

Gamification Effect of Collection System for Digital Photographs with Geographic Information which Utilizes Land Acquisition Game

Rie Yamamoto¹(✉), Takashi Yoshino¹(✉), and Noboru Sonehara²

¹ Faculty of Systems Engineering, Wakayama University, Wakayama, Japan
s165059@center.wakayama-u.ac.jp, yoshino@sys.wakayama-u.ac.jp

² Information and Society Research Division,
National Institute of Informatics, Tokyo, Japan
sonehara@nii.ac.jp

Abstract. As digital photos with geographic information are helpful as a new tourism resource, in this study we developed the “Photopolie” digital photo collecting system that includes geographic information. Through GWAP, which utilizes a land acquisition game, Photopolie defines photography targets that are useful as tourism resources, and promotes digital photo submission with accurate position information. Evaluation experiment results showed the following three points: (1) Through clarifying photography targets that are useful as tourism resources, and considering compatible gamification elements, there is the possibility of being able to collect more data. (2) User interaction has the possibility of motivating work. (3) It may be possible to maintain motivation for data submission for dynamic users who enjoy land acquisition games.

Keywords: Digital archive · Digital photograph · Location information · Motivation · GWAP (Games With A Purpose)

1 Introduction

Digital photos and videos of landscapes and reconstruction are thought to be valuable regional and tourist resources for stimulating a region. In order to preserve this scenery, digital photos and videos of every region that captures their cities is essential. However, most digital photos show bias towards where they are shot, since they are typically either tourist or private photos. In short, it is necessary to promote the digital photography of every area. Therefore, we considered that through encouraging the collection of digital photography that may serve as tourist resources for every region, and further reorganization of the collected data, the possibility would open up of being able to provide tourism information in a variety of forms, allowing the possibility to stimulate areas and help support tourism. In this study, we are constructing a digital archive for the

purpose of supporting tourism by developing a digital photo collecting system called “Photopolie”, which utilizes a land acquisition game. Hakodate Digital Museum for digital archive influenced tourism [1, 2]. This system encourages the collection of digital photos that can be used as tourism resources for all regions through the use of GWAP, which utilizes a land acquisition game. A digital photo map is also provided to users by finding the association between digital photos and geographical information and mapping the data out into the map. Here, we suggest concentrating on collecting digital photos relating to parking lots. For example, if you could find out about tourist sites in unfamiliar areas or know about parking lots at commercial facilities prior to taking a trip by car, you could look up parking information at your destination, or cut down on time loss spent looking for parking lots. Knowing where there are handicap parking spaces is also useful information both for the handicapped individual and their family. In order to correlate more digital photos regarding parking lots with geographical information, we considered the appropriate gamification elements. In this paper, we will outline “Photopolie” and describe utilization experiments for the purpose of collecting digital photos of parking lots.

2 Related Work

GWAP (Games with A Purpose) is a game that produces profitable resources as a secondary effect that also has an accompanied purpose whenever a person plays it. In order to produce profitable resources, it is necessary to consider corresponding gamification elements. The ESP game [3] is the most popular example for research of GWAP. The ESP game is an online game wherein two randomly selected players are shown the same image and, without any mutual communication, the players input any words that come to mind from the image and score points if their words match. In this game, you are tagged by the picture as a secondary effect. As a study into GWAP, which aims for the large-scale collecting of digital photos, Tuite et al. have developed an online game for the purpose of large-scale data collecting in order to construct a 3D city model that hypothetically could be used for urban planning [4]. As a result of two competitions held between universities, a large amount of digital photos that captured city buildings from all angles was compiled. Among the students who participated in the game, various competitions for the highest score were used as motivation for data submission. The compiled digital photos that came from comparisons with 3D models constructed from digital photos shared on Flickr were useful for constructing even more detailed 3D models. Another relevant GWAP is the mobile game EyeSpy which Bell et al. have developed [5]. In this game, this game can collect photos and tags that would be useful for navigation. In this study, digital photos with correlated geographical information of various regions which are not tourist spots are collected by utilizing a land acquisition game. Gaining points and land through mutual player interaction is used to motivate the player.

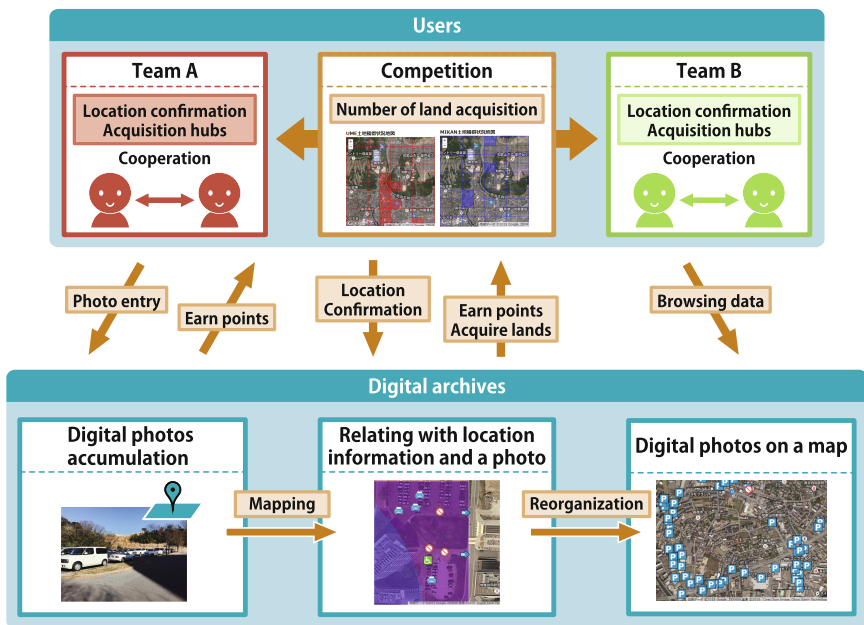


Fig. 1. System configuration.

3 Photopolie

3.1 Outline of Photopolie

Figure 1 shows the configuration of this system. It is composed of a digital archive that stores and reorganizes users who submit digital photos with location information and submitted digital photos. Location confirmation between users is performed in order to more make more accurate geographical information correlating with digital photos, enabling point and land acquisition. Users are motivated to submit data through mutual interaction by verifying each other's location. Users are separated between two teams, the allying team working among itself to acquire land and verify location information for digital photos. The opposing team competes for the most land acquisitions and photos with confirmed location. Thus, collecting digital photos of parking lots in every region is encouraged, and any stagnation of addition or updating of the digital archive is prevented. Digital photos that were collected for parking lots are mapped onto a map and reorganized as a digital photo map that gives parking lot information.

3.2 Functions of Photopolie

This subsection shows the functions of Photopolie.

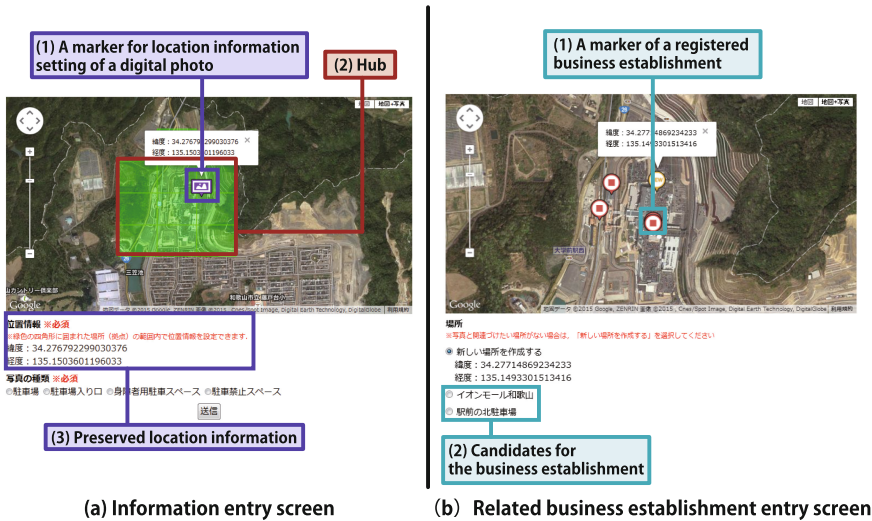


Fig. 2. An screen example of the digital photography submission function.

(1) Digital Photo Submission Function. With this function, it is possible to submit digital photos and geographical information regarding the place the photo was shot to the built digital archive. Users can upload digital photos, input information, obtain GPS information from Exif information, obtain their current location from their device, and transfer marks to Google Maps in Fig. 2-(a)-(1). This system is setup to separate a mesh on a map of Japan of the range possible to submit a digital photo of your position. The separation on the map uses a 1/4 regional mesh of the regional mesh code. The width of the mesh is 250 m. For the position that is the green square in Fig. 2-(a)-(2), it is necessary to set the digital photo location information only within the area surrounded by the green square We call the green square “hub”. The submitted location information is displayed in Fig. 2-(a)-(3). Four types of digital photos, namely parking lots, parking lot entrances, handicap spaces, and no parking zones are laid out. Users can select a business establishment related a digital photo in Fig. 2-(b). Marks on Google Maps show location of registered business establishments in Fig. 2-(b)-(1). Registered business establishments nearby location information of a digital photo are displayed as candidates of the business establishment related a digital photo in Fig. 2-(b)-(2).

(2) Location Confirmation Function. With this function, geographical information from digital photos that were submitted by users is verified. It is possible to visit and confirm the place submitted as a digital photo’s geographical information by pressing the “Confirm” button located in the list beneath Google Maps’ digital photo’s geographical information above the 125 m blue radius circle that centers on your current position. The rules for visiting the position of a digital photo and confirming its veracity is to make sure that it is a mark

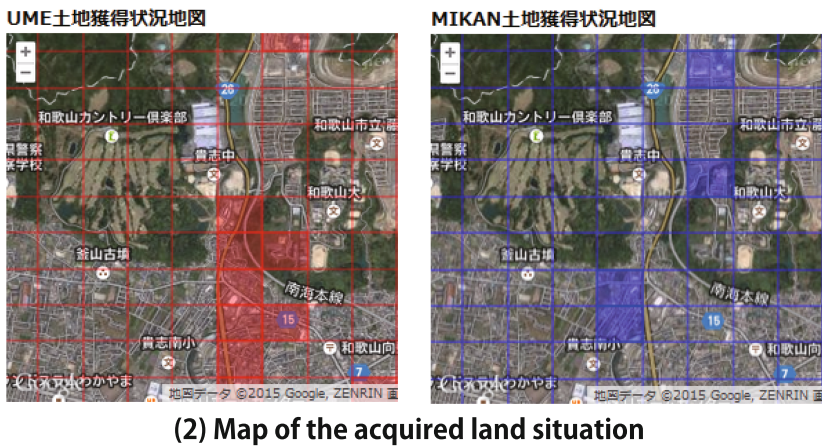
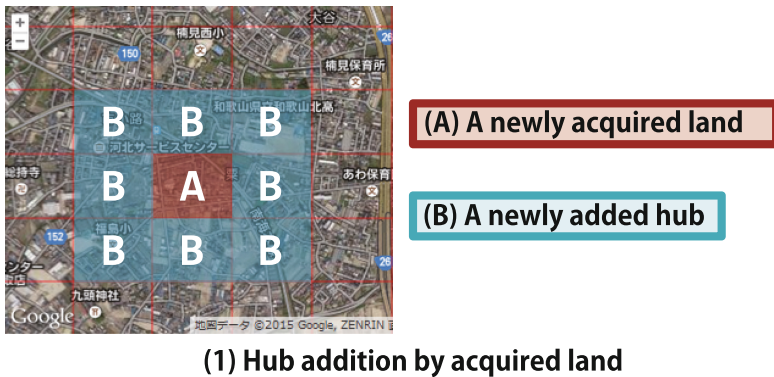


Fig. 3. A screen example of the land acquisition function.

that can be easily located. If the geographical information does not match with the digital photo, you can report it to the system by pressing the “Mismatch” button.

(3) Land Acquisition System. This system utilizes a land acquisition game. Each user confirms the digital photo’s geographical information that members of the same team have submitted within the position, and any land in that position can be acquired when the whole team has a total of three digital photos that have had their position confirmed in the same location. It is possible to add the surrounding of the acquired land (Fig. 3-(1)-(A)) as a new hub (Fig. 3-(1)-(B)). You can view the acquired land situation in map for each team in Fig. 3-(2).

(4) Point Earning System. You can earn points with this function by submitting and confirming position of digital photos, and by submitting and adding

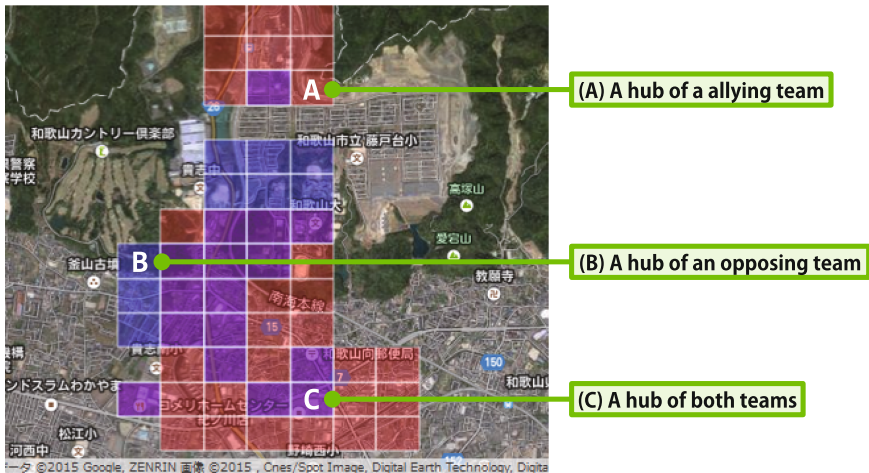


Fig. 4. Hubs on a location confirmation screen.

information. Once you have used 100 points, you can add a position. As you add positions, this adds merit to both your team members and yourself as it makes it easier to submit photos. While you cannot compare points between users with this system, it does add incentive to submitting data. This system was made to grant bonus points since it collects many digital photos for parking lots and correlates accurate geographical information with them. You can get points if you confirm a digital photo's geographical information in a hub of a allying team (Fig. 4-(A)) or a hub of an opposing team (Fig. 4-(B)). However you may get bonus points if you confirm a digital photo's geographical information in a hub of both teams (Fig. 4-(C)). Also, You can get bonus points if you submit various types of digital photos of business establishments.

4 Evaluation Experiment

4.1 Summary of Evaluation Experiment

This experiment was carried out from February 7, to February 14, 2015. There was also a midway survey on February 9 and a final survey at the end of the experiment. Participators were information science students (7 men, 5 women) residing in Wakayama. We asked users to use Photopolie on the web. Below are the experiment tasks.

- (1) Submit three photos of parking lots for business establishments every day.
- (2) Confirm geographical information for more than one photo submitted to Photopolie

Table 1. The number of submitted digital photos and the number of location confirmation.

UME team			MIKAN team		
	Number of submitted digital photos	Number of location confirmation		Number of submitted digital photos	Number of location confirmation
User A	42	38	User G	15	10
User B	55	12	User H	6	0
User C	13	17	User I	33	39
User D	21	8	User J	5	0
User E	13	0	User K	15	5
User F	4	0	User L	9	0
Total	148	75	Total	83	54

In this experiment, users were automatically assigned to two teams, UME (plum) and MIKAN (tangerine orange)¹. Six people were assigned to the UME team (five men, one woman), and six people were assigned to the MIKAN team (two men, four women). The goal of this experiment was to promote the use of the digital archive and evaluate where data that could be used as tourism resources could be accumulated by having users use the system. Through the experiment, the following hypotheses were formed.

- (1) Through utilization of the land acquisition game, collecting of digital photos for parking lots could be encouraged
- (2) Through utilization of the land acquisition game, association with accurate position information for digital photos could be encouraged
- (3) Through utilization of the land acquisition game, motivation to submit data could be preserved

Furthermore, manuals that explained how to use Photopolie were distributed before the experiment began. After the experiment, four information science university students were asked to evaluate photos that were collected. Evaluation contents are shown below.

- (1) Determine where the digital photo is for a parking lot
- (2) Match the type of digital photo

5 Experiment Results and Consideration

A total of 231 digital photos were submitted by users. Table 1 shows the amount of digital photos submitted by each user. The total of digital photos submitted

¹ UME (Plum) and MIKAN (tangerine orange) are a Japanese name of a fruit of a specialty in this area.

Table 2. Questionnaire survey about the experiment.

Question items	Team	Evaluation					Median	Mode
		1	2	3	4	5		
(1) I actively conducted the submission of digital photos for parking lots	U	0	1	0	2	3	4.5	5
	M	0	0	2	2	0	3.5	3,4
(2) The point earning system encouraged me to submit digital photos	U	1	0	2	3	0	3.5	4
	M	0	1	0	3	0	4	4
(3) It was difficult confirming geographical information of digital photos for parking lots	Both	0	1	4	3	2	3.5	3
(4) I checked the position information of a digital photography about a parking lot aggressively for a supporter team	Both	4	1	2	2	1	2.5	1
(5) It was difficult for me to understand a rule of “hub”	Both	0	1	4	4	1	3.5	3,4

- Evaluation: 1: Strongly disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly agree

- “Evaluation” is the number of people.

- U: UME team, M: MIKAN team, Both: Both teams

by the UME team was 148, while the total for the MIKAN team was 83. After evaluating 231 of the collected photos, 165 of the total were determined to be for parking lots. Also, when users were asked to list photo types, digital photos that matched with the type that submitters gave was 126 out of 231 total. As a result of the midway survey, seven people responded, while ten responded to the final survey. The survey used the 5-point Likert scale (represented below as the “5 point evaluation”). The items of the 5 point evaluation were: “1: Strongly disagree”, “2: Disagree”, “3: Neutral”, “4: Agree”, and “5: Strongly agree”.

5.1 Evaluations of Digital Photo Submission for Parking Lots

Perception Change of Data Submission for Land Acquisition Game.

For the survey item “I actively conducted the submission of digital photos for parking lots” listed in Table 2-(1), the UME team had a median of 4.5 and a mode of 5. Meanwhile, the MIKAN team had a median of 3.5 and a mode of 3 and 4. The following opinions in Table 1 for why that is were taken from User A and User I, who both submitted over 21 photos.

- The game got fun as my ally’s land expanded.
- Since my team had not collected many photos, I took the initiative since I didn’t want to lose to the opposing team.

For the survey item “The point earning system encouraged me to submit digital photos” in Table 2-(2), the UME team had a median of 3.5 and a mode of 4.

Meanwhile, the MIKAN team had both a median and mode of 4. From this, we assume users had a sense of rivalry with their opposing team and actively submitted data in order to earn points. From the above, it was learned that it was possible to encourage collecting of digital photos for parking lots from users who enjoyed the game.

Data Accumulation Effect Through Clarification of Photography Target. For the survey item “I submitted various types of digital photos of business establishments in order to earn bonus points”, the below opinions were given as free-description answers.

- I took pictures at establishments where I could take numerous types of photos while being conscious of bonus points.
- Since I wanted to increase positions and needed to get more points, I thought to submit as many types of photos as possible for bonus points.

While it has been understood in experiments thus far that it is possible to encourage submission of digital photos through the point earning system, the bonus point earning system for when users submit various types of digital photos in business establishments encourages the taking of more digital photos for parking lots. Also, from evaluation results for digital photos, it can be assumed that over 50 % of digital photos collected can be accumulated as digital photos for parking lots categorized appropriately by type.

Evaluations for Association with Accurate Geographic Information.

Results showed a total of 11 land acquisitions for the UME team and a total of 4 for the MIKAN team. From Table 2-(3), the survey item “It was difficult confirming geographical information of digital photos for parking lots” had a median of 3.5 and a mode of 3. From the free-description answers, we also got the following opinions: “It took time to properly photograph things at establishments with wide parking lots”. “It was difficult getting present geographical information through the browser”.

In the free-description answer portion of the survey in Table 2-(4), User A and User B, who both gave high evaluations, said that it was fun being able to acquire land, and that they actively confirmed locations and expanded their location in order to increase the total area that other members could submit photos for. User H said that “I could not actively back my team since I didn’t know who was a member”.

From the above, mutual user interaction has a possibility of giving incentive for actively confirming locations, as the acquiring of land and confirming positions with one another increases positions, making it easier to submit photos. However, confirming position information can be a burden for users, which splits evaluations. Also, since there was no system for communicating within teams, there is a necessity for a support system so users can collaborate.

5.2 Evaluations for Data Submission Motivation

Figure 5 shows the separately dated data submission of each user. The users who submitted data for more than four days and submitted over 21 digital photos were User A, B, D and I. In the free-description answer portion of the survey, User A and User I gave favorable views, stating that “it was fun being able to acquire land” and “I had fun. It was exciting being able to go to areas I normally do not go to”. From this, we can assume the possibility of being able to preserve motivation for data submission for users that enjoy being able to acquire land and have initiative. From Table 2-(5), we see the possibility of the difficult game rules hindering the maintenance of motivation for data submission. It will be necessary to propose continued gamification elements, and will be our task here on out to make the rules easier for users to understand.

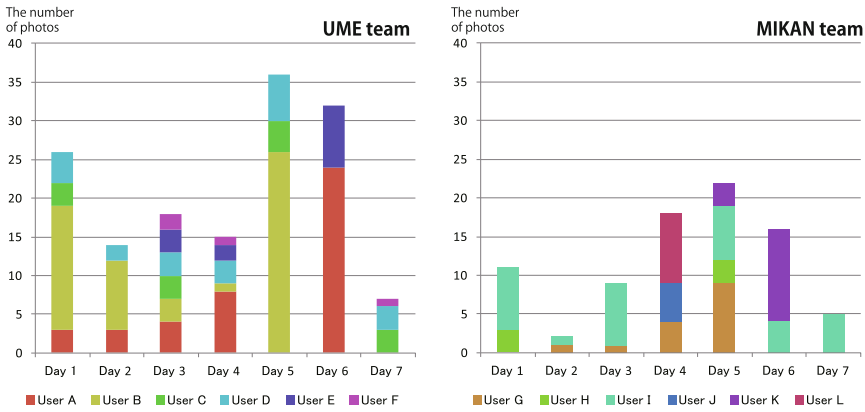


Fig. 5. The number of photos uploaded per a day.

6 Conclusion

This paper discussed the “Photopolie” image collecting system which utilizes a land acquisition game. Through utilization of the land acquisition game, we ran an experiment that encouraged use of a digital archive and evaluated whether data could be collected that could be used for tourism resources. The results of the experiment proved the following three points:

1. Through clarifying photography targets that are useful as tourism resources, and considering compatible gamification elements, there is a possibility of being able to collect more data.
2. User interaction has the possibility of motivating work.
3. It may be possible to maintain motivation for data submission for dynamic users who enjoy land acquisition games.

Hereafter, we will improve usability on smartphones and carry out privacy measures.

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