City Explorer: Gamifying Public Transit Trips While Exploring the City

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Abstract
Many people use public transit on a recurring basis to travel for work, school, or other activities. Yet rides can be isolating despite encountering the same people on a regular basis. We designed City Explorer, a city exploration transit game, to provide transit riders with a channel to strengthen the sense of community. In City Explorer, players collect points as they ride public transit. They can complete route-specific challenges and collaborate with other riders to multiply points by riding the same route. Players can also create geo-tagged posts to describe and share community-related information. We share our design requirements, followed by details of game features, and our implementation of City Explorer.

Author Keywords
Community, people, public transport, transit, mobile technologies, social computing, location-based games

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI)

Introduction
The idea of *community* is constantly changing, as people continue to experience, adapt, and shape the world around them. Many communities have developed

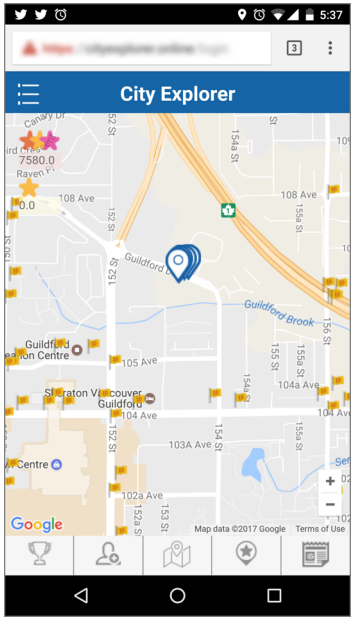

Figure 1: Home screen for City Explorer depicting player location and nearby transit stops within 100m.

a set of practices that represent connectivity and solidarity with others [2,6]. We see these practices appearing within rural towns and city neighborhoods with the desires to be aware of the happenings and activities within one's environment and city [12]. For example, people are often interested in knowing about upcoming events or sharing ideas concerning their neighborhoods. We also see the social phenomenon of *Familiar Strangers*, individuals that we regularly encounter but do not necessarily interact with [15]. An example of a Familiar Stranger is a person one sees on a public transit bus every morning. Our research focuses on one aspect of community, which is the use of public transportation within a metropolitan city. That is, we are interested in the social behaviors of individuals who share similar bus or train routes that may span multiple neighborhoods of a city.

Social computing offers new ways for public transit authorities to interact with transit riders. Real-time sharing and visualizations of transit bus stops and arrival times have been found to be valuable [1,2,7]. A recent study found opportunities for a co-designed system where people are encouraged to share their personal narratives with the transit service provider [17]. Systems have also been developed that allow commuters to engage in multiplayer games with others traveling on the same route [17,18]. Findings from evaluations of such systems offered several influences on game design, including the length of game sessions and the start and end times of the game. Our system was built with the influence focused more on the player's geographic location and collocation with others. Specifically, we were interested in exploring how players determine when to play individually or collaboratively, and how a game might foster new social connections.

We designed and developed a mobile game called City Explorer (Figure 1) that enables transit riders to explore areas of the city during their travels. The game encourages the sharing of user-generated content related to their transit trips. It also offers incentives for players to explore the city, with bonuses for doing so collectively. In turn, players collect game points which can be redeemed for tangible prizes from the transit authority (e.g. bus tickets or monthly credit for transit passes). In the following sections of the paper, we present related literature, describe the design and implementation of City Explorer, and then discuss how we imagine people will use the game, including any foreseeable concerns that may arise.

Related Work

Studies have explored how digital technologies can provide a communication channel for people to connect with others and with public agencies [9,10,12]. Similar to how Web 2.0 tools have brought a more participatory Internet experience, technologies within a community should be useful in connecting a diverse and mobile population [9]. Ubiquitous computing technologies offer people access to place-specific information, with everyday technology become smaller, embedded, and accessible anywhere. Therefore, making real-time information available facilitates a major transformation of the way we perceive, understand and subsequently travel through city spaces. While social media can support opportunities for engagement, community members are sometimes concerned with privacy and security [11]. Mobile systems and location-based games have been successful in linking people with

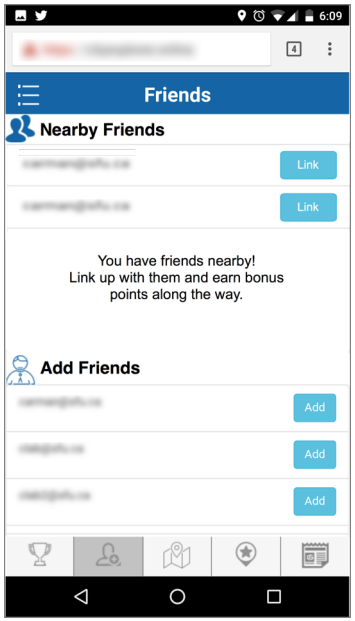

Figure 2: Friends are detected within 150m of the player's location. Once linked, friends become multipliers, earning linked players bonus points for a shared commute.

community information and providing access for people to retrieve, capture, and share information [3,9,10].

Prior work has also explored opportunities for enhancing the experience for transit commuters, both before and during their journey [8]. TrainRoulette is a mobile app designed to encourage situated, real-time chats between train commuters [4]. An evaluation of the system showed that passengers were interested in their collocated passengers, including what they do and their interests. Here we see that social interactions between strangers is valuable, and that limiting such interactions to a physical space (i.e. transit bus) has advantages.

Given this, our research interest focused on designing a system that would connect riders to location-based community information as they travel. To further explore the opportunity to understand the social interactions between both strangers and friends, we designed a transit game that can be played individually or collaboratively. We hope to better understand how the sense of community is built Next, we describe the design process for City Explorer.

The Design of City Explorer

Our primary goal was to design a mobile game that would allow people to connect with their community and enjoy their transit experience. City Explorer is a city exploration transit adventure game designed in partnership with Translink, the transit authority for the Greater Vancouver area in Canada. Players compete to earn the highest number of total points by traveling via transit (Daily Play) and/or travelling to a specific destination (Challenge Play). The goal is to have players use the game as part of their daily commutes.

Design Requirements

We began our design process by reflecting on prior work around transit commuter experiences and community awareness. We were also inspired by board games such as Ticket to Ride, the popular mobile app, Foursquare, and Facebook. Based on this literature and existing technologies, we decided on three design requirements for our game.

Location-Based

Many studies have identified the need to design for mobility as people move throughout their day [3,5,16]. Users' searches on their mobile devices are highly influenced by geographic location, such as within the vicinity of their current location, while in transit, or about information related to their destination [5]. As such, we wanted to incorporate location detection and geotagging of community information. Our mobile game enables place-based communication and flexibility to connect when and where needed.

Social Collaboration

Prior work has also shown interest in people learning more about others who are in transit with them or who frequent the same areas [4,14]. Requirements are different for systems that facilitate communication between people who are based in the same physical area. People are close enough so that they can meet in person if they wish. For this reason, we needed to balance the affordances of playing individually or collaboratively. We wanted to address potential privacy concerns people may have with location detection and/or sharing, while preserving the ability to connect with those in close proximity.

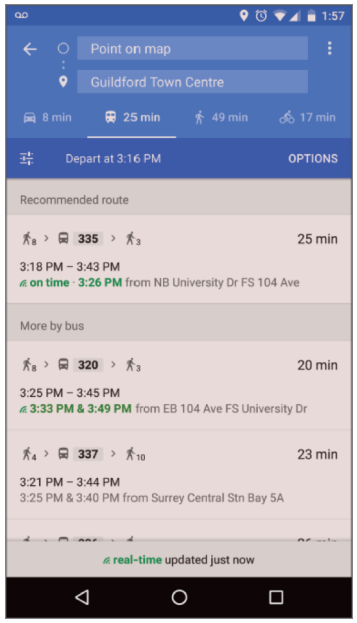

Figure 3: Challenges are based on the player's geographic location and the number of transit vehicles required to arrive to the challenge destination.

Community Engagement

Existing digital tools, such as social media, have been shown to connect neighborhoods and support community engagement [13]. However, often, the amount of information is overwhelming to navigate [13]. Our aim was to leverage the ease of posting geo-tagged information users may already be familiar with in using existing social media tools, such as Facebook or Twitter. While our game borrows the 'posting' mechanics seen in these tools, our interests surround how surfacing this information based on one's exact location may influence behaviors. For example, what types of information do people consider valuable for others in the area? How can we support creating and sharing user-generated content specific to one's transit ride?

Considering these design requirements, we then iteratively designed and developed the game. City Explorer contains five main screens: Map, Friends, Challenges, Posts, and Leaderboard. We discuss each of these next.

Map

City Explorer's map is the home screen for the game (Figure 1). Once signed in, the game detects the player's location and nearby bus stops within a 100m radius. Each bus stop offers potential points (marked on the orange flags) that can be earned by passing by the bus stop. Once the player passes the stop, the flag disappears and the player earns the points marked.

A player can only earn points for a stop every 30 min. This parameter was set to restrict players from earning duplicate points for the same stop while they were waiting for the bus to arrive (we determined the expected maximum wait time for a bus to be 30 min).

Friends

To meet our design requirement for social collaboration, players can build and access a Friends list for those who have set their visibility to "ON". Players can choose to add friends (this request can be accepted or declined). Players with visibility set to "ON" will show up in their Nearby Friends list, only if they have been successfully added as a friend and if they are within a 150m range (Figure 2). This range was determined by our estimation of the average length of transit buses, trains, and/or terminals. Players can choose to link with nearby friends within this range.

We recognize that some players may have concerns with having their location be known to others. To respect such concerns and to support individual play, we included a setting where players can set their visibility to "OFF". This would hide their location from other players, rendering them invisible in the game.

Accepted friends within a 150m range become "multipliers" for their shared trip in Daily Mode. This means travelling with one friend along the same route will yield both players x2 points (travelling with two friends = x3, three friends = x4, etc. to a maximum of 8 friends). Thus, even though the game is competitive, there is an advantage to periodically collaborating with others.

Challenges

Another feature of our game offers challenges to players based on their geographic location. Details of all possible challenges for the player will display on the screen shown in Figure 3. It was our aim to challenge players to explore nearby areas, atypical of their daily routine. Challenges include routes with multiple stops and are predetermined in the game's design.

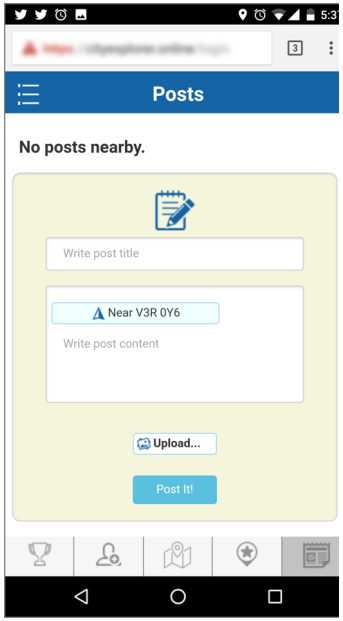

Figure 4: Players can add content to the game.

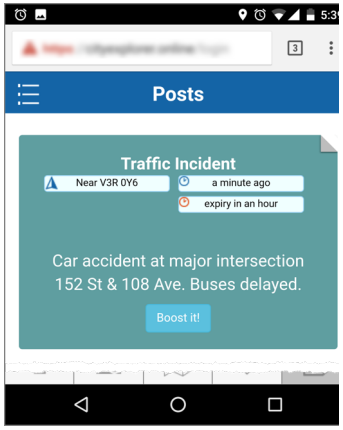

Figure 5: Players can boost posts to keep it active for another hour.

Many games employ a time limit to indicate how much time the player has to complete a level. We decided to set an expiry period based on the difficulty of the challenge: 2 hours (Easy), 6 hours (Medium), or 12 hours (Difficult). The number of points awarded with each completed challenge increases with the level of difficulty.

DIFFICULTY CALCULATION

Our game automatically determines the difficulty of the challenge based on the player's current location and a calculation of the number of vehicles (buses, train, sea bus) required for the player to arrive at the destination (Figure 3). An "Easy" challenge requires a player to use one transit vehicle (e.g. one bus) within a single trip. A "Medium" challenge requires more transit vehicles (e.g. one bus and one train) to complete the challenge. Finally, a "Difficult" challenge contains more transfers and changes of vehicles (e.g. two buses and two trains). As it is unlikely people will commute for more than 12 hours to arrive at their destination, we set this as the time limit for the most difficult challenge.

For example, Stanley Park (a large park in downtown Vancouver) may be "Easy" for a player currently located downtown as it is within 10 km away, but it may be "Difficult" for a player located in a suburb 40 km away as the routes may involve the use of multiple vehicles.

Posts

To support community awareness and discussions, we included the Posts feature in our game. Players can add content (text, links, photos, videos) within a 150m radius of their location (Figure 4). Content is then linked to its location. We set this radius to contain the news to the surrounding areas within which players travel, only surfacing the information to viewers when it is geographically relevant (e.g. they are close by).

We are interested in the types of information people choose to share with others during their transit commute. Because these posts are geo-tagged and related to the players' locations (e.g. traffic condition, road detours, or construction, etc.), we set a default expiry period of one hour for all posts. Players can "Boost" a post to keep it active for another hour (Figure 5). This allows any City Explorer players to determine the value of community information and whether it needs to remain available for others to view past the hour. For example, a traffic incident may only be needed for the hour whereas a petition for enhanced park security may need to remain active for a number of days. Boosting can only be done every 12 hours by a player for a post (this prevents players from continuously boosting the same post).

Leaderboard

City Explorer's Leaderboard allows players to see how they rank amongst other players (Figure 6). The Leaderboard displays the *All Time Ranking* for the lifetime of the game for the top 10 players. It also shows *Today's Ranking* for the past 24 hours for the top 10 players. This offers players a sense of in-time competition to increase their engagement with the game.

Usage Scenarios

Next, we offer two usage scenarios to further explore the potential experiences we imagine City Explorer offers.

Scenario 1: Karen is on her way to work. She launches City Explorer which automatically geo-tags her current location and follows her as she walks to her usual bus stop. While waiting for the bus, she accepts the (easy) challenge for the day, which has her stopping at the new coffee shop that opened two blocks from her work. As she travels on the bus, she earns points for each bus

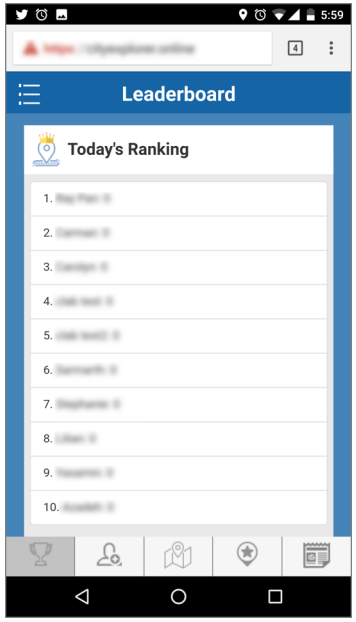

Figure 6: Players can see how they compare to others in the game.

stop passed. She checks the leaderboard to view her points balance, which has a running total of 760 points. She is currently in 17th place, with the 1st place player having accumulated 1,320 points. After picking up her morning coffee, she earns 570 bonus points for completing her challenge.

Scenario 2: Roger and Kyle are at the central transit exchange downtown, waiting for their train to head to school. They are acquaintances, having seen each other on their daily commute since the beginning of the semester. Roger asks Kyle if he may add him as a friend on City Explorer so that they can receive double the points for their ride to school. Kyle accepts his friend request. They board the train and begin collecting points as they pass each station. Instead of individually earning 380 points for their commute, they have now each earned 760 points. When they arrive at their destination, they are notified with a City Explorer post that a student bake sale is happening that afternoon. The post is set to expire in 35 min. Kyle boosts this post, keeping it active for 1hr 35 min, hoping other students stay informed of the sale.

Implementation

City Explorer was built as a web application that users access through their mobile phone browser. The front-end of the game was developed using a combination of HTML5 and JavaScript. The back-end of the game is built with Spring MVC, AJAX, and Tomcat. It also integrated data from Translink's existing Open API (General Transit Feed Specification) to provide transit data, including bus stops, train stations, routes, and schedules. We then designed our database using MongoDB to store the locations of the stops and added a geographic index for calculating the distance for challenges. The records of users were also stored in a remote MongoDB server. Finally, the geolocation detection of the user was implemented through the HTML5 API for accessing the current GPS data.

Discussion and Conclusion

The system design presented in this paper describes a platform in which players can connect with others in their community and enhance their transit experience. City Explorer also offers a new way for players to add, review, and promote contextually relevant information related to their community and tied to transit routes. We leveraged common social media tools, such as the geo-tagging features from Twitter and Facebook, and the location-detection feature from Foursquare, to design a transit adventure game. We believe that by providing players with the option to play individually or collaboratively, we are designing to allow people to play within their own comfort while in transit (i.e. anonymously or collocated with other players).

While we do hope that people will use City Explorer on a regular basis as they travel to and from their homes, we recognize that we have only scratched the surface with respect to privacy. We foresee this as an important area to pursue, especially as the game has built-in location detection and maps the players' routes. In future work, we plan to explore what specific privacy concerns may arise while users are playing the game. Finally, we want players to consider stepping outside of their daily routines and exploring other areas of the city via transit. We hope that an evaluation of the system will enable us to further explore any social behaviors and patterns that may surface.

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References

1. Hannah Bast, Patrick Brosi, and Sabine Storandt. 2014. Real-time movement visualization of public transit data. In *Proc. of the 22nd ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems* (SIGSPATIAL '14). ACM, New York, NY, USA, 331-340.
2. James Biagioni, Adrian Agresta, Tomas Gerlich, and Jakob Eriksson. 2009. TransitGenie: A context-aware, real-time transit navigator. In *Proc. of the 7th ACM Conference on Embedded Networked Sensor Systems* (SenSys '09). ACM, New York, NY, USA, 329-330.
3. Anne E. Bowser, Derek L. Hansen, Jocelyn Raphael, Matthew Reid, Ryan J. Gamett, Yurong R. He, Dana Rotman, and Jenny J. Preece. 2013. Prototyping in PLACE: A scalable approach to developing location-based apps and games. In *Proc. of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '13). ACM, New York, NY, USA, 1519-1528.
4. Tiago Camacho, Marcus Foth, and Andry Rakotonirainy. 2013. TrainRoulette. *In Proc. of the 2013 ACM Conference on Pervasive and Ubiquitous Computing Adjunct Publication* - UbiComp '13 Adjunct, ACM, New York, NY, USA.
5. Karen Church, Barry Smyth, Paul Cotter, and Keith Bradley. 2007. Mobile information access: A study of emerging search behavior on the mobile Internet. *ACM Trans. Web* 1, 1, Article 4 (May 2007).
6. Karen Evans. 2013.(January 2013). Re-Thinking Community in the Digital Age?. In Digital Sociology. (pp.79–94). Retrieved from http://www.palgraveconnect.com. /pc/doifinder/10.1057/9781137297792.0011
7. Brian Ferris, Kari Watkins, and Alan Borning. 2010. OneBusAway: Results from providing real-time arrival information for public transit. In *Proc. of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '10). ACM, New York, NY, USA, 1807-1816.
8. Marcus Foth and Ronald Schroeter. 2010. Enhancing the experience of public transport users with urban screens and mobile applications. In *Proc. of the 14th International Academic MindTrek Conference: Envisioning Future Media Environments* (MindTrek '10). ACM, New York, NY, USA, 33-40.
9. Marcus Foth, Ronald Schroeter, and Irina Anastasiu. 2011. Fixing the city one photo at a time: Mobile logging of maintenance requests. In *Proc. of the 23rd Australian Computer-Human Interaction Conference* (OzCHI '11). ACM, New York, NY, USA, 126-129.
10. Craig H. Ganoe, Harold R. Robinson, Michael A. Horning, Xiaoyan Xie, and John M. Carroll. 2010. Mobile awareness and participation in community-oriented activities. In *Proc. of the 1st International Conference and Exhibition on Computing for Geospatial Research & Application* (COM.Geo '10). ACM, New York, NY, USA, Article 10, 8 pages.
11. Paul T. Jaeger, John Carlo Bertot, and Katie Shilton. 2012. Access perspectives and design values in government social media usage. In *Proc. of the 13th Annual International Conference on Digital Government Research* (dg.o '12). ACM, New York, NY, USA, 216-222.
12. B. Joon Kim and Stephen W. Kleinschmit. 2012. A logistic multilevel model for civic engagement and community group impact in the digital age. In *Proc. of the 6th International Conference on Theory and Practice of Electronic Governance* (ICEGOV '12), J. Ramon Gil-Garcia, Natalie Helbig, and Adegboyega Ojo (Eds.). ACM, New York, NY, USA, 34-37.
13. Christina A. Masden, Catherine Grevet, Rebecca E. Grinter, Eric Gilbert, and W. Keith Edwards. 2014. Tensions in scaling-up community social media: A

multi-neighborhood study of Nextdoor. In *Proc. of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '14). ACM, New York, NY, USA, 3239-3248.

14. Carolyn Pang, Carman Neustaedter, Jason Procyk, Daniel Hawkins, and Kate Hennessy. 2015. Moving towards user-centered government: Community information needs and practices of families. In *Proc. of the 41st Graphics Interface Conference* (GI '15). Canadian Information Processing Society, Toronto, Ont., Canada, Canada, 155-162.
15. Eric Paulos and Elizabeth Goodman. 2004. The Familiar Stranger: Anxiety, comfort, and play in public places. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '04). ACM, New York, NY, USA, 223-230.
16. Jaime Teevan, Amy Karlson, Shahriyar Amini, A. J. Bernheim Brush, and John Krumm. 2011. Understanding the importance of location, time, and people in mobile local search behavior. In *Proc. of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services* (MobileHCI '11). ACM, New York, NY, USA, 77-80.
17. Daisy Yoo, John Zimmerman, and Tad Hirsch. 2013. Probing bus stop for insights on transit co-design. In *Proc. of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '13). ACM, New York, NY, USA, 409-418.
18. Nairan Zhang, Youngki Lee, and Rajesh Krishna Balan. 2015. Matchmaking Game Players On Public Transport. In *Proc. of the 2nd Workshop on Mobile Gaming* (MobiGames '15). ACM, New York, NY, USA, 31-36.