Level-of-Detail AR

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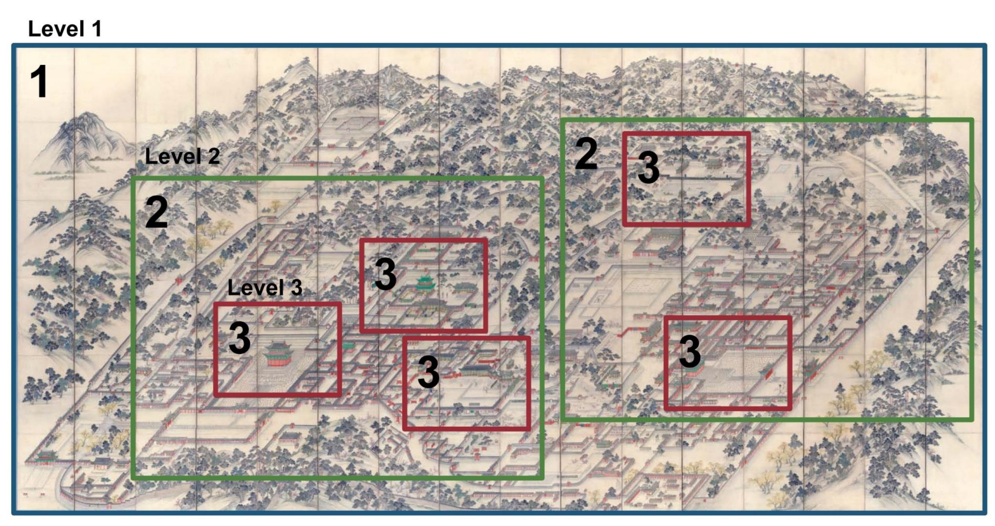
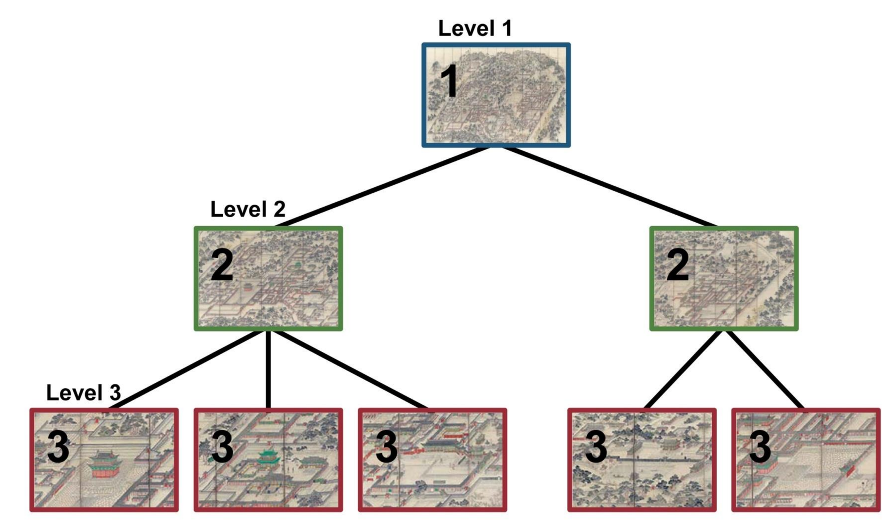
Objectives

We present level-of-detail(LOD) AR which is a novel approach to handle multi-layered information of the target image. Previously, multi-target recognition and tracking methods were used to handle augmentation in a complex scene. In more complex situations, when the target can be divided into the depth-based layers, it is not feasible by simply employing multi-target methods. To solve this problem, we propose a tree structure of points of interest and a practical method to identify which part the user is the most attentive to.



A large-scale map with three-level points of interest(POIs)



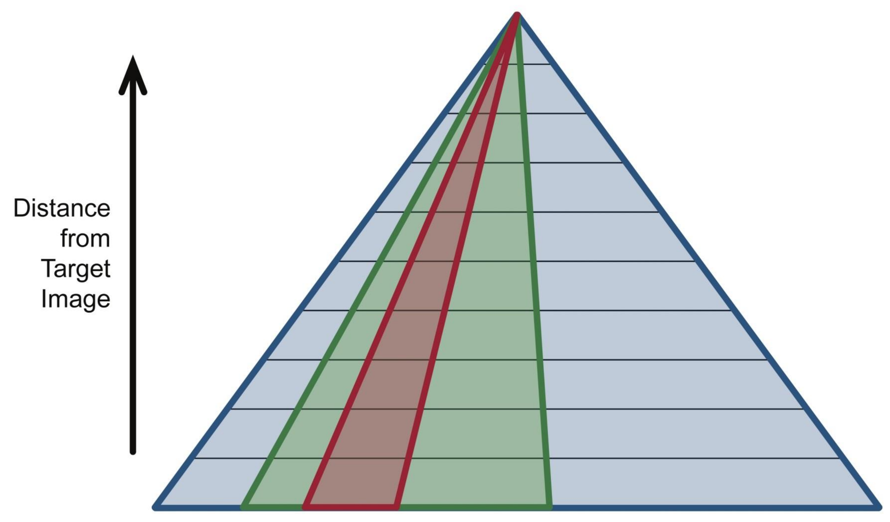
POI's hierarchical orders based on their inclusion relationship

We demonstrate the feasibility of our idea by implementing a mobile LOD AR system that handles very large targets which are commonly shown in real situations such as museums. Our technology is very adequate to apply on the large paintings and exhibitions in the museum.

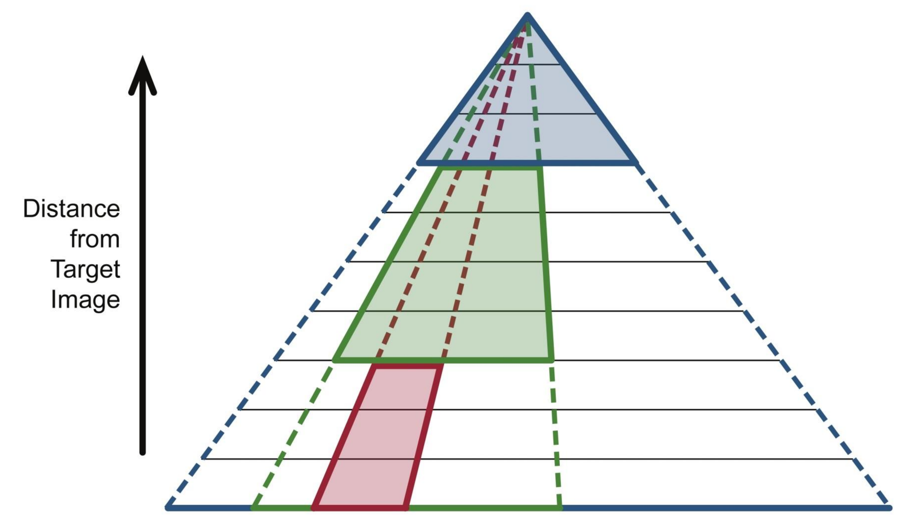
Methods

In our real-time AR tracking system, we use a large-scale image as a natural feature marker. Multiple POIs are defined on this target image, and each POI has independent AR content. The key feature of our system is to allow POIs to have inclusion relationship with each other. According to this relationship, their hierarchical positions are determined in the POI tree. The root POI in the tree includes all POIs defined on the target image, and as the level increases, a POI takes up a smaller area of the target image.

This depth-based POI attention system is implemented by assigning restricted depth range for each POI. AR contents of POIs can be displayed only when the estimated user's position is in the depth range of the POI. We set the maximum depth of one POI equals to the minimum depth of its parent POI, so that only one POI can receive attention at one time. The minimum depth of each POI is determined by the size of POI images. Since the captured POI image size becomes larger as the distance to the target gets closer, the minimum depth is determined by the maximum threshold of captured POI image size.



(a)



(b)

One-dimensional description of multi-scale image pyramid. Horizontal black lines indicate down-scaled target images, and colored triangles mean POI's coverage in feature descriptor generation. As the distance from the target image gets farther, the size of captured image decreases. Unnecessary and overlapped parts covered in (a) are excluded by our depth partitioning method as shown in (b).

Results

Level	Orig. Image Size (pixels)	Max. Capture Image Size (pixels)
1	24850×13616	1280×960
2	3200×2400	1280×960
3	1280×960	1280×960

Original and maximum capture image size of POIs

In our experiments, we implemented a real-time AR tracking system on mobile devices using HIP descriptor and created an AR application for a very large-scale map. The original image size of the map is 24850×13616 pixels.

The depth ranges for POIs were determined by the setting of the maximum capture image size threshold.

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