Rapid Information Propagation using Beacons

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Final Project Report | H681 Spring 2015 | Advisor: Dr. Anthony Faiola | IUPUI

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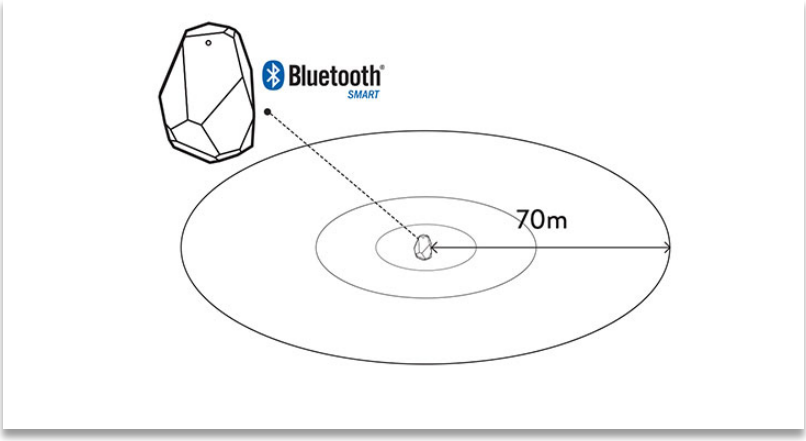
I. Problem Space and Conceptualization

A. Introduction

In several neighborhoods and education campuses, people often miss out on relevant information such as events, alerts, advertisements, job opportunities and so much more. Such information is generally available in many different ways like flyers, bulletin boards or online like social media sites, mailing lists etc. but is often delivered very late or in a manner that is easy to ignore. Another bottleneck is that most often, users only pay attention or are limited to information relevant to their workplace/building/school etc. and might miss out on several fun/important activities being held elsewhere on the premises.

B. Solution - 'Prox'

Drawing inspiration primarily from Apple's iBeacon indoor positioning systems (and other LE Bluetooth emitting transmitters/receivers used in location-sensing studies) that work very well with location-aware and context-aware applications, this design concept aims at rapid information propagation to smartphone users via a localized network of beacons and a mobile app, 'Prox' that runs in the background and listens for incoming notifications when the user is in proximity of a beacon.

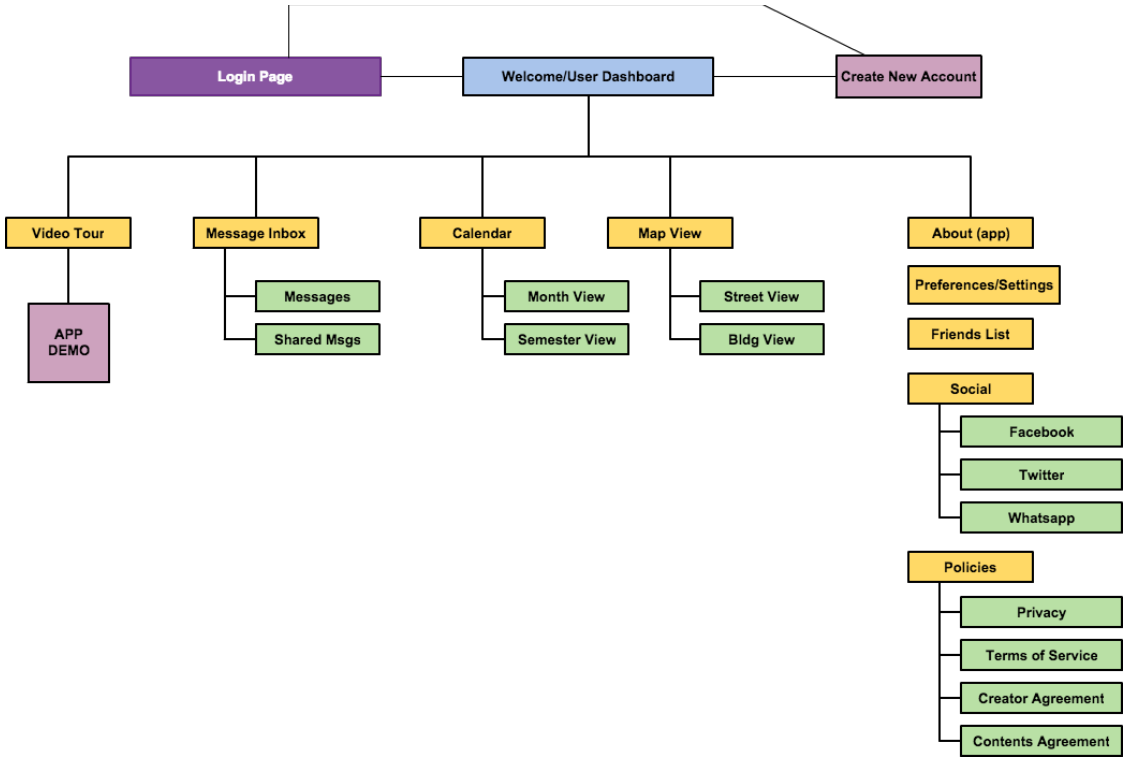


From an HCI standpoint I would like to explore the user experience behind:

- *What information is available and how relevant it is?*
- *Whom would they like to share the information with?*
- *How did they receive the information?*

C. Preliminary Design Ideation and Prototyping

Initial product requirements were gathered via talking to experts and professionals who organize mailing lists and publish events, surveys and informal interviews with potential users. These led to the initial concept building in the form of system mapping, user scenarios, supporting use-case diagrams, rapid sketching, paper prototypes and early wireframes to gain iterative feedback from users.



The following diagram illustrates the system map and interaction sequencing that will define the user pathways within the system.

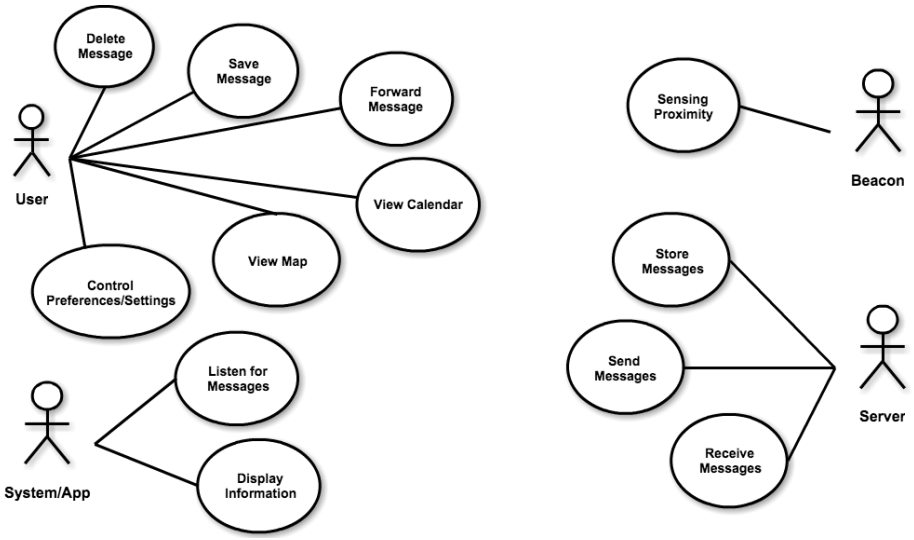


Fig. Use-case diagram illustrates the various actors involved in the system design and the different roles served by them.

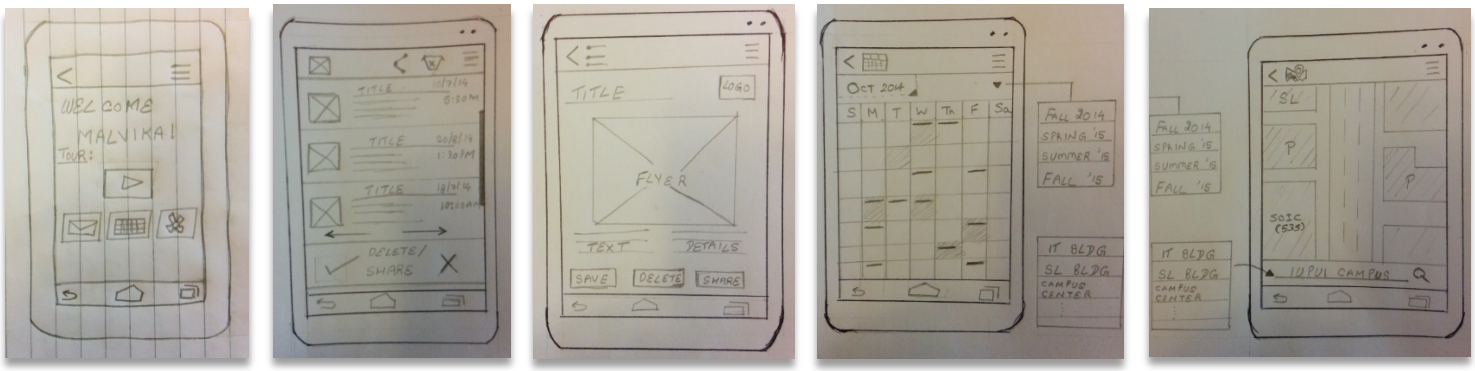


Fig. Preliminary sketches depicting the welcome screen, inbox and open messages and illustrating the utility of the calendar and the map view.

Mary / 25 years / Graduate Student

Mary is a full-time graduate student. Having been an active student volunteer for several on-campus activities during the course of her undergraduate degree, she hates missing out on several relevant campus event notifications at her new graduate school. She likes being on top of her schedule but because of the last-minute notices and updates, she misses out on several opportunities such as seasonal events, recruitment drives or cultural events.

(Typical user scenario)

Fig. Illustrating a few paper prototype screens including login, dashboard, message view and inbox (with actions).

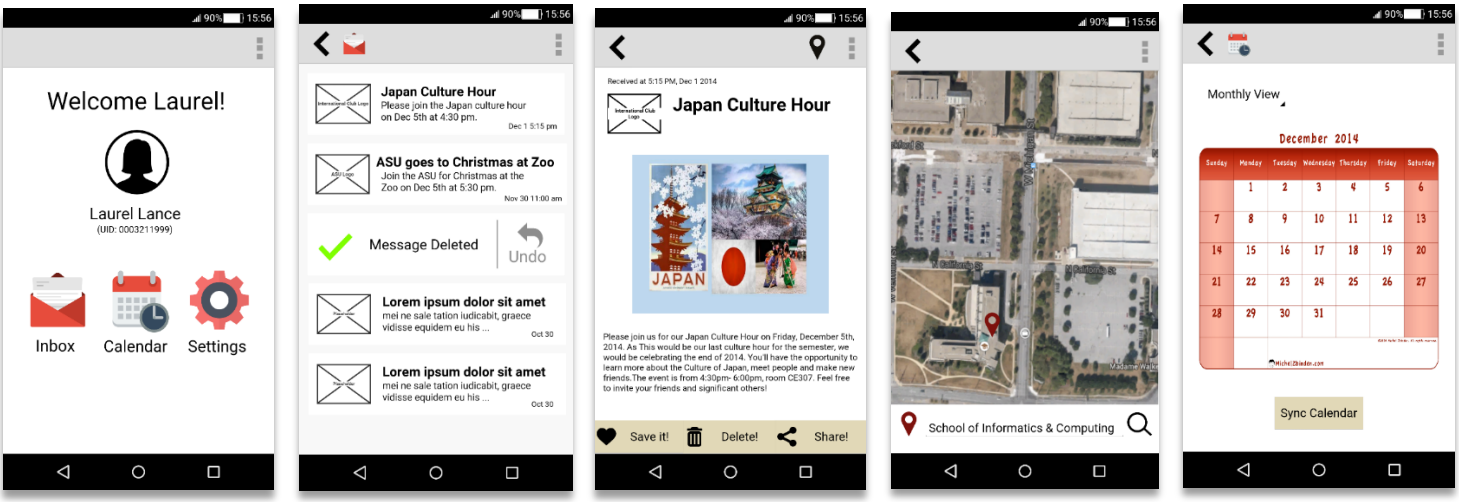


Fig. Illustrating a few screens from the first round of wireframes generated to get early feedback from users and experts alike. (Generated using proto.io)

D. Initial Evaluation and Summary of Findings

The first round of feedback was received by conducting:

- Cognitive Walkthroughs with UX experts (given a scenario, the expert was asked to evaluate each action step in a given sequence of steps to accomplish a general task on the wireframe)
- User Experience Studies with potential users (using a task based scenario where users performance and satisfaction were evaluated by having them perform simple tasks on the generated wireframes on a mobile phone or remotely using InVision)

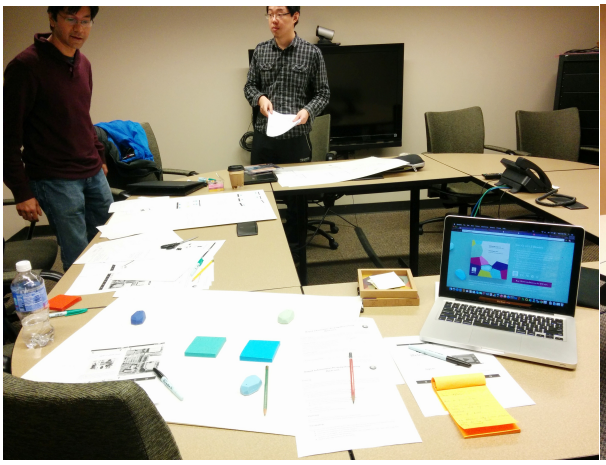
While generally positive about the usability and practicality of the app, some concerns were raised about some of the visual design elements and some recommendations were offered to fix them.

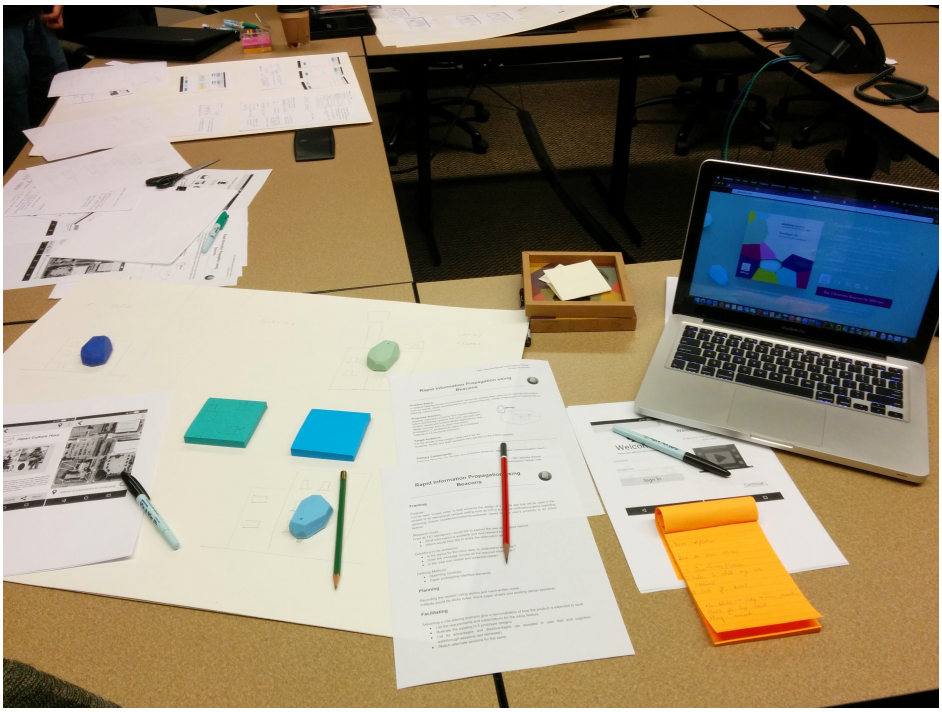
Table: Findings and Concern Areas

Problem Areas/Concerns	Recommendations
Every card in the mailbox looks cluttered and dense with information.	Only use the logo, Title and date and omit a part of the mail's body to only display the essential components at first glance.
The 'Save' button is misleading and it appears as if save adds the event as a reminder. The sync with the calendar is not obvious.	Change the wording of 'Save' to better illustrate the functionality with the synced calendar. Maybe 'pin it' or 'save to calendar'?
The 'map' symbol is not really visible and doesn't convey any meaning at its current position. It is not clear that this can be used to look up the venue location.	Adjust the position and visual representation of the map symbol to make its functionality clearer.
The contact list on the share pop-up is very confusing as users didn't understand who/where these contacts are from.	Giving a clear idea of using one's phone contacts or only school contacts that also use this app.
The 'settings' button was confused with the default Android settings button	Using a different icon and placement for the settings button altogether.
The sender's logo wasn't clearly visible.	Editing the layout of a typical message and making the logo much more prominent.

II. Participatory Design

To revisit the app's conceptual design, user requirements and expectations and facilitate better and well informed design considerations, another round of participatory design was conducted with real users and a UX expert. Users were asked to collective brainstorm ideas for what the product should look like and how it could solve the problem at hand, then shown the snapshots of the current wireframes and asked for their feedback and recommendations.





III. Product Development

The high-fidelity prototype for Prox was developed using Eclipse IDE, Android SDK and Estimote SDK (for the beacons) and could be installed and run as a native Android app on any Android smartphone (4.4+). The app was coded in a way that 10 notifications could be received within a span of 6 hours during any day. This was done to facilitate the field testing and cater to the participant's availability in the IT building.

Shown below are the snapshots of Prox's user interface:

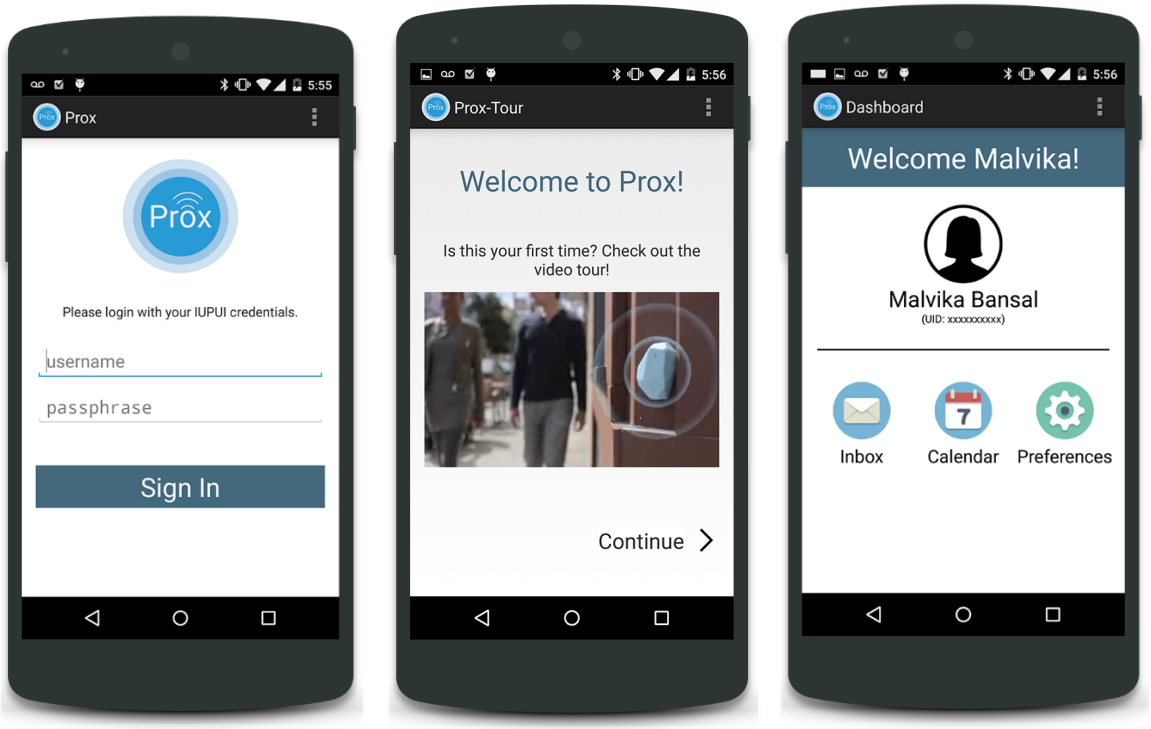


Fig. The Login screen followed by the first-time Tour landing page for new users. The user's home (dash) screen with quick access to messages, calendar and settings.

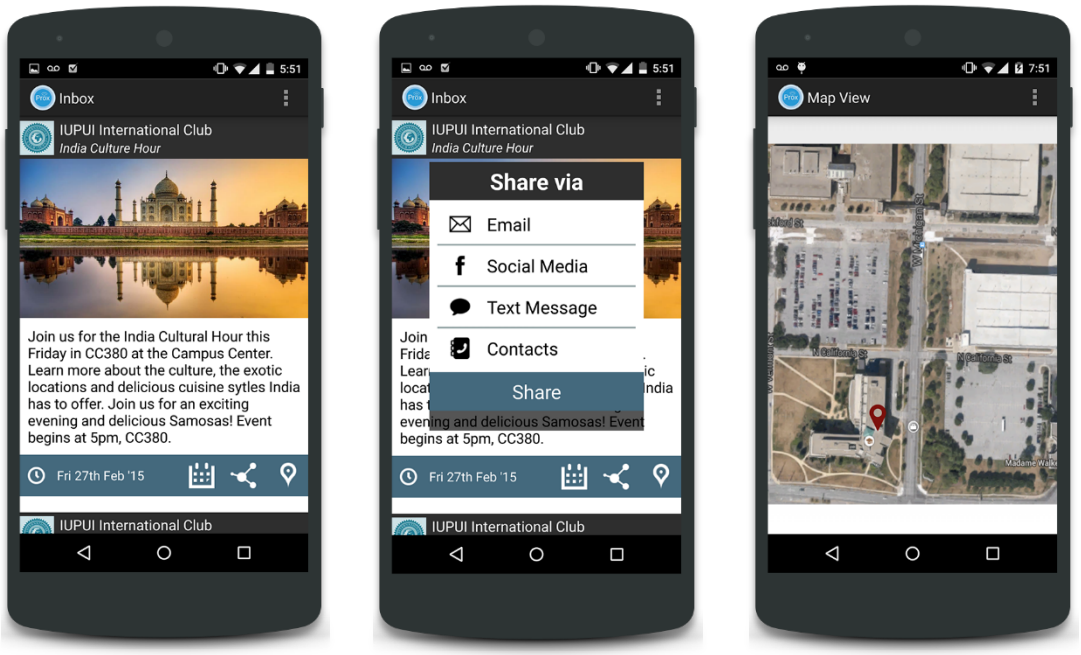


Fig. The first screen shows the inbox. The second is how a typical message would look like with a map view illustrated on the right that indicates the exact location of the event.

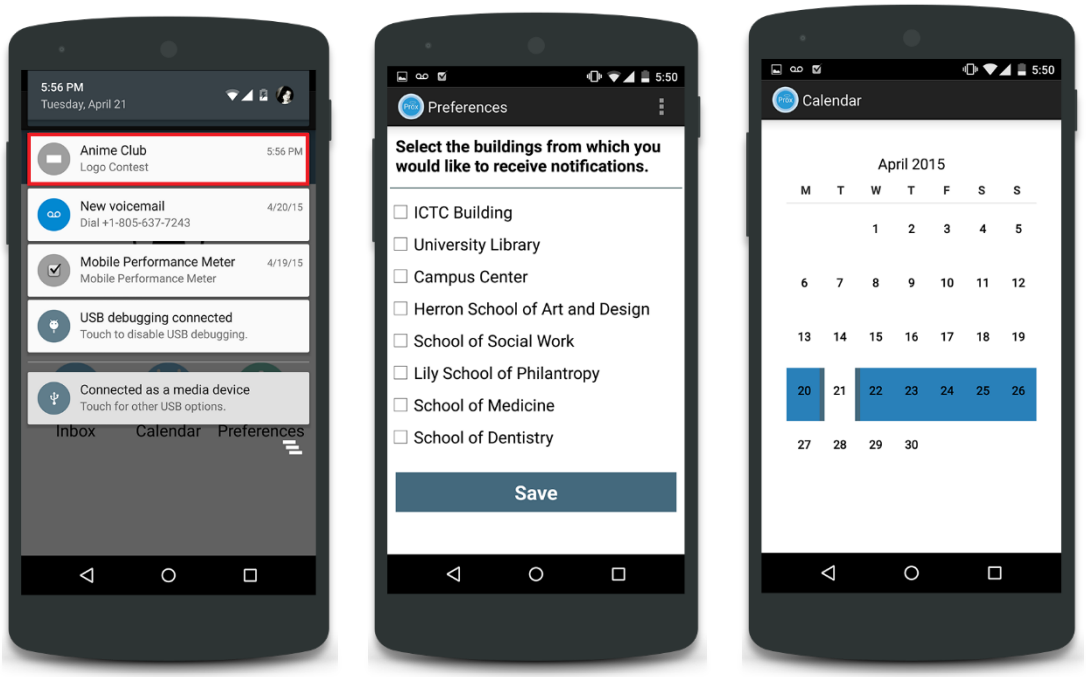


Fig. Swiping left deletes the message. Sharing right shares the message. Last screen shows the calendar screen with a ‘monthly’ and ‘semester’ view.

IV. User Testing and Analysis

A. Participant Recruitment

Six participants were recruited for user experience study, after conducting one pilot test. The demographic details are as under:

- 2 male participants, 4 female participants
- 3 Asian Indians, 3 Americans
- All participants were graduate students at IUPUI
- Age range: 24-32 years
- Participants were recruited through publishing on social media, direct emails and flyers put on school bulletin boards.

B. Testing Methodology

A field study was conducted to evaluate the user experience of using Prox in one's daily life. Given below is the approach used to conduct the field testing and collect user responses:

- A briefing session was conducted with each participant that involved
    - background information about the participants and currently used methods for receiving campus information
    - introduction to the app and goals of the study
    - installation of a custom version of the Prox prototype on participant's Android phone (tailored to best match their availability in the IT building)
    - feedback on the login page, video tour and user dashboard
- 2 beacons were placed in strategic locations within the IT building premises for maximum coverage.
- Every participant used the app on a pre-chosen day for 6 hours during which they were required to keep Bluetooth on their devices ON and received notifications every half hour.
- Post-field test interview and feedback from participants to better understand their experience of using the app for the limited timeframe.
- SUS questionnaire.

C. Quantitative Analysis

Based on responses collected to the post-test SUS questionnaire, the average SUS score for Prox was computed.

SUS score: 90

Referring to the Measuring Usability website,

"The average SUS score is 68. A SUS score above a 68 would be considered above average and anything below 68 is below average."

"A score above an 80.3 is the top 10% of scores. This is also the point where users are more likely to recommend the product to a friend."

D. Qualitative Analysis (User Feedback)

Overall feedback:

- Overall, the concept was found to be useful and informative.
- Participants commented that the UI looked clean, minimalistic and intuitive.
- Notifications weren't invasive and most of them were relevant to participants.
- Participants felt aware and motivated to attend events after reading notifications.
- Participants said that they were likely to use the app and recommend it to their friends.
- Compared to their current method of receiving information about the events, they didn't have to take an extra step (sign up on a number of social media websites) to receive this information.

Participant Quotes on the UI design:

- *"simple and effective"*
- *"smooth, sleek, like it a lot, intuitive"*
- *"easy to understand and navigate"*
- *"icons clear, makes sense"*
- *"inbox layout is nice"*

Participant Quotes on the User Experience:

- *"Only concern was that it would be invasive which it isn't coz I didn't look at notifications while working, and saw everything together at end, but if its at entry and exit <of building> then I know I'll look for it <notifications> only then"*
- *"Notifications were little overwhelming. I will not like getting notifications continuously like every half an hour."*
- *"Yes, I would attend the events if it interests me. This would make me aware of events I don't know about and motivate me."*

V. Appendix

A. Prox- User Testing Briefing Session

Thank you for coming in today to help me improve a product with your valuable feedback. My name is Malvika and I'm a final year MS HCI student in SoIC. To give you a brief background, my HCI Capstone Project, **'Prox'**, is a location-aware app which senses the proximity to the bluetooth low energy beacons located on campus. It then sends you notifications for all the events happening on campus.

In this session, you will be giving me an initial feedback of the prototype. Remember, I am here today to test the system and NOT YOU, so there's nothing wrong you can do here. If at any point you feel tired or uncomfortable proceeding with the session, you are free to leave. After the initial feedback, we would select a testing day for you. Then, I'm going to ask you to install the prototype on your mobile phone. At the end of the testing day I would schedule a short interview with you and ask you to fill a 10-question survey. If at any point during the session you have any questions, feel free to ask them. I would also request you to think aloud as you are going through the prototype. Once again, I thank you for taking some time out of your busy schedule to help me evaluate this prototype. If you do not have any other questions, we can proceed with the first round of introductory questions.

Background Questions

Let us start with some preliminary background questions before working with the system.

- How often do you attend events on campus?
- What kind of events do you attend? Do you prefer to attend events alone or with others?
- How do you currently receive information about the event? Word of mouth, Social network, email, bulletin board etc.
- What type of technology do you currently use like smartphones, tablets, laptops etc.?
- Do you keep services like Wi-fi, Bluetooth, GPS, 3G etc. on on your phone? If not, why? Would you be willing to keep these services on if they give you enough value?
- Are you familiar with any location-aware apps or technology? Have you heard/read/know about apple's ibeacon or estimotes? If yes, have you ever tried using it?

B. Informed Consent Form

Please read and sign this form before you proceed to the user testing session.

Thank you for participating in this session!

This study is for a graduate-level Human-Computer Interaction capstone course at IUPUI taught by Dr. Anthony Faiola.
Participation in this study is voluntary. You can withdraw your consent to the experiment and stop participation at any time.

All information will remain strictly confidential. The descriptions, recordings and findings will only be shared amongst persons directly involved within this study and may be used to help improve the product further. However, at no time will your name or any other identification be used.

There are no substantial benefits and rewards for your participation in this study. Additionally, there are no risks anticipated with participation in the study.
If you have any questions, please contact Malvika Bansal at bansalm@iupui.edu.

I have read and understood the information on this form and had all of my questions answered.

Date: _____

_____
Subject's Signature

Malvika Bansal
_____
Investigator

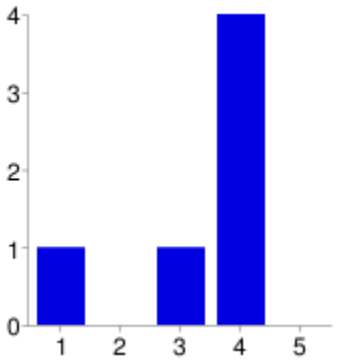
C. Post-Test Questionnaire

When a System Usability Scale is used, participants are asked to score the following 10 items with one of five responses that range from ‘Strongly Agree’ to ‘Strongly disagree’:

- I think that I would like to use this system frequently.
- I found the system unnecessarily complex.
- I thought the system was easy to use.
- I think that I would need the support of a technical person to be able to use this system.
- I found the various functions in this system were well integrated.
- I thought there was too much inconsistency in this system.
- I would imagine that most people would learn to use this system very quickly.
- I found the system very cumbersome to use.
- I felt very confident using the system.
- I needed to learn a lot of things before I could get going with this system.

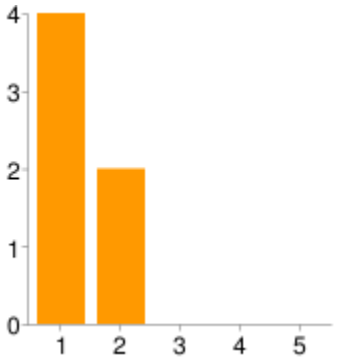
D. SUS Questionnaire and Responses Summary

I think that I would like to use this product frequently.



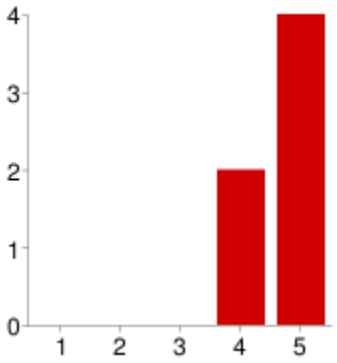
1	**1**	16.7%
2	**0**	0%
3	**1**	16.7%
4	**4**	66.7%
5	**0**	0%

I found the product unnecessarily complex.



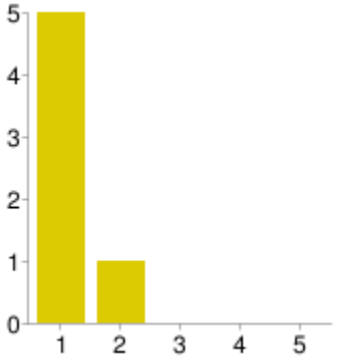
1	**4**	66.7%
2	**2**	33.3%
3	**0**	0%
4	**0**	0%
5	**0**	0%

I thought the product was easy to use.



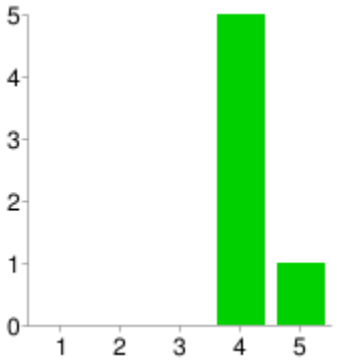
1	**0**	0%
2	**0**	0%
3	**0**	0%
4	**2**	33.3%
5	**4**	66.7%

I think that I would need the support of a technical person to be able to use this product.



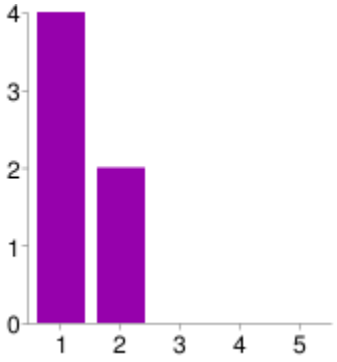
1	**5**	83.3%
2	**1**	16.7%
3	**0**	0%
4	**0**	0%
5	**0**	0%

I found the various functions in this product were well integrated.



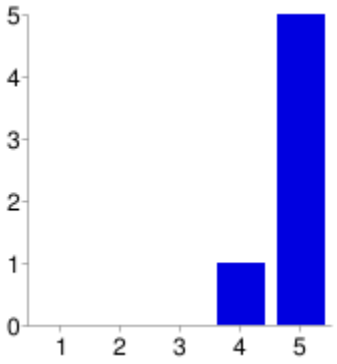
1	**0**	0%
2	**0**	0%
3	**0**	0%
4	**5**	83.3%
5	**1**	16.7%

I thought there was too much inconsistency in this product.



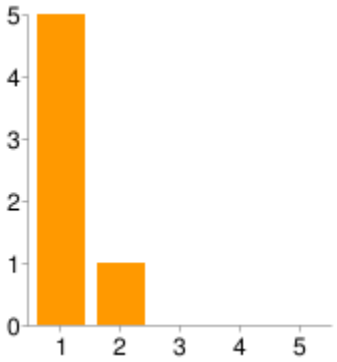
1	**4**	66.7%
2	**2**	33.3%
3	**0**	0%
4	**0**	0%
5	**0**	0%

I would imagine that most people would learn to use this product very quickly.



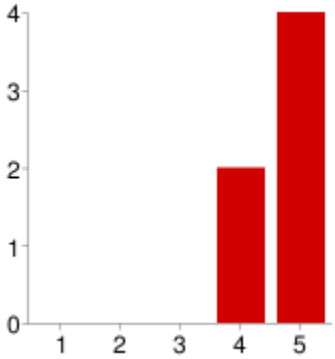
1	**0**	0%
2	**0**	0%
3	**0**	0%
4	**1**	16.7%
5	**5**	83.3%

I found the product very cumbersome to use.



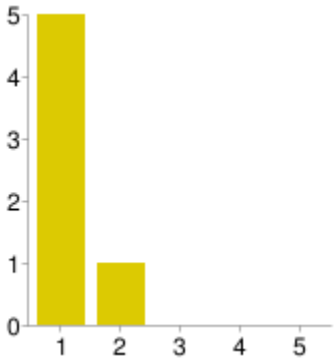
1	**5**	83.3%
2	**1**	16.7%
3	**0**	0%
4	**0**	0%
5	**0**	0%

I felt very confident using the product.



1	**0**	0%
2	**0**	0%
3	**0**	0%
4	**2**	33.3%
5	**4**	66.7%

I needed to learn a lot of things before I could get going with this product.



1	**5**	83.3%
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