Intuitive Annotation of User-Viewed Objects for Wearable AR Systems

Ryuhei TENMOKU Masayuki KANBARA Naokazu YOKOYA
Nara Institute of Science and Technology
8916-5 Takayama, Ikoma, Nara, 630-0192 Japan
{ryuhei-t, kanbara, yokoya}@is.naist.jp

Abstract

By realizing augmented reality on wearable computers, it is possible to overlay annotations on the real world based on the user's current position and orientation. However, it is difficult for the user to understand links between annotations and real objects intuitively when the scene is complicated or many annotations are overlaid at the same time. This paper describes a view management method which emphasizes user-viewed real objects and their annotations using 3D models of the real scene. The proposed method highlights the objects viewed by the user. In addition, when the viewed object is occluded by other real objects, the object is complemented by using a synthetic image, which is made from 3D models, on the overlaid image.

1. Introduction

In recent years, augmented reality (AR)[1], which merges the real and virtual worlds, is realized on wearable computers[2] to make it possible to intuitively present location-based information to users. We have already developed a wearable AR system which overlays annotations on real scenes[3]. However, in most current wearable annotation overlay systems, it is hard for users to link annotations to their target objects intuitively when a lot of annotations are presented densely. In this paper, we propose a new annotation presentation technique emphasizing user-viewed annotations and their target objects.

Related work in this field is briefly reviewed below. Azuma et al.[4] have proposed a view management method for AR scenes, which rearranges multiple annotations without mutual overlap. Bell et al.[5] have proposed a view management method for VR and AR scenes, which can rearrange annotations using image regions where no object is projected, based on 3D models of scenes. However, most previous work focuses on how to arrange annotations spatially on augmented scenes when there exist multiple annotations. The proposed method focuses on how to intuitively present links between annotations and their target objects.

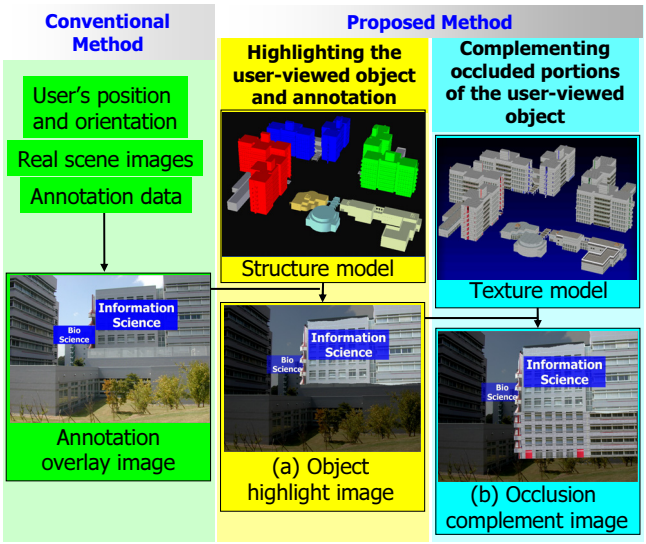


Figure 1. Outline of conventional and proposed methods.

2. Intuitive Annotation of User-Viewed Objects

Figure 1 illustrates the outline of the conventional annotation overlay method and the proposed method. The proposed method consists of two intuitive annotating methods of user-viewed objects. These two methods generate two kinds of images **(a) object highlight image** and **(b) occlusion complement image** as shown in Figure 1 to support the user's intuitive understanding of links between annotations and their target objects. To highlight the user-viewed object, the system needs a 3D model of the real scene which is painted a different color on every object distinctively. To complement occluded portions of the user-viewed object, the same 3D model with detail textures is needed additionally. The 3D model with two kinds of textures are called a "structure model" and a "texture model", respectively. The structure model can be made from CAD data of buildings easily.

The proposed method shows a pair of a user-viewed an-

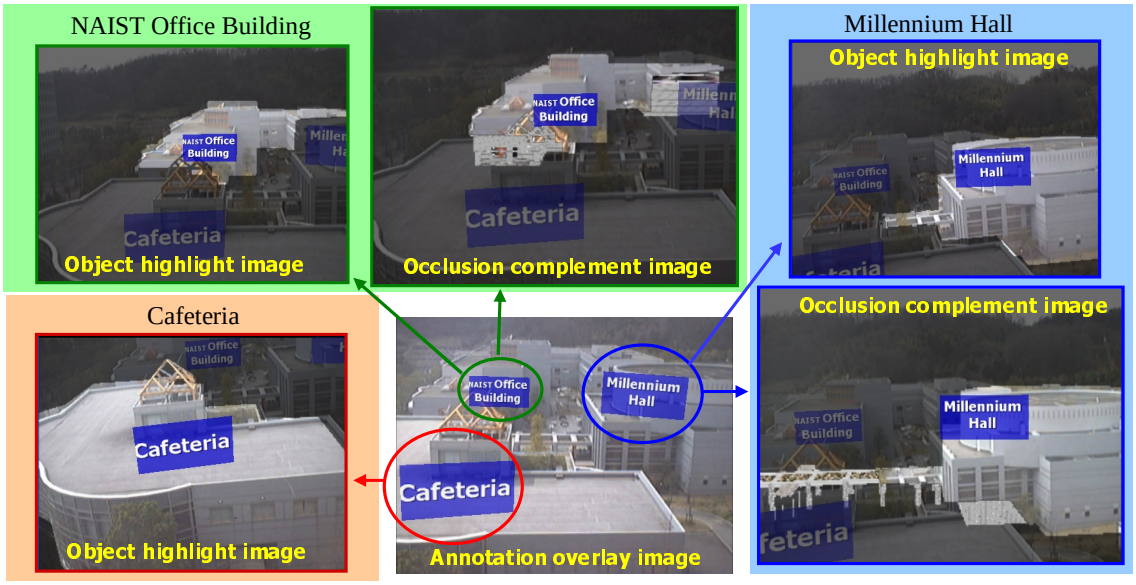


Figure 2. Generated user's view images.

notation and its target object intuitively. The present system assumes that the user views the object at the center of a user's view image. To generate object highlight images, image regions which the user-viewed object is projected on are calculated by projecting the structure model. Moreover, the occluded portions of the user-viewed object is determined by projecting the texture model. Occluded portions of the model are overlaid on object highlight images to generate occlusion complement images.

3. Experiments Using Prototype System

We have constructed a prototype system using the proposed method to carry out an experiment of intuitively presenting annotations to the user in our campus. The prototype system measures the user's position and orientation using IrDA sensors whose positioning error is within 1 meter and an inertial sensor[3].

In this experiment, there are three buildings ("Cafeteria", "NAIST Office Building", and "Millennium Hall") and three annotations are overlaid on each building. The central image of the lower line in Figure 2 shows an annotation overlay image when the system detects no user-viewed object. This user's view is generated by the conventional annotation overlay method[3]. The other images of Figure 2 show generated user's view images of the proposed method when the user views each object. Through this experiment, we have confirmed that the proposed method can present the correspondence between real and virtual objects to the user clearly.

4 Summary and Future Work

This paper has proposed an intuitive annotation technique using 3D models of real scenes as a new view management method for wearable AR systems. We have also carried out preliminary experiments using a prototype system. In the future, we have to apply our proposed method to much more registration errors such as positioning errors of a GPS. In our plan, we try to decrease the influence of errors on intuitive annotation using image processing techniques.

Acknowledgments

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