Information Identification Support Method for Areas with Densely Located Signboards

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ABSTRACT
We developed methods and implemented a system prototype to help people find specific signboards in areas with densely located signboards. In addition, we examined whether the proposed methods would reduce the search time of a specific signboard. The result showed that the proposed method was superior in cases where there were multiple signboards to be searched and background saturation was low.

Author Keywords
Augmented Reality; Diminished Reality; Visibility of visual information

ACM Classification Keywords
H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

INTRODUCTION
A large amount of visual information is present in urban areas. People make decisions based on this information. When people search for a store in an urban area, signboards are one of the indicators for discriminating the type of stores, e.g., a restaurant and a clothing shop. However, as there are several signboards in areas such as downtown areas, it is difficult to find a specific signboard quickly. The purpose of our study is to improve the discrimination of visual information and shorten the search time in areas with densely located signboards.

Umair et al. [3] proposed an augmented reality-based navigation system using a wearable device that acquires the current location of a user through Wi-Fi or a geomagnetic sensor and shows arrows in the direction to be bent. In contrast, Kawai et al. [2] proposed diminished reality, which visually removes actual objects from video images by filling missing regions with background textures. Hata et al. [1] proposed an attention control method based on the unnoticed blur effect. Their method gradually blurs an image on a display to a threshold at which viewers are aware of the modulation of the display, while the region where viewers' attention should be guided remains unblurred.

To achieve our objective, we propose information presentation methods that help people search for a specific signboard.

PROPOSED METHOD
We adopt two kinds of approaches. The first is adding information, such as store names, based on augmented reality, and the second is subtracting unnecessary visual information by making it grayscale based on diminished reality. We define information presentation methods as follows:

- No processing (normal type; shown in Figure1-(a))
- Display store name next to a signboard (addition type; shown in Figure1-(b))
- Convert color information to grayscale, other than specific signboards in the image (subtractive type; shown in Figure1-(c))
- Convert color information to grayscale, other than specific signboards in the image, and display store name next to a signboard (hybrid type; shown in Figure1-(d))

EXPERIMENT
We implemented a prototype for an experiment using Unity (ver 5.6.0f3) to run the prototype on mobile devices. To make the experimental environment closer to the actual environment, we used whole sky images of day and night, which were shot in the vicinity of the Shin-Nippon Shinchi building using RICOH THETA, to see through the mobile device. As signboards cannot be sharply photographed with a whole sky ball image, we set signboards as 3D objects. We used 61 signboards that were hung on the Shin-Nippon Shinchi building in Kitashinchi, Osaka Prefecture, as the signboard information for the experiment. We stored three-dimensional coordinates in the whole sky ball image, the name of the shop, the type of store and the image of these signboards in a database. In this prototype, users can orient the mobile device in all directions in the full sky ball image. The aim is displayed at the center of the screen, and the system can recognize that a specific signboard has been selected by matching the local coordinates of the aim and the world coordinates of the signboard. In the experiment, we used 4 types of information presentation methods. By comparing the search time for the hybrid type method with that for the addition type and subtraction type methods, we confirmed the advantage of the proposed method with respect to search time. The results of the experiment are provided below.

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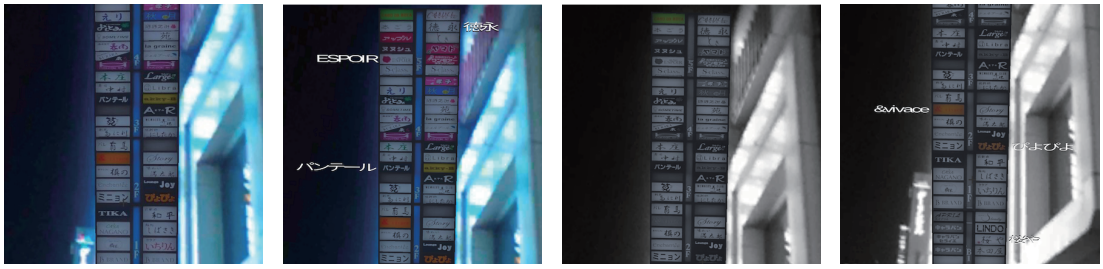
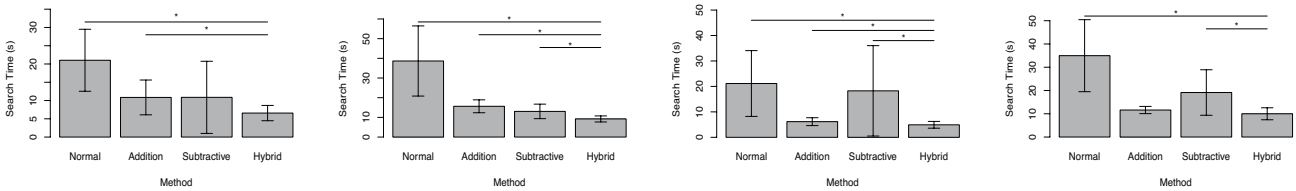


(a) Normal type (b) Addition type (c) Subtractive type (d) Hybrid type

Figure 1. Information presentation methods



(a) Day, Simple (b) Day, Multiple (c) Night, Simple (d) Night, Multiple

Figure 2. Experimental results ($*: p < .05$)

Day, Simple (Figure 2-(a))
In this case, the time zone is day and the search target is simple. The search time for the hybrid type is significantly shorter than that for the (1) normal type ($t(22) = 5.729, p < .05$) and (2) addition type ($t(22) = 2.852, p < .05$). However, there is no significant difference between the search times for the hybrid type and (3) subtractive type ($t(22) = 1.478, n.s.$).

Day, Multiple (Figure 2-(b))
In this case, the time zone is day and the search targets are multiple. The search time for the hybrid type is significantly shorter than that for the (1) normal type ($t(22) = 4.325, p < .05$), (2) addition type ($t(22) = 2.103, p < .05$), and (3) subtractive type ($t(22) = 2.485, p < .05$).

Night, Simple (Figure 2-(c))
In this case, the time zone is night and the search target is simple. The search time for the hybrid type is significantly shorter than that for the (1) normal type ($t(22) = 4.325, p < .05$), (2) addition type ($t(22) = 2.103, p < .05$), and (3) subtractive type ($t(22) = 2.485, p < .05$).

Night, Multiple (Figure 2-(d))
In this case, the time zone is night and the search targets are multiple. The search time for the hybrid type is significantly shorter than that for the (1) normal type ($t(22) = 5.512, p < .05$) and (3) subtractive type ($t(22) = 3.129, p < .05$). There is no significant between the search time for the hybrid type and (2) addition type ($t(22) = 1.857, n.s.$).

DISCUSSION

In the cases where the time zone is night, that the search time for the subtractive type is longer than that for the addition type. This is probably because the saturation of the background of the image used in the experiment is low and the effect of subtraction is reduced because several signboards that we used were composed of white and black. On the contrary, in the cases where the time zone is day or night and the search target is simple, the search time of the hybrid type is significantly shorter than that of the addition type and subtractive type. This suggests that the hybrid type is effective in cases where the saturation of the background is low or when users search multiple signboards. In addition, the search time for the hybrid type is the shortest in these cases, regardless of the environment.

CONCLUSION AND FUTURE WORK

In this paper, we proposed information identification support methods, i.e., addition type, subtractive type, and hybrid type. In addition, we implemented a prototype that runs on mobile devices to verify the superiority of proposed methods. Using the prototype, we conducted a comparative experiment in which a specific signboard was searched using the proposed methods and search time was measured. As a result, we showed that the hybrid method is effective when the saturation of the background is low or when a user searches multiple signboards. The limitation of this study is that the prototype supports only still images. In future, we plan to build a signboard database for a certain shopping street and implement a prototype that can be used in an actual environment.

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