Hidden View Game: Designing Human Computation Games to Update Maps and Street Views

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ABSTRACT
Although the Web has abundant information, it does not necessarily contain the latest, most recently updated information. In particular, interactive map websites and the accompanying street view applications often contain information that is a few years old and are somewhat outdated because street views can change quickly. In this work, we propose Hidden View - a human computation mobile game that enables the updating of maps and street views with the latest information. The preliminary implementation of the game is described and some results collected from a sample user study are presented. This work is the first step towards leveraging human computation and an individual's familiarity with different points-of-interest to keep maps and street views up to date.

Categories and Subject Descriptors
H.5.m [**Information interfaces and presentation (e.g. HCI)]:** Miscellaneous

Keywords
Human computation, Game with a purpose, Crowdsourcing

1. INTRODUCTION
Information that is available on the Web is constantly changing and, in many cases, does not accurately reflect the most current information in the real world. One example of this is mapping sites such as Google Maps. In addition to simply providing street information and directions, the mapping sites provide much more including identifying the locations of different points of interests, restaurants, stores, etc. However, the information constantly changes (e.g. a restaurant might close and be replaced with a different store) and the mapping tools do not necessarily reflect the current real world information. In addition to the traditional top-down map view, street features are also commonly provided; these street views provide a panoramic view of different locations from the perspective of walking along the street. It provides a close-up view of the area so that users can more easily identify their destination or discover the appearance of an area. Unfortunately, street view images are also not necessarily the latest, most recently updated view of the particular location.

The images used in the street view are often collected manually using a vehicle (or a bicycle in some cases) that drives (rides) through the area with cameras. Based on the images collected, a panoramic view of the street is created. However, there is a significant cost associated with this image collection. As a result, it becomes very difficult to keep the street view updated with the latest view. For example, in Google Street View, some street views from London are very recent as they are from 2012, but other major cities in the world are much older: the images from Paris were captured in 2008, Seoul in 2009, and New York City and San Francisco in 2011. One Internet service provider in Korea (Daum) has a very similar service (called Road View) and they provide information on the date that the current and previous road view images were obtained. Based on this information, it can be known that some views near major cities are updated approximately every six months while other locations are updated every year or two. An example of how a street view changed over a period of two years is shown in Figure 1. It is clear that some information (e.g. TGI Fridays) remains the same while other parts of the image (highlighted in the yellow square) have consistently changed during this time.

Figure 1. An example of how a street view has changed

Because of this limitation of maps and street views, Google provides a Map Maker service [1] that allows individuals to submit changes to the current map information, including identifying new streets, new stores, new restaurants, etc. Once update requests are submitted, it requires another "expert" to verify and validate the request. However, this service is very labor-intensive and the process is not scalable, which increases the difficulty in providing numerous updates. In addition, this service is limited to the traditional top-down view of the maps and does not include the street views.

In this work, we attempt to provide updates to old data in street view by designing a human computation game called "Hidden View" that was designed for users to identify differences between a stored image and the current real world. The game is based on similar principles to the "Hidden Catch" game, which provides two images with subtle differences that the user identifies (Figure 2(a)). This type of game is very straightforward and depending on the subtlety of the differences, the difficulty of the game is increases or decreases. If necessary, the computer can easily solve this problem by comparing the images. However, if one of the reference images is not available (e.g. Figure 2(b)), then the "Hidden Catch" game cannot be completed by a computer. In this work, the Hidden View game is proposed; it is based on similar principles to those in the Hidden Catch game, i.e. leveraging the familiarity of the users/players with the street views in order to identify the differences.

Figure 2. An example of (a) the Hidden Catch game and (b) the Hidden View game with an unknown image

EXPECTED OUTPUT: From a large number of users playing the game, we expect to collect up-to-date information about the street view and consumers will be provided with more accurate

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information (Figure 3 ②). In addition, based on the differences identified, the game can also be used by service providers to note which areas have changed the most and provide guidance on which areas need to have the street view images collected again.

2. HIDDEN VIEW GAME

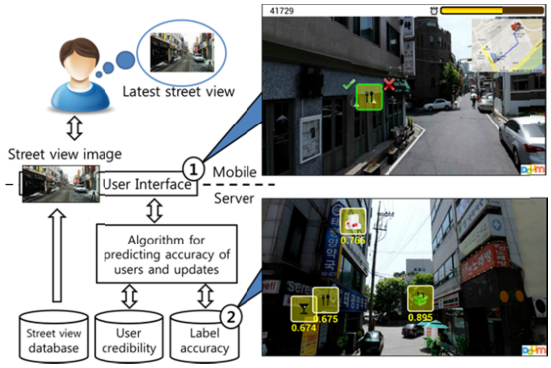

Figure 3. High-level block diagram of the Hidden View game.

A high-level block diagram of the Hidden View game is shown in Figure 3 and a screenshot of the game is shown in ①. The user is given a street view image and the goal of the game is to identify whether a label (or icon) exists or not in the *latest* street view. The latest street view can be based on the user's experience of being familiar with that particular location or the user can compare the street view image with the street view physically in front of them if they are currently at that particular location.

The user is shown an icon and is expected to drag the icon to the appropriate location on the street view and confirm the chosen location by selecting the checkmark; if the icon does not exist in that particular street view, then the user selects 'X'. A sample of the different icons used in the game is shown in Figure 4. In order to keep the game simple and entertaining, the following three features were added: 1) only one icon is shown at a time and the user has a limited time to make a decision; 2) the user's score is updated based on the accuracy and timer; and 3) a competition is also used to garner more interest. The upper right corner of the screenshot in ① in Figure 3 presents a map of the current location and the destination. The street view "moves" toward the target destination and it changes once the icon is selected (either checkmark or 'X') or if the timer expires.

Figure 4. Sample of different icons used in the game

The initial database in Hidden View contains labels obtained from the Google Places API, which provides point of interests (POIs). Throughout the game, this database is used as well as randomly generated labels. Although the initial database is likely to be accurate, those data are also not necessarily the most current. As users play the game, the database will be updated with a score that represents the accuracy of the labels. There are two significant challenges in the Hidden View game: 1) can the user selection be trusted? (i.e. user credibility) and 2) how accurate are the labels that are currently in the database? (i.e. label accuracy). These two scores are inter-related, i.e. an input from a more credible user will increase the label score while an input from a less credible user will not significantly impact the label accuracy score. The output of the game can provide this accuracy value to consumers as shown in ② in Figure 3.

A simple probabilistic approach is used to design the algorithm that predicts the user accuracy and the label scores; it is based on the following relationships:

$$label\_score = f(label\_score, user\_credibility, selection)$$
$$user\_credibility = g(label\_score, user\_credibility, selection)$$

selection indicates whether the user selected a checkmark or an 'X' for the icon and this score is updated after every user entry. The *label_score* is set between 0 and 1; as the score approaches 1, there is a higher confidence that the icon is correct, while as it approaches 0, it can be assumed that the icon is incorrect. If a user selects a checkmark for a label that has a score close to 1, this will increase the *user_credibility* while selecting 'X' will decrease the *user_credibility*. In the initial implementation, all icons that were obtained from the Google Places API were given an initial score of 0.6 and the randomly generated icons were given an initial score of 0.4. As different users play the game, the score of each label will change (Figure 5).

A user study was performed based on the initial implementation of Hidden View. The user study had two goals: 1) to obtain feedback on the user interface of the game and 2) to determine whether meaningful information could be collected. There were 17 participants who were familiar with the locations of the street views used in the game. Each user played the Hidden View game three times, i.e. they "drove" through the same area three times in the game but because the icons were randomly selected, their choices were not necessarily the same each time. Each game consisted of 25 street view images that covered approximately 300m of streets. The street view images were sourced from Daum Road View, and the images were taken from May 2011.

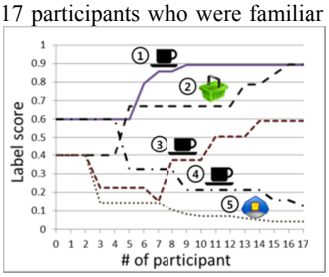

Figure 5. Scores for different labels and their evolution

Some results from this study are shown in Figure 5. From these results, two coffee shops can be identified, both of which were available in Google Places (but located in different street view images) and started with a score of 0.6. Through the game, the coffee shop scores diverged: the score of ① increased to signify that the coffee shop actually exists in the location while that of ④ gradually decreased because that coffee shop no longer exists in that location.

3. SUMMARY

In this work, an initial implementation of the Hidden View game was presented; this game provides an opportunity to obtain the latest information of a street view through a crowdsourced game. We plan on expanding the game to include additional entertainment features so that it will attract more users. In addition to the commonly used POIs, we plan on expanding the icons to non-traditional POIs, such as construction icons (Figure 4), which could provide valuable information to drivers.

4. ACKNOWLEDGMENTS

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5. REFERENCES

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