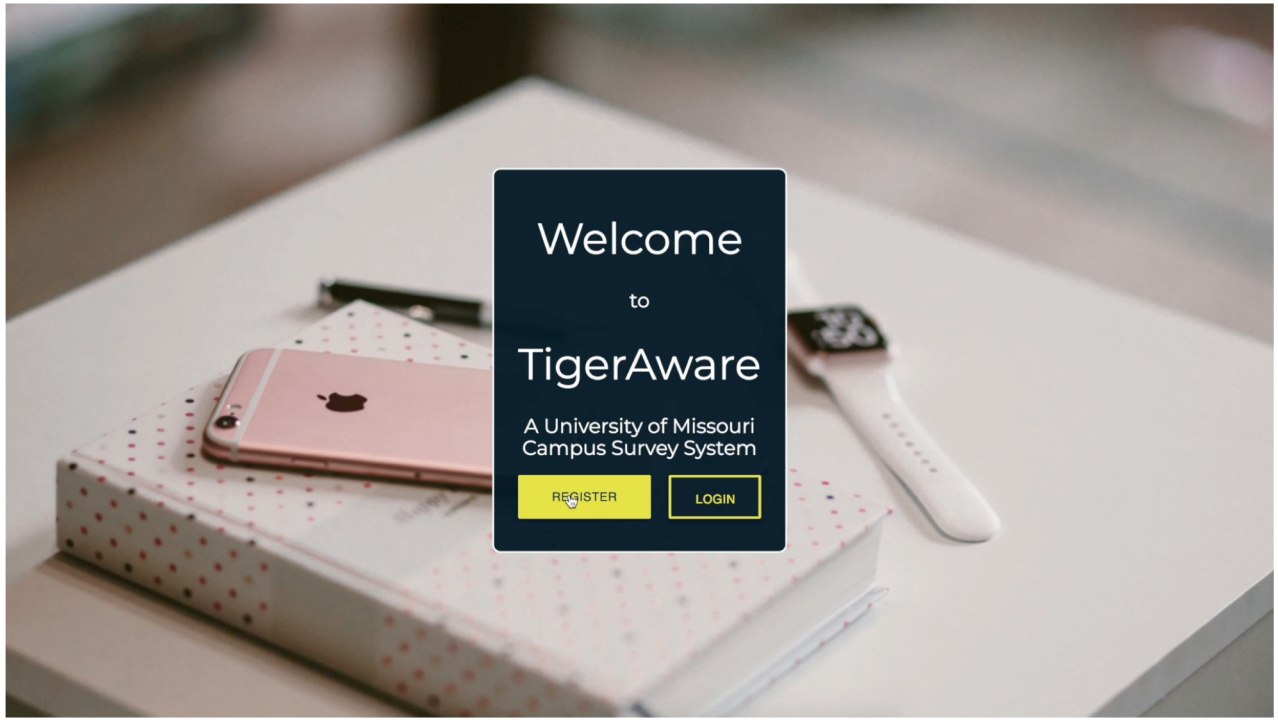
Dashboard Demo



TigerAware Applications

Research Studies Platforms / Functionalities	Driving After Drinking Alcohol Study	Bilingualism and Aphasia Study	Implicit Racial Bias Study	Characterizing Low Alcohol Sensitivity in Laboratory and Real-World Contexts
Quiz	X	✓	X	X
Survey	✓	✓	✓	✓
Response based Branching	✓	✓	✓	✓
Notification Scheduler	✓	X	✓	✓
Survey Visualization	✓	✓	✓	✓
External Data Sources	✓	X	X	X
Survey Templates	X	X	X	X

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Conclusion

Survey Platforms / Functionalities	REDCap	DEMONS	AndWellness	Survey Monkey	Previous TigerAware Dashboard	New TigerAware Dashboard
Quiz	X	X	X	✓	X	✓
Survey	✓	✓	✓	✓	✓	✓
Response based Branching	✓	X	✓	✓	X	✓
Notification Scheduler	X	Localized Triggers	User Created Triggers	Email Based Notifications	X	Push Notifications
Survey Visualization	X	✓	✓	✓	Limited	✓
External Data Sources	X	Mobile	Mobile	Mobile	Mobile	Mobile and third party virtual assistants
Survey Templates	✓	X	X	X	X	✓

Thank You!

Questions?

University of Missouri