Software Design Document

Challenge Expeditions
May15-15

Design Overview

The biggest challenge we face designing our project is building a system that allows us to reduce redundancy and provide an adaptable interface for expansion and maintainability. With a limited amount of time, need to limit the amount of code we have to write. We also want the system to provide a way to add on new features and changes. If we can provide a way to abstract sensor data we'll able to add new sensors and create challenges that use those sensors very easily.

Goals

- Reduce redundancy
- Highly scalable
- Easy maintainability

Use Cases

1. **Starting the App**
    a. Actors
        i. User of the App

ii. Online Server

b. Preconditions
    i. App has been successfully installed
    ii. Phone has internet access
    iii. User has a profile created
c. Basic flow of Events
    i. User starts the app by clicking the icon on her phone
    ii. App goes full screen and begins loading
    iii. Login Screen is open
    iv. User clicks on Input box for username or password
    v. App brings up the user's preferred keyboard
    vi. User inputs her username or email and password
    vii. User clicks login or hits the enter key on the phone
    viii. USE CASE: Validate User is performed
    ix. User logs in successfully
    x. App displays main menu, ending the use case
d. Alternative Flows
    i. Invalid User
        1. On step viii, if the username is not recognized, use case fails and "Username not found" displays, goes to step iii.
    ii. Invalid Password
        1. On step viii, if the password does not match the password for the given username, use case fails and "Incorrect Password" is displayed, goes to step iii.
    iii. Create a new account
        1. On step iv, users may instead opt to create a new account by pressing a "sign up" button
        2. Perform Use Case: Creating an Account
        3. Use case ends successfully

iv. No internet Access

1. On step iii, if no internet access can be found, app prompts user “No internet found, start in offline mode? Yes | Cancel | Try Again”
    a. Hitting Cancel closes the app
    b. Hitting Try Again attempts to connect to the internet and goes to step iii.
    c. Going in offline mode starts Use Case: Offline Mode start

2. Finding a Nearby Park

a. Actors
    i. User of App
    ii. Online Server
    iii. Database of Parks
    iv. Google Maps or similar system
b. Preconditions
    i. User has successfully logged into the app
    ii. Phone has internet access
    iii. Phone has access to a maps system
c. Basic Flow of Events
    i. From the home page (landing page from login), user clicks on the “Find Nearby Parks” Option
    ii. App accesses phone’s gps coordinates
    iii. Sends the coordinates to the online Server
    iv. Online Server searches through the database and finds the (5) closest parks

v. Online Server sends simple data of the parks to the app
vi. App displays the parks sorted by nearest-park-first
vii. User can click on one of the parks and another request is sent to the server
viii. This time the server will send back the full park data
ix. Use case ends, sending user to the park details page

d. Alternative Flows
    i. No Internet Access
        1. Page simply displays “No internet connection can be found”
        2. button “try to establish connection?”
        3. pressing the button attempts to find a connection, goes to (ii)
    ii. No GPS
        1. Page displays “No GPS Signal can be found”
        2. button “try to establish a signal?”
        3. pressing button attempts to find a signal, goes to (ii)

3. Searching for a specific Park

a. Actors
    i. User of App
    ii. Online Server
    iii. Online Database of Parks
    iv. On Phone Database of Parks
b. Preconditions
    i. User has successfully logged in
    ii. Phone has internet or downloaded database of parks
c. Basic Flow of Events
    i. From the landing page, User clicks “Search Parks”

ii. Search parks page comes up, with a list of the park data downloaded.
iii. User can type in a park name or city and hit “search”
iv. Phone first checks through any downloaded parks data and displays that
v. Phone sends request to online server
vi. Online Server performs a search on the database
vii. Sends back simple data for listing purposes
viii. Phone displays search results with limit (5)
ix. User can click on a result and another request is sent to the server
x. This time the server will send back the full park data
xi. Use case ends, sending user to the park details page

d. Alternative Flow of Events
    i. No Internet Access
        1. Behaves as normal, but no online server requests are sent
        2. searches only go through downloaded database
        3. Details of parks only come from the downloaded database
    ii. No Park Found
        1. Page displays “ no results found, try broadening your search”

4. Starting a Challenge

a. Actors
    i. User of App
    ii. Park Details Data
    iii. Online Server
b. Preconditions

i. User has successfully logged in
ii. Internet Connection available
iii. Any necessary features specific to the challenge are on the phone

c. Basic Flow of Events
    i. User clicks a challenge from the park details page
    ii. Challenge details page comes up
    iii. App determines whether phone has necessary features for the challenge
    iv. User starts the challenge
    v. App records starting conditions of the challenge
    vi. Challenge is added to the Active Challenges list
    vii. Specific Challenge Protocol is followed
d. Alternative Flow of Events
    i. Required Features Not Found
        1. Start button is greyed out and inaccessible
        2. Message “Features necessary for this challenge cannot be found”
        3. “Features needed: “ and then a list of what is missing

5. Completing a Challenge

a. Actors
    i. User of App
    ii. Park Details Data
    iii. Online Server
b. Preconditions
    i. User has successfully logged in
    ii. Internet Connection available
    iii. Any necessary features specific to the challenge are on the phone

iv. User is in a park
v. Challenge exists

c. Basic Flow of Events
    i. User has started a challenge
    ii. User follows instructions given on the phone
    iii. Phone tracks when parts of challenge are completed
    iv. User inputs when challenge is complete
    v. Phone confirms based on gps tracking that challenge is complete
    vi. System updates user statistics and leaderboards =

d. Alternative Flow of Events
    i. Required Features Not Found
        1. Start button is greyed out and inaccessible
        2. Message “Features necessary for this challenge cannot be found”
        3. “Features needed: “ and then a list of what is missing
    ii. GPS data says challenge is not complete

6. Building a Challenge

a. Actors
    i. User of App
    ii. Park Details Data
    iii. Online Server

b. Preconditions
    i. User has successfully logged in to mobile or web application
    ii. Internet Connection available

c. Basic Flow of Events
    i. User selects location for the challenge
    ii. User names challenge
    iii. User selects the type of challenge

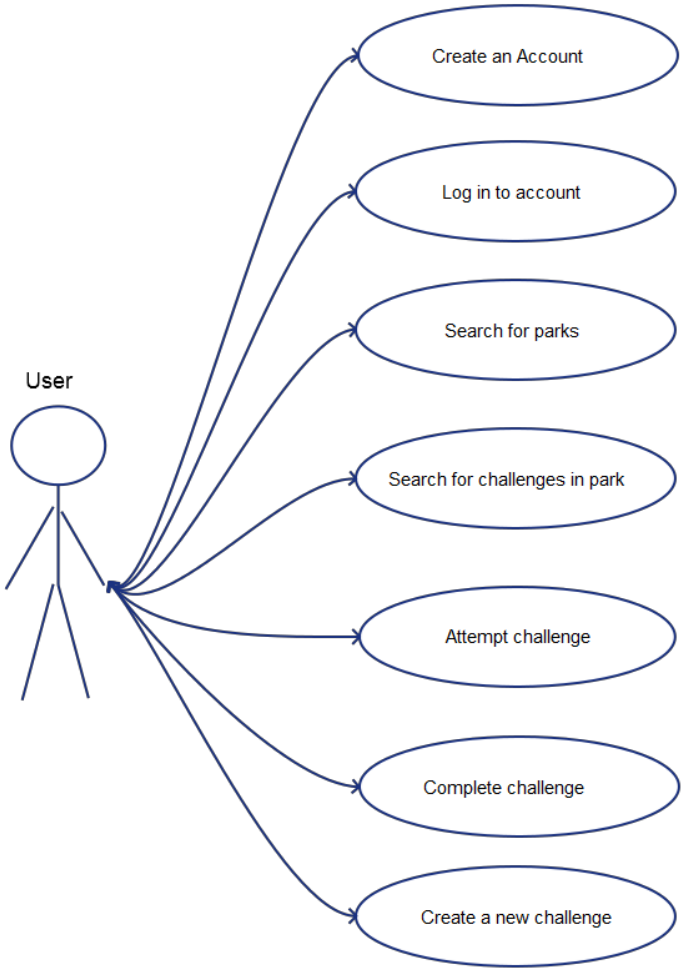
iv. User inputs challenge parameters

d. Alternative Flow of Events
    i. Required Features Not Found
        1. Start button is greyed out and inaccessible
        2. Message “Features necessary for this challenge cannot be found”
        3. “Features needed: “ and then a list of what is missing

7. Creating an Account

a. Actors
    i. User of App
    ii. Online Server
b. Preconditions
    i. Internet Connection available
    ii. User Downloads application
c. Basic Flow of Events
    i. User inputs username and password
    ii. User inputs information
    iii. User uploads profile picture
d. Alternative Flow of Events
    i. Required Features Not Found
        1. Start button is greyed out and inaccessible
        2. Message “Features necessary for this challenge cannot be found”
        3. “Features needed: “ and then a list of what is missing
    ii. Username or password is invalid
        1. User inputs new username and password

Use Case Diagram



System Architecture

Mobile Client

The mobile client is responsible for providing the everyday interface and utilities for the user. It will be composed of breaking down the sensor data and registering it with the challenges and activities. The application must provide a usable and

understandable interface as this we be the primary device for the system. The mobile client is responsible for accessing local and remote sensor data. It must verify the completion of challenges and sync the data with the server. Along the same lines, it should be able to pull challenges and stats for challenges, friends, and parks. It should able to find new challenges and parks as well.

Server

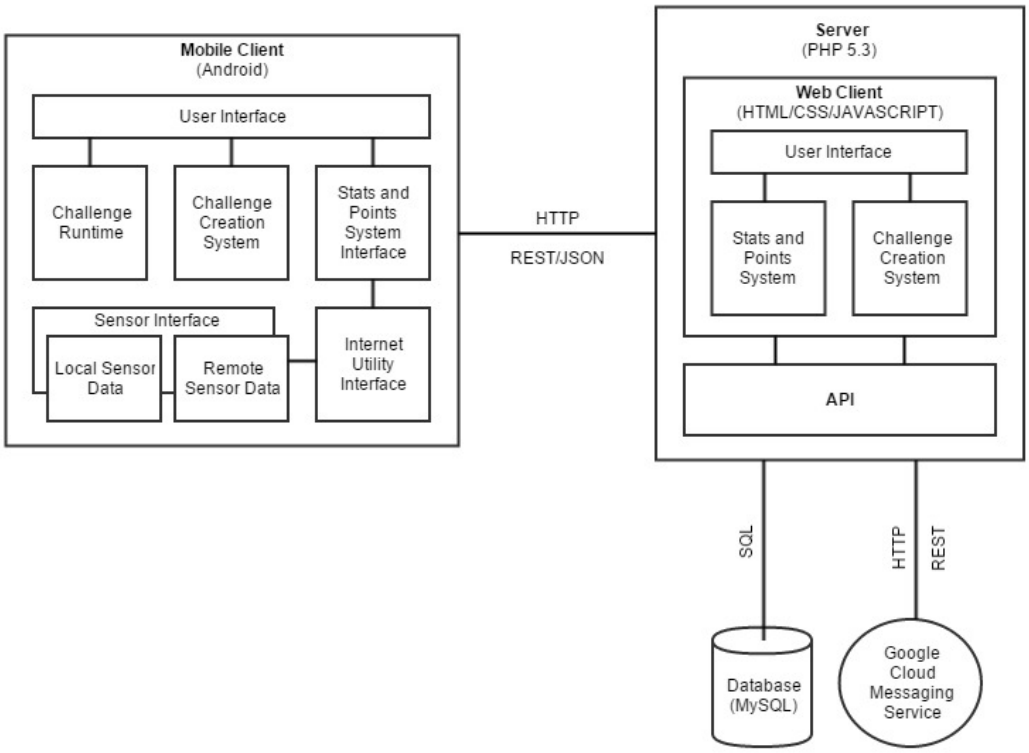
The server will be the interface for the web application and the API. The web application will provide a limited number of features that the mobile client has. These features are viewing stats on challenges, managing profiles, and finding parks. The user will not be able to perform challenges through the site or access sensor data in any way.

The server also holds the API for our system. The API provides all the calls for accessing any data about challenges or profiles. Any outside data that we need to access (Google Maps, park and recreation data, etc.) will also be accessed through our API and will fetch the data. It also allows storing of data that needs to persist in a central way.

Database

The database will simply store are application data. It will be built on the fundamental models of our system (challenges, users, and badges).

Architecture diagrams



Data Design

User

User will contain information involve the following:

1. Personal Information
    a. Name
    b. Age
    c. Gender
    d. Username
    e. Password
    f. Friends
    g. Photos
2. User Application Information
    a. Parks visited
    b. Challenges completed

c. Scores

Challenge

A challenge is the most important data model for our application. Below we have some of the types of challenge we would like to implement.

1. **Running/Biking- Race type (get to finish as quick as possible, any route)**
   - *1.1. Associated Park*
   - *1.2. Start Location*
   - *1.3. End Location*
   - *1.4. Maximum Avg. Speed (Prevent cheating)*
   - 1.5. Player's Avg. Speed
   - 1.6. Players Current Location
   - 1.7. Players Start Time
   - 1.8. Players End Time
   - 1.9. Weather at time of race
   - 1.10. Points are given for avg. speed times distance of race.
   - 1.11. Bonus points given for improving one's score
   - 1.12. Bonus points given for top 10 in leaderboard
   - 1.13. Bonus points given for Extreme Weather
2. **Running/Biking - Free Ride**
   - 2.1. *Associated Park*
   - 2.2. Players Speed (only to determine distance)
   - 2.3. Weather
   - 2.4. Points given for Distance Only
   - 2.5. Bonus points for improving one's own score
   - 2.6. Bonus points for Extreme Weather
   - 2.7. No Leaderboard
3. **Running/Biking - Checkpoint (Players must go through specific checkpoints before finish)**
   - *3.1. Associated Park*

3.2. Start Location

3.3. Ordered list of next locations

3.4. max avg. speed(prevent cheating)

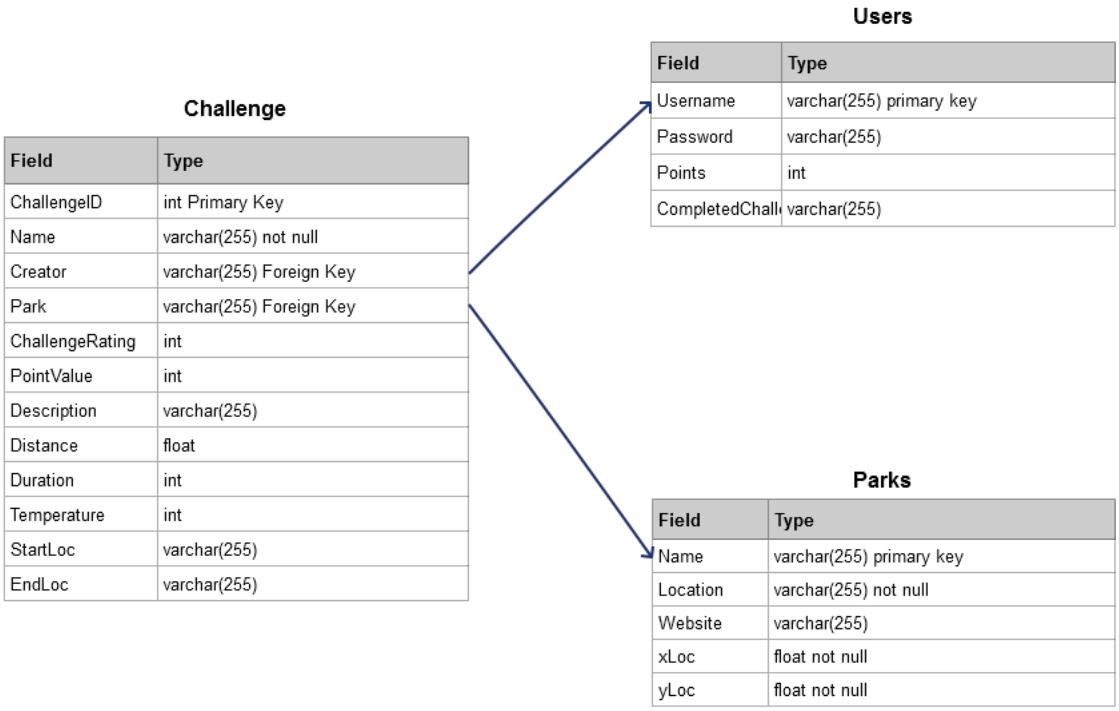
3.5. Players Current Location

3.6. Players Start time

3.7. Players End Time

4. **Running/Biking - Time Attack (Need to reach a gate in limited time, time gets added on for each gate. Go through as many gates as possible)**
5. **Running/Biking - Endurance (Go as long as possible without ever going below a certain speed)**
6. **Biking/Running - Collection (Get to checkpoints in any order)**
7. **Biking - Speed Trap (Similar to Checkpoint, but speed is recorded at each point and added)**
8. **Biking - Zone (after set time, need to maintain a higher and higher min. speed)**
9. **Orienteering (Map checkpoints, uses clues)**

Database Schema



Challenge

Field	Type
ChallengeID	int Primary Key
Name	varchar(255) not null
Creator	varchar(255) Foreign Key
Park	varchar(255) Foreign Key
ChallengeRating	int
PointValue	int
Description	varchar(255)
Distance	float
Duration	int
Temperature	int
StartLoc	varchar(255)
EndLoc	varchar(255)

Users

Field	Type
Username	varchar(255) primary key
Password	varchar(255)
Points	int
CompletedChall	varchar(255)

Parks

Field	Type
Name	varchar(255) primary key
Location	varchar(255) not null
Website	varchar(255)
xLoc	float not null
yLoc	float not null

Component Design

Component 1

…

Component 2

…

Component 3

…

Technology Rational

The project we are trying to accomplish requires multiple tools to be successful. We spent lots of time doing research on mobile application frameworks, web languages and tools, and databases. When doing this research, we really had to consider what were the most important factors in getting this project accomplished well.

When we thought about it, and time was the biggest factor. We only have two semesters with all of us having classes and work that take up our time. We need to be able to start quick and change things easily. Familiarity with tools helps speed up thing because we do not have to learn new tools. We also need to be able to prototype quickly because not many of us are familiar with the domain for the project. Quick prototyping allows us to make mistakes and fix them rapidly.

The other important factor is scalability. We want this app to be expandable in the future. We need to ensure the technologies we use can accommodate that with future support and decent user base stability. Choosing to work with frameworks and languages that cater to future growth is something we value.

Android Framework

We decided to go with Mono for Android. We believe that we will save more time by having the same code base in C#. This will allows us to build the iOS application fast when we are done with the prototype. We were a bit hesitant because it's in a different language than most of us know but since it's similar to Java we think it won't be to difficult to transition.

When compared to using the standard Android framework we would know more of the language. We also would would be able to use multiple libraries specifically made for the platform since all that code is written in Java. The library argument would also be the same for iOS with CocoaPods able to give extensions that we could use. Most of us don't know Objective-C or Swift for iOS though.

PHP Web Server

We decided to make the web application and API using PHP. We believe it was a good choice due to it's great developer community and easy learning curve. It also

helps that at least one person on our team has already used PHP before. We'll be able to ask for help and easily find resources for what we want to do.

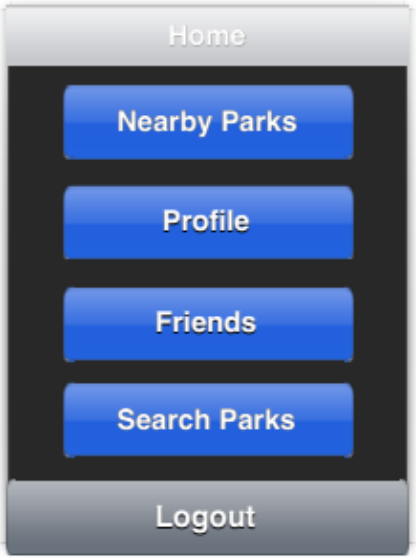
We considered Java and Spring MVC because we all know Java, but we felt that configuration would be a hassle and writing APIs in Java is clunkier and not as quick to prototype.

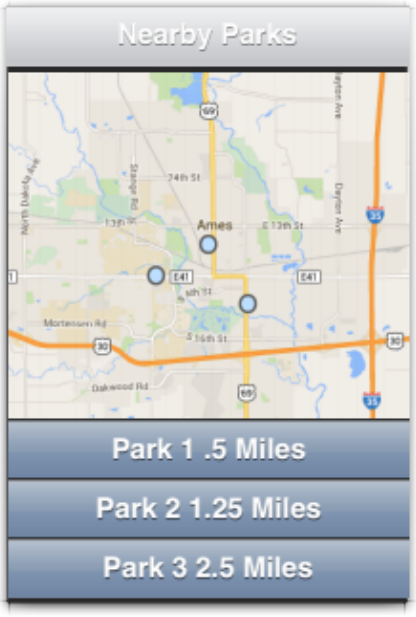
MySQL Database

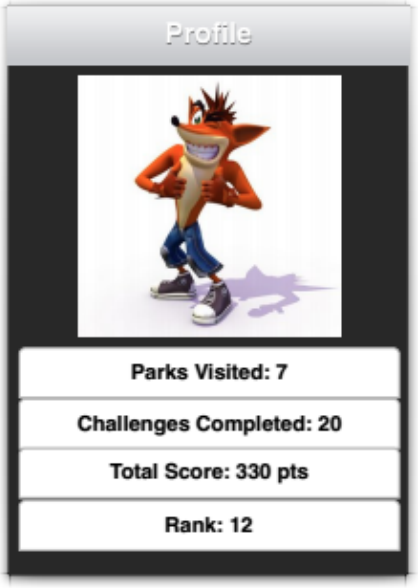
We mostly chose MySQL because it was what a lot of our Iowa State projects use as a database. It's fast, simple, and efficient. A NoSQL database probably wouldn't have been a bad idea as our data models might change often during the prototyping phase. We decided not to go with a NoSQL database just because we're familiar with SQL mostly and PHP pairs nicely with SQL as it is.

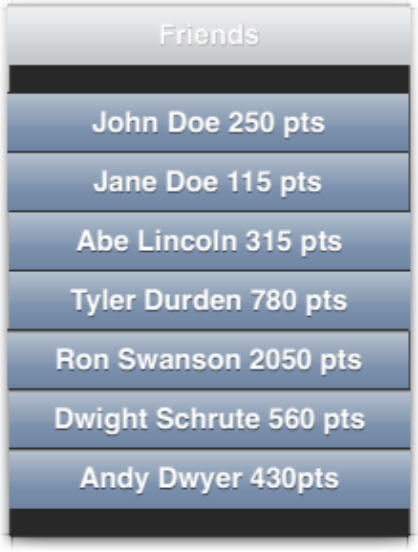
Interface Design

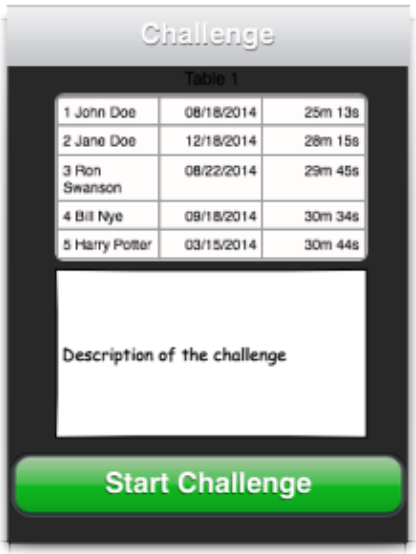
Mobile application


Home
Nearby Parks
Profile
Friends
Search Parks
Logout


Nearby Parks
Ames
Park 1 .5 Miles
Park 2 1.25 Miles
Park 3 2.5 Miles

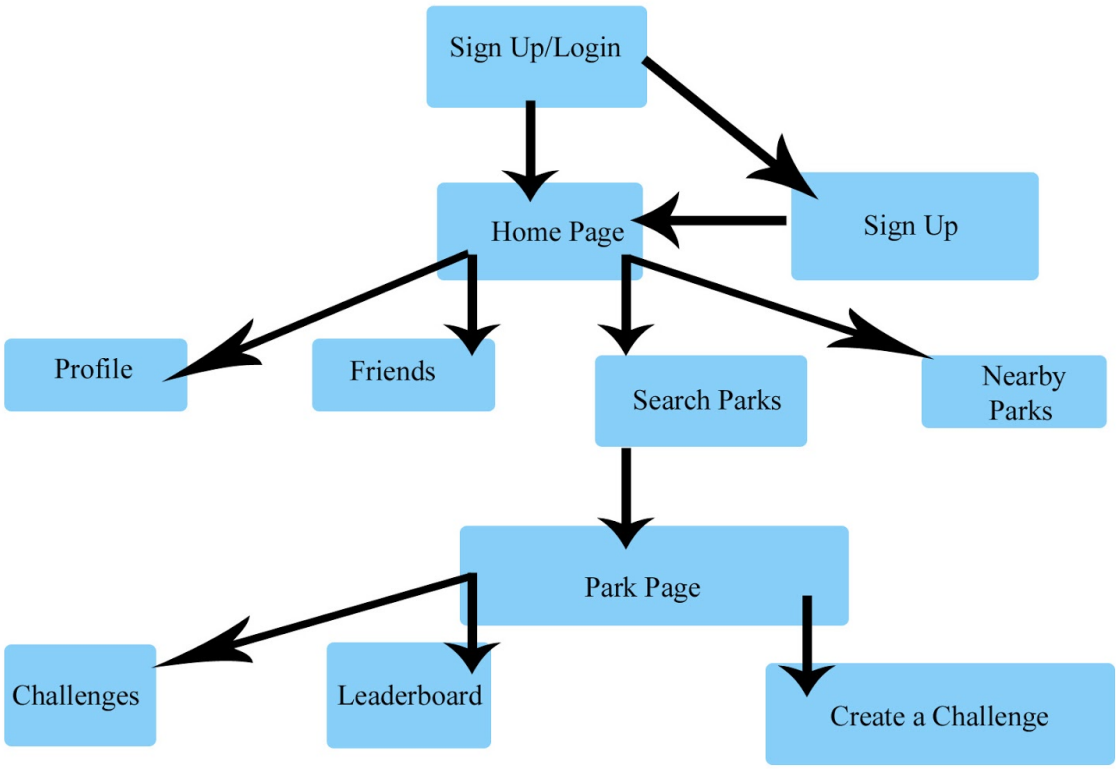

Profile
Parks Visited: 7
Challenges Completed: 20
Total Score: 330 pts
Rank: 12


Friends
John Doe 250 pts
Jane Doe 115 pts
Abe Lincoln 315 pts
Tyler Durden 780 pts
Ron Swanson 2050 pts
Dwight Schrute 560 pts
Andy Dwyer 430pts



User Interface Description

Mobile application flow



Design Rationale

The system works by separating implementation into mobile client, server (web application and API) , and database modules. We decided to go with this model because they align with our goals. In terms of reducing redundancy we focus on building a mobile application that uses an API for everything it needs. This allows us to only have to write specific calls once on the API and let the web application and mobile application use those calls. It also means when something needs to change, we just change it in the API and everything just works.

We also separated the modules in such a way, that they can easily be swapped out and replaced. We want them to be highly decoupled and very much replaceable. If

this app is to be scalable and be capable of advancing, there is a high chance that performance would need to be increased and having more replaceable modules will expedite this process. This will also allow easier updates and overall code maintenance better.