Interactive Public Display

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1. INTRODUCTION

Public displays are ubiquitous. They can be seen in many public locations including malls, schools, and coffee shops. Public displays share these common characteristics:

- They appear in public places (as mentioned above)

- Their locations are usually fixed (not portable)

- They are usually large in size

- People pass by or gather around the display

- There are limited interfaces. Keyboards, touch screens are usually not provided

- No internal memory available (it is just a screen)

With those characteristics, public displays are often being used as a screen to display content. It could be static content like posters, images and Ads; or it could be dynamics content like news channels, trends or music videos. However, public displays are not necessarily aware of its surroundings. Most importantly, displays don't respond to the presence of people. In other words, public displays are not interactive. For instance, a public display in a mall could show music videos of Justin Bieber all day long, even though none of the people in the mall is a Belieber[1].

2. OBJECTIVES

The objectives of this project are to make public displays interactive. We set different scenarios, such as cocktail parties where people mostly mingle with others; or a coffee shop where people standing in line waiting to order. Specifically, we hope to achieve two goals. First, we would like to encourage interaction between people and display, and also to make displays and people aware of each other's presence. Second, we would like to foster interaction between people and encourage discussion.

In order to engage people, we started with designing an application that should attract people's attention. Many ideas were emerged, such as developing games or tools that will allow people to participate in activities. We believe that game is an efficient way to gather people's attention in a short period of time, hopefully in a pleasant way also.

The objectives of the game are very simple. It allows people to interact with display and promote interaction between people quickly. Since we set up our game in scenarios like cocktail parties and coffee shops, where people are usually occupied, we want to make sure that players can join the anytime. Moreover, players shall not feel obligated to stay in the game; she/he should be able to leave the game anytime. In additional, the game should not be too intellectual or difficult to play.

We conducted a series of brainstorming and came up with several game ideas, such as action game (e.g., darts, basketball), gambling game (e.g., roulette), word puzzle game and trivia game. We later realized that action requires too much commitment to the game and space for movement, which doesn't suit our scenarios; puzzle game involves too much intelligence and it is time consuming; whereas gambling game is basically random guess. As a result, developing trivia game(s) was a favorable idea.

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3. GAME IDEAS

To generate a sourceful question pool for trivia game, we utilized Google APIs, which provide ample useful information.

3.1 Battle of Cities

Google radar search (part of Google Places APIs) provides number of a certain type of places (e.g., restaurant, bakery) in a given area. With this information we can develop a trivia game that is based on numbers of places in different cities. Here is a sample questions: Which city has more bars,

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[*]This author will be graduating soon.

[†]This author will be graduating soon.

[‡]This author still has a lot to suffer.

[1]A huge Justin Bieber fan.

New York City or Shanghai?

We select more than 10 high-profile cities in both the eastern and western atmosphere and 80 place types to generate questions.

3.2 Translator's Dilemma

Google translate game idea was emerged when browsing a website called Translation-telephone, which is similar as the traditional "Telephone" game, where people pass a message around a circle and see how it turns out at the end [1. Reference the website]. In the translation-telephone, a message gets translated to random languages and back to original language.

We thought it is an interesting and wanted to develop a game based on it. Google Translate is one of the most widely used translate engine, is a great tool to use in this game. In the same way as translation-telephone, we select random collection of languages and use Google translate API to generate translations. In addition, we have two collections (paths) of languages and provide one final translation. In the end, players will get to choose which path the final translation is coming from.

4. PRELIMINARY DESIGN

5. DESIGN GUIDELINES

Table 1 summarizes the design guidelines we hope will help in the design of games for interactive public displays.

The design guidelines were formulated based on user feedback and results from a user study that was conducted as part of the live deployment. We also used the results of the user study to evaluate if we met the objectives of the game. The study responses were scale responses scaled from 1 to 10. We normalized the scaled responses to standard[1]. In simple terms, the percentage calculated from the z-score represents the percentage of responses that are greater than or equal to the benchmark selected during the z-score calculation. We have selected a benchmark of 8 for the scale from 1 - 10.

In the following subsections, we discuss each design guideline and the user study related to the guideline.

5.1 The questions should be intuitive or easy to understand;
The answers should be correct or logical

The first question we asked participants was, "How easy is it for you to understand the objective of the game?". Figure 2 shows the the responses for the game Battle of Cities and Figure 3 is the responses for Translator's Dilemma.

37.98% of the participants felt that the Battle of Cities game was easy to understand. This was primarily because the question was quick to read and easy to understand. There was higher participation in the game as a consequence.

Compared to Battle of Cities, only 13.85% of the participants felt that Translator's Dilemma game was easy to understand. As mentioned before Translator's Dilemma game is based on the "Telephone" game. During the user study we noticed that it was very hard for participants to understand the objective of the game as most of them had not played the "Telephone" game before. The question text was also long and complex in this case.
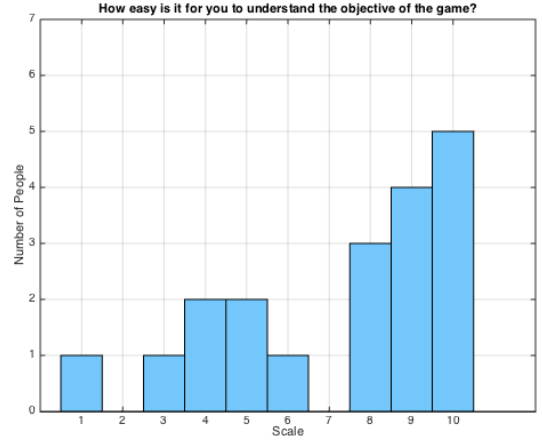

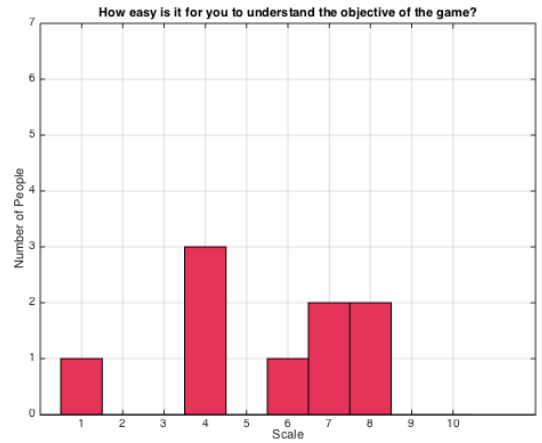Figure 2: Battle of Cities - How easy is it for you to understand the objective of the game?

Figure 3: Translator's Dilemma - How easy is it for you to understand the objective of the game?
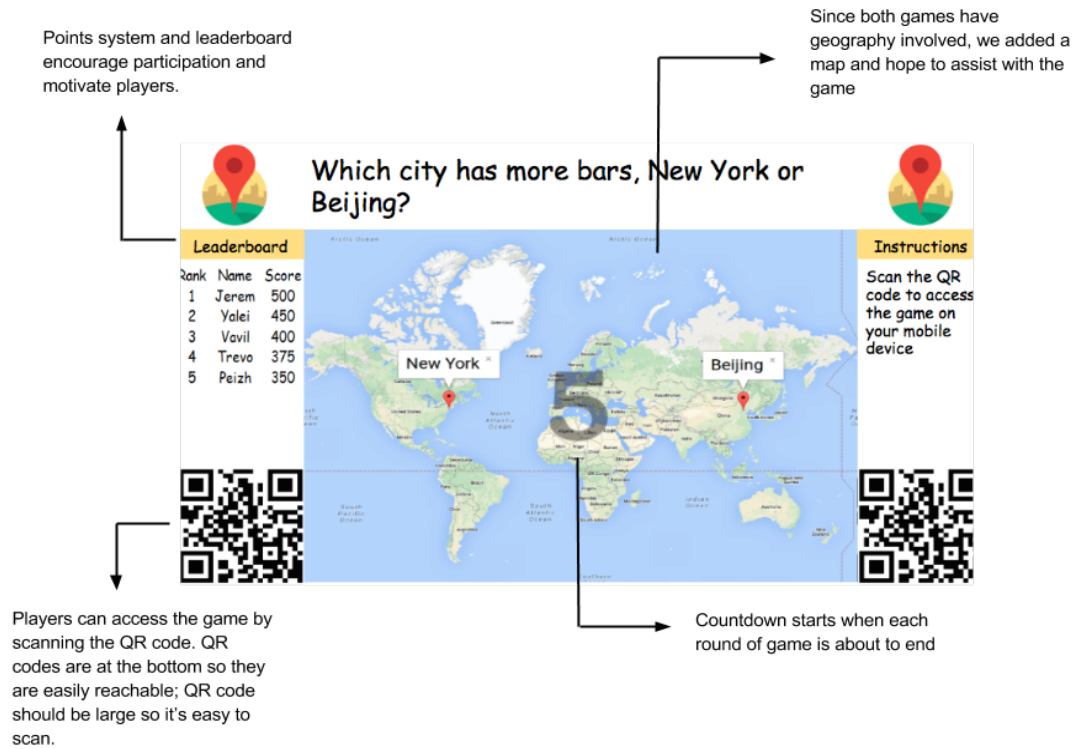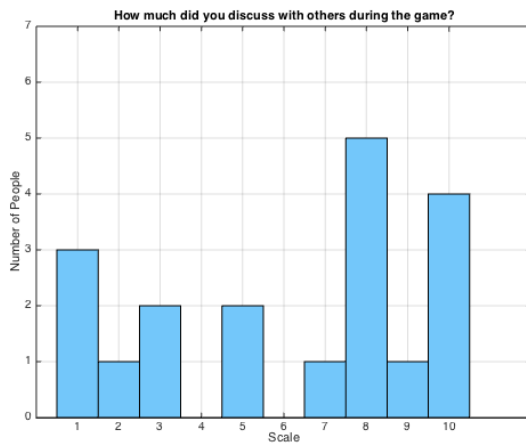
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Figure 1: Preliminary Design

Figure 4: Battle of Cities - Did you discuss with others during the game?

Figure 5: Translator's Dilemma - Did you discuss with others during the game?

The following question we asked participants was, "Did you discuss with others during the game?". Figure 4 shows the the responses for the game Battle of Cities and Figure 5 is the responses for Translator's Dilemma.

27.30% of participants discussed with others during the Battle of Cities game and 22.93% of the participants discussed with others during the Translator's Dilemma game. Knowledge of popular cities is common and there is enough time to discuss after deciding on the answer, therefore there is comparatively higher percentage of participants that dis-
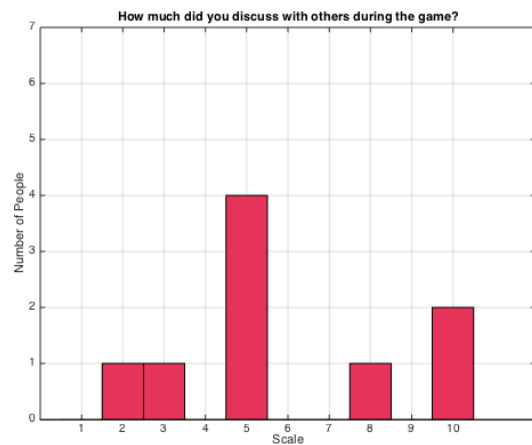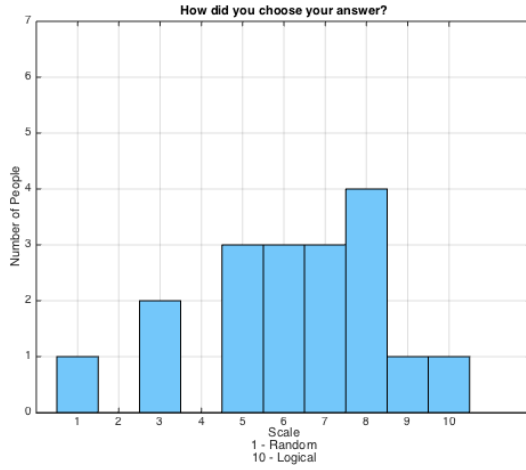
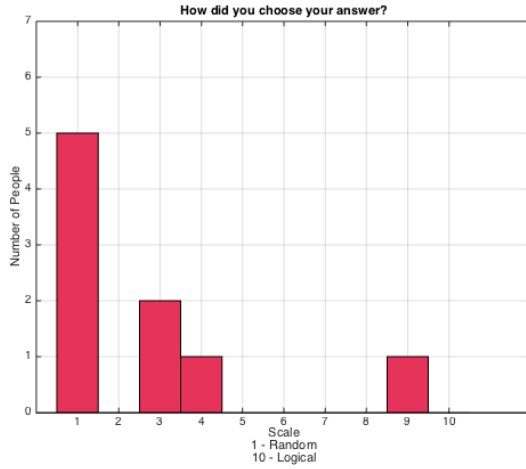Figure 6: Battle of Cities - How did you choose your answer?

Figure 7: Translator's Dilemma - How did you choose your answer?

cuss during the game. Whereas in the translator's dilemma game, knowing all languages in the list is highly unlikely. The question is also long and complex so there is no time to discuss the results.

During the user study we also noticed that all participants were surprised with answers that they thought were fairly obvious. The discrepancy happens as Google Radar search does not enough data to return answers that match user expectations. This causes participants to lose interest in the game. The above observations logically lead us to the following design decisions mentioned previously.

5.2 Strike a balance between guess work and logical thinking

We asked the participants, "How did you choose your answer". Scale 1 meaning random and scale 10 being logical. Figure 6 shows the the responses for the game Battle of Cities and Figure 7 is the responses for Translator's Dilemma.

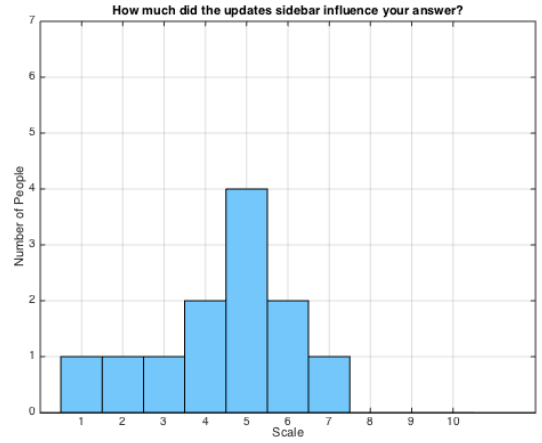21.54% of the participants in the Battle of Cities game felt

Figure 8: Battle of Cities - How much did the updates sidebar influence your answer?

that they chose the answer logically. This is mainly because the game itself has cultural and geographical hints that helps users logically guess the number of places of a type in the given locations.

Only 2.19% of the participants of Translator's Dilemma game felt that they chose the answers logically. It is highly unlikely that a participant knows all languages that are in the question. The answer is also based on analyzing text rather than comparing numbers.

The above study leads us to believe that there should a good mix of logical thinking and guess work to encourage interaction among participants.

5.3 Attention span of users is limited. The timing between rounds of games has to be reasonable

During the course of the user-study we observed that the timing between rounds in the game is a very important factor to keep participants engaged to the game. If the time is too long, participants get distracted from the game. If the time is too short, participants do not get time to interact with each other.

The timing has to be adjusted based on the game too. There is no "one size, fits all" solution. For instance, the time for the Translator's Dilemma game was 10 seconds more than that allotted for the Battle of Cities game owing to the difficulty of the Translator's Dilemma game.

5.4 Make sure the player knows the status of the game at all times

We have a dynamic updates sidebar in the game that gets updated in real-time with messages about user activity including "player joined", "player submitted answer" and "player changed answer". We asked participants, "Did you look at the updates sidebar?". 68.42% of the participants of Battle of Cities game and 77.77% of the participants of Translator's Dilemma game noticed the updates. Both games have a high number which leads us to believe that it is an important feature for interactive displays.

The follow up question asked participants, "How much did the updates sidebar influence your answer?". Figure 8 shows
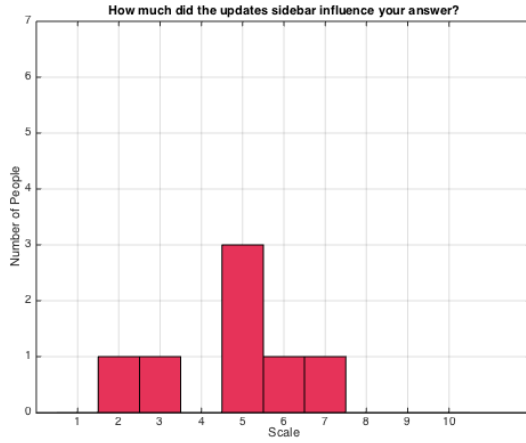
Figure 9: Translator's Dilemma - How much did the updates sidebar influence your answer?

the the responses for the game Battle of Cities and Figure 9 is the responses for Translator's Dilemma.

Surprisingly, only 1.47% and 2.69% of the participants in Battle of Cities and Translator's Dilemma game were influenced by the updates. This means that the updates bar primarily served as an activity monitor that provides feedback on user actions. The fact that a majority of the users noticed the updates but did not get influenced by it shows that it is very important to let the participant know what is the status of the game at all times.

In our prior design, we did not have a timer on the device that showed the time left in the current round. Lot of the participants were confused about what was happening after they selected their choice. The timer on the device helped alleviate this confusion.

5.5 Players should be motivated

We asked participants, "Do you want to be on the leaderboard?". Figure 10 shows the the responses for the game Battle of Cities and Figure 11 is the responses for Translator's Dilemma.

28.53% and 22.8% of the participants from the Battle of Cities and Translator's Dilemma game want to be on the leaderboard respectively. Battle of Cities has comparatively higher number as the game itself is easier and leads to more participation. The difficulty of the Translator's Dilemma game discouraged participation and there was no incentive to be on the leaderboard. This observation leads us to believe that participants should be motivated to participate. Points system and leaderboard encourage participation and motivate players.

6. LESSONS

Do not underestimates the efforts to implement web page on mobile devices. The challenge of making a fluid UI is to deal with different resolutions of screens. A basic solution is using relative units such as em or percent(%) instead of pixels(px). However, in deployment we found out that since the dimensions of the screen itself is different, the UI is not consistent across all screens. To handle the problem of different screen dimensions we used viewport, which
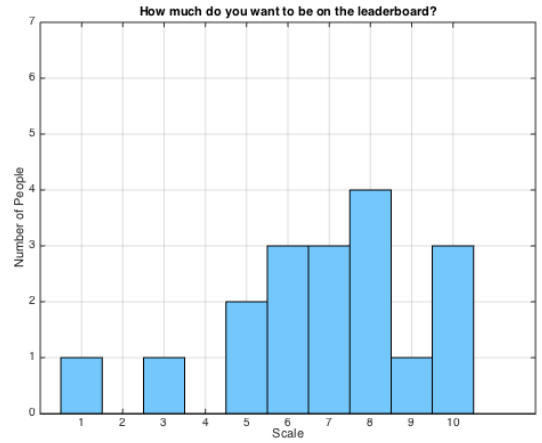

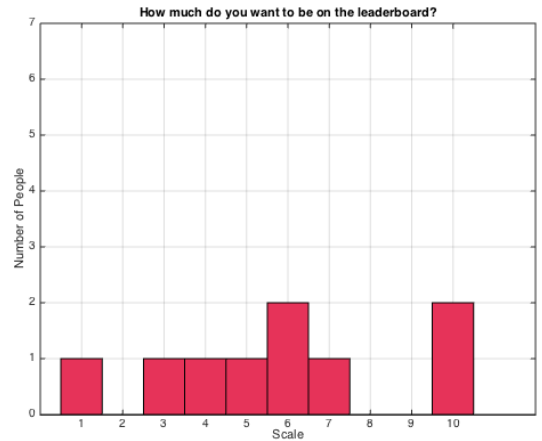**Figure 10: Battle of Cities - Do you want to be on the leaderboard?**

Figure 11: Translator's Dilemma - Do you want to be on the leaderboard?

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arranges elements by the actual size of the screen. Users may hold the device in different orientations too. We used CSS media query to detect the orientation of the devices and then display the elements on the screen. Even though we spent a lot efforts in device UI, the UI is not consistent on old devices.

Public display should be self-configurable. Initially, the URL of the backend server was hard-coded to ensure users can connect to backend servers. And the QR code was static. Consequently, when the backend server is deployed in another location, all those static components need to be configured before deployment. A solution to ease deployment is to leverage the information that web browser is aware of where the page is loaded from.

Long-duration deployment discloses bugs. The potential bug isn't revealed until long duration deployment. In deployment, the problems may arise from unreliable dependencies, race conditions between multiple players operating at the same time etc.

Fault-tolerance at public display. In the deployment, we often don't have the direct control over the public display. The display may lose the connection with the server, in which situation the public display should be able to reconnect to backend server. If bugs are found in the frontend page, the display needs to reload the web page. A script which periodically reloads the web page is helpful in deployment.

Backend server should be publicly addressable. A common mistake in deployment is to deploy the backend server with a private IP address. Due to the NAT problem, only the devices that are in the same network can access the game. Therefore, a public addressable interface is essential to the backend server.

Alternative to allow device to access the game. In the deployment, we assumed that users will scan the QR code to find the game. It turned out that most of devices were not equipped with QR code scanner and players are reluctant to install one. Alternative way such as tiny URL is helpful.

Carefully choose the place to conduct user study. The place of deployment was in a student common area. Students mostly were in a rush. The unsolicited involvement was low.

6.1 References

Generated by bibtex from your .bib file. Run latex, then bibtex, then latex twice (to resolve references) to create the .bbl file. Insert that .bbl file into the .tex source file and comment out the command \sigproc.

7. REFERENCES

[1] Standard score, Feb 2015.
[2] Mic Bowman, Saumya K. Debray, and Larry L. Peterson. Reasoning about naming systems. *ACM Trans. Program. Lang. Syst.*, 15(5):795–825, November 1993.
[3] Malcolm Clark. Post congress tristesse. In *TeX90 Conference Proceedings*, pages 84–89. TeX Users Group, March 1991.

Table 1: Design Guidelines Summary

Aspect	Lesson
Content	The questions should be intuitive or easy to underst
	The answers should be correct or logical
	They are usually large in size
	People pass by or gather around the display
Player Perception	Attention span of users is limited. The timing betw
	Make sure the player knows the status of the game
	Players should be motivated