Face Card: An Information-sharing Framework on Google Glass

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Abstract  
Wearable devices such as Google Glass can provide an efficient way to get around users’ information. We present Face Card – a system builds on Google Glass to provide information-sharing service with around people. With a look at Google Glass, users can quickly get information of nearby and coming users. Utilizing Bluetooth Low Energy (BLE) and proper user interface, Face Card demonstrates the potential of being an efficient information sharing system framework.

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Wearable computers; information sharing; social networks;

ACM Classification Keywords  
H.5.2. Information interfaces and presentation: User Interfaces – Input devices and strategies.

Introduction and Related Work  
Nowadays, people are used to sharing information via social networks, emails, and other Internet services. All of these services are built on personal computers such as mobile phones, tablets, desktops, and laptops. However, as ubiquitous and wearable computing becomes popular, wearable computers such as Google Glass emerged. Based on characteristics of wearable computers, what kind of new information-sharing
interaction can be built and how to provide a socially acceptable and efficient information-sharing service is open problem.

Previously, Starner [1] propose the Augmented Reality through Wearable Computing System. The system utilizes face recognition and overlays the returned name and useful information about the person. The effect is similar to Figure 1[2]. NameTag[3] is a similar system based on Google Glass. However, because face recognition requires strict condition such as distance and angle, both Starner’s work and Nametag are not practical. Instead of identifying people via face recognition, researchers [4] investigate using wireless signals to identify users or their devices and building a social context. The social context is only based on mobile devices.

Based on previous research, we build Face Card, a social context system on Google Glass. Face Card utilizes wireless signals to identify users or their devices and displays name and useful information about users on Google Glass. Through Face Cards, users can get useful information on Google Glass. The useful information comes from other nearby users. From our pilot study of Face Card, we demonstrate Face Card is socially acceptable and promising. In the end, we discuss limitations and future work of Face Card.

System design and Implementation
As shown in figure 2, Face Card consists of five components: Mobile phone end, Google Glass end, server, web crawler, and database.

Mobile phone end
To pair Google Glass and utilize existing API, the mobile phone end is implemented solely on the Android platform. The mobile part provides two functions: communication and information management. There are three types of communication: phone-phone, phone-server, and phone-glass communication. The phone-phone communication is exchanging information between two phones, e.g. getting another phone’s Bluetooth ID. The phone-server communication includes querying information and receiving information from the server. The phone-glass information is sending information to paired Google Glass. In mobile phone end, users can manage information, which includes personal information, tags, posts, and linked social network accounts. Because Google Glass lacks an efficient input information, tags, posts, and linked social networks accounts. Because Google Glass lacks efficient input method, all of information management and input are in mobile phone end.

Google Glass End
At the Google Glass End, the main function is displaying information to users. To acquire displayed information, Google Glass needs to pair with a mobile phone and listen socket channel. Google Glass end receives and decodes coding information from mobile then displays it. To help users efficiently get information on Face Card, we design three kinds of views on Google Glass. Users can scroll backward and forward on Google Glass to select cards. In each of view, Google Glass shows eight face cards, four face cards, and one face card. Because the amount of information can be displayed on the Glass interface is limited, the more face cards are shown, the less personal information is shown. However, multiple face-cards-view provides more
options to users. Users can efficiently find the face card he or she wants to check. In later evaluation section, cards and personal information. Another open problem is about personal information shown on Google Glass and privacy issues related to it. In our implementation, face card shows user name, picture, academic position, and personal tags. This information can be changes based on social context. The privacy issues will be discussed in discussion part.

**Back end**

The back end includes server, web crawler, database, and a recommendation system. To make server and database of Face Card System reliable, we set server and database on the Amazon Elastic Compute Cloud (EC2). The server receives input information and social networks account information from mobile phone end. Web crawlers crawl users' profiles and posts from social networks. In the current implementation, Face Card only supports Google Plus. Database stores users' input, profiles, posts on Google Plus, and related Bluetooth ID. Another main function of the server is forwarding query from mobile end to the database and forwarding query results from the database to mobile. In each query, mobile sends a list of Bluetooth IDs to server in HTTP format. Server parses the list and queries database with each Bluetooth ID. After server collects all information related to Bluetooth ID from database, we prototype a recommendation system to order this information. The recommendation system provides better user experience by reordering face cards based on users' interests. A user can meets many users. Therefore, the mobile end sends multiple Bluetooth IDs to the server. However, the user is only interested in checking information of a few other users. To help users see interesting users in the highest priority, the recommendation system ranks nearby users based on users recent view history and interests match.

**Evaluation**

**User Interface**

Our goal is to test how quickly a user can find the face card he or she wants via the user interface. To evaluate the user interface, we recruited 16 participants. Participants are required to find a specific face card in three different views (one-card view, four-card view, and eight-card view) from different number (5, 10, and 20) of cards. To overcome bias, we use the within subjects design and ask participants repeat each task three times. The results are shown on Figure 4. The study shows that users prefer one-card view for five-card selection task and eight-card view for twenty-card selection task. This implies that user interface should adjust based on the number of face cards around. In the real world, Face Card should use eight-cards view in crowded space while one-card view in sparse space.

**Bluetooth latency**

As we described in system design and implementation section, the speed performance of Face Card mainly depends Bluetooth latency of discovering nearby mobile devices. To evaluate Bluetooth latency, we use Nexus 5 to discover other Nexus 5 devices via Bluetooth in Klaus Advanced Computing Building of Georgia Tech. From figure 4, we can see the average lower bound of Bluetooth delay is around 100ms, the average upper bound of Bluetooth delay is around 10,000ms, and the average of Bluetooth delay is 1,700ms. This implies that the average delay of showing around users face cards is no more than 2 seconds, which is socially acceptable.
Recommendation System
The recommendation system ranks face cards in order so that interesting face cards are shown in higher priority. To evaluate, we ask users to input their Based on users’ interests, the recommendation system re-orders 100 profiles in the system. Participants are required to check if they are interested in these profiles. We recruit four participants to perform this task. From figure 5, we see that prediction accuracy of the recommendation system is 75% in first five predictions. As the number of recommended people increases, the accuracy goes down.

Discussion and Future Work
Face Card is at the intersection of wearable devices like Google Glass and information sharing in social context. Because Google Glass and smart watches have gone into market recently and people haven’t widely accept on-body sensing technology, based on characteristics of wearable devices, building a socially acceptable and efficient information sharing is still an open field. In Face Card, we use wireless signals to identify nearby people and their devices, queries information from information, and displays useful information to users. Through Face Card, users can quickly share and acquire useful information. However, because of social contexts and users’ preferences, it’s hard to find a unified definition of useful information. In addition, people have different needs of privacy in different social contexts. Protecting privacy while sharing useful information to other people in different social contexts is another issue of face card. In the future, we plan to run more user studies and investigate the needs of information and privacy in various social contexts, user interface that helps users efficiently sharing and acquiring information, and Bluetooth latency and energy performance in various scenarios. The system design of Face Card is easy to migrate to other wearable devices such as Moto 360. We plan to implement Face Card on Moto 360 and compare usability between On-head device (Google Glass), smart watch (Moto 360), and mobile phones (Nexus 5). Face Card currently uses Bluetooth Low Energy (BLE) to scan for nearby devices. This is ideal for use when there are not many people around the user. Providing context aware recommendation system will allow the system to be used in a variety of context including, but not limited to, crowded conference, cocktail party, and career fair. The system will be able to show Face Cards in the order of importance (whether it is by most unfamiliar, most interested, etc.) based on each user.

Conclusion
In this paper, we present Face Card, a system framework for information sharing based on Google Glass. We demonstrate the evaluation result of Face Card and describe our future work.

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