Applications of Geospatial Data in Digital Communication

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Motivation

- Digital communication is important
  - Over 4.5 billion social media users worldwide

What's the problem?

- We live in the real world!
- Even though 99% of social media is through mobile devices...
- Digital communication mostly independent of the physical space around us

My hypothesis?

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Tying digital interaction to physical proximity increases user engagement

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The goal?

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Tying digital interaction to physical proximity increases user engagement

The goal?

A social app that gates messaging to proximity

Background and related work

Geospatial data

- Data related to a specific geographic position
- Combines location, attribute, and temporal information

In social media

Approach

Key features

1. Main screen showing the user’s location and surrounding area
2. Ability to leave ephemeral messages at one’s location, visibly indicated to all users
3. Messages can only be read near coordinates where they were posted

Why?

Why?

Messages both spatially and temporally relevant!

Why?

Messages both spatially and temporally relevant!

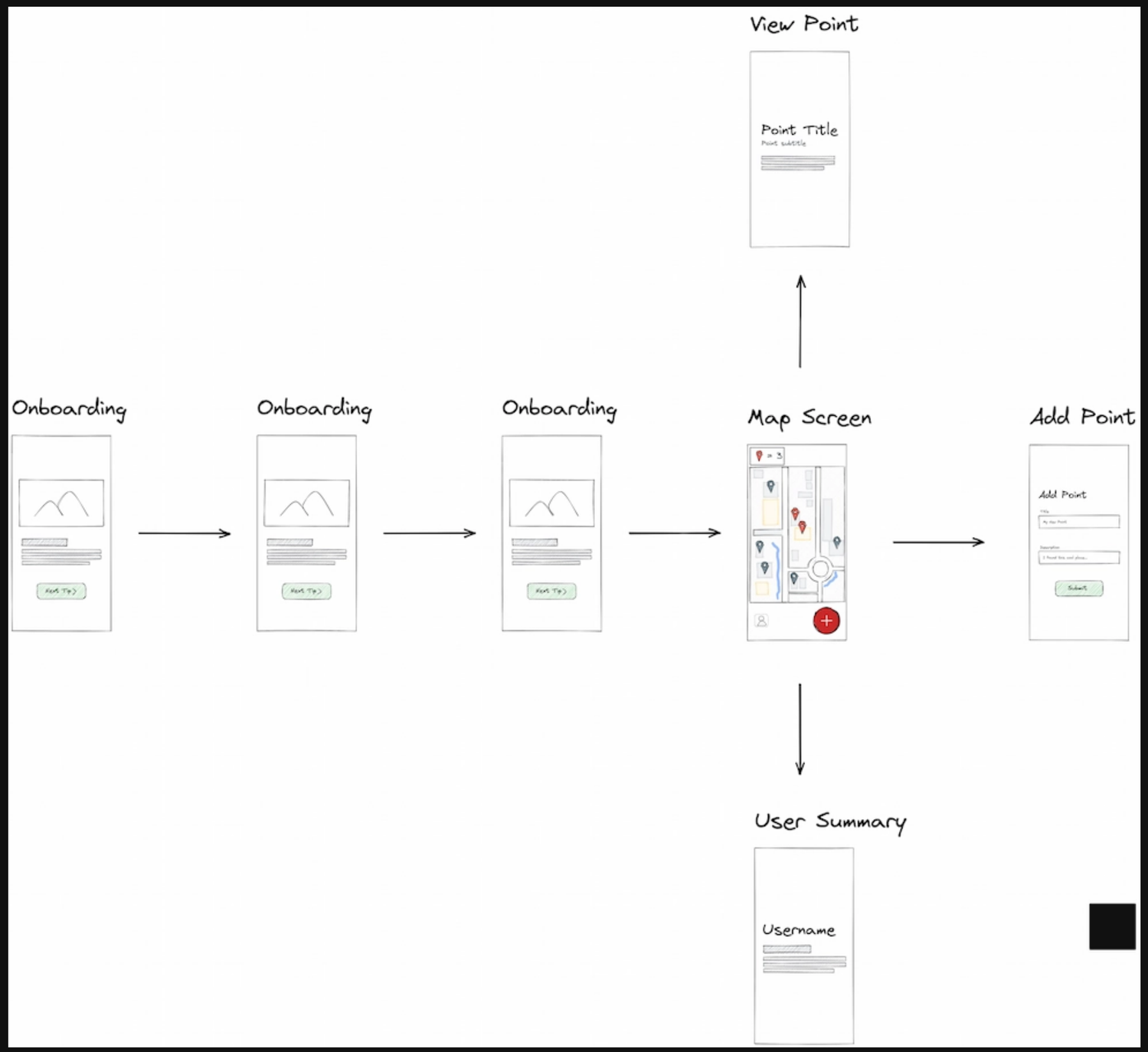
Access directly gated by physical proximity

Implementation

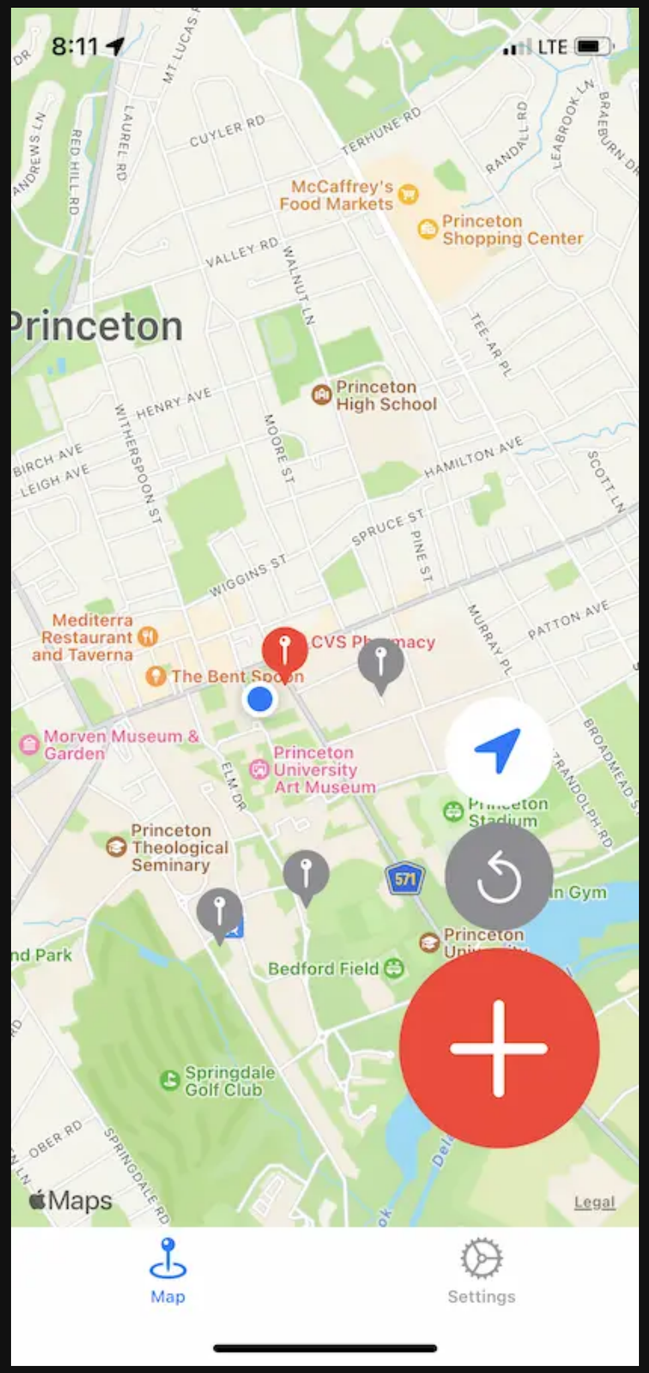
Project architecture

- Client-server model, client is iPhone app
  - Access to Apple's `MapKit` and `SwiftUI` frameworks
- Client handles all user-facing tasks
- Server handles content, authentication, geospatial queries, and other centralized functionality

From design...


View Point
Point Title
Point subtitle
Onboarding
Onboarding
Onboarding
Map Screen
Add Point
Add Point
Submit
User Summary
Username

...to implementation



Client details

- `SwiftUI` is a declarative framework
  - Describe interface you want, layout engine handles the details!
  - Separates presentation from business logic
- Good fit for MVVM (Model–view–viewmodel) design pattern

Shared services

- Wrote *managers* to represent a shared service layer, injected at startup:

```
 1
 2 import SwiftUI
 3
 4 @main
 5 struct Geo: App {
 6
 7     let settingsManager: SettingsManager
 8     let authenticationManager: AuthenticationManager
 9     let locationManager: LocationManager
10
11     init() {
12         self.settingsManager = SettingsManager()
13         self.authenticationManager = AuthenticationManager(set
14         self.locationManager = LocationManager(settingsManager
15     }
```

Server details

- Containerized application using Docker
- Redis as database
  - Fast ($\mathcal{O}(N + \log M)$) and straightforward geospatial queries
- `FastAPI` as webserver
  - Entire server is < 200 LOC

Demonstration

Evaluation

Testing logistics

- Deployed server on DigitalOcean Droplet
- Distributed app using Apple's TestFlight service
- Solicited testers on different Princeton listservs

How to test?

How to test?

- Evaluate off qualitative feedback
- Ask questions to confirm/reject initial hypothesis.

Results

- 19 unique users
  - 15 opened app at least once
  - Average of 8.4 sessions/user
  - Average rating of 7/10 on overall UX
- Positive feedback overall
  - Comparisons to geocaching, Pokémon GO
  - Majority agreed with hypothesis
  - 83.3% believed primary purpose would be for status updates

Negatives

- No tutorial, onboarding flow
  - Unclear on interaction radius, message expiration
- Inability to respond to messages
- Low user population → lack of community

Was it a success?

Was it a success?

YES!

Conclusions

- Intersection of geospatial data and digital communication is relatively unexplored
- Geospatial data can connect people
- Future work?

Code availability

- Client: https://github.com/thisstillwill/Geo-Client
- Server: https://github.com/thisstillwill/Geo-Server
- Report: https://github.com/thisstillwill/Geo-Thesis

Thank you!