

# Exploring the Use of Handheld Augmented Reality Authoring and Guidance in an Unprepared Indoor Environment

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## INTRODUCTION

Handheld augmented reality (HAR) provides the best way to introduce AR to the mass market due to large adaptation of smartphones and tablets [1], but current HAR applications do not yet fulfill users' expectations [2]. In addition to solving HAR's technical problems, it is fundamentally important to understand the utility and usability related design factors as well. This study is part of an ongoing development project of a simultaneous localization and mapping (SLAM) based HAR system, which combines in situ authoring and guidance into a one single system. This system include three important areas of HAR: 1) SLAM technology enables the system to be used in various indoor environments without any kind of preparation. 2) In situ authoring with easy-to-use authoring tools is essential for the wide adaptation of HAR [3]. 3) Using HAR for guidance provides a highly practical use scenario. We investigate the SLAM-based guidance and in situ authoring with an iterative design and evaluation process of the proposed system. As a contribution, we present general and SLAM-related design guidelines for HAR in situ authoring and guidance.

## PROPOSED SYSTEM

We propose an iPad system that enables the authoring of short textual instruction annotations to static objects in the real world. User authoring the instructions takes a picture of the environment and marks different areas of interest into the picture. Purpose of this picture is to give user an overview of the whole working area and highlight the areas where instructions are located. A SLAM map can then be created to each of these areas by following the instructions given by the system. Other users can then use the same system to view the created instructions by selecting the marked area from an overview picture. Instructions then displayed to the user in the AR view. Figure 1 illustrates the map creation phase, the overview picture of marked areas and two annotations in the AR view of one of these areas.

## USER STUDIES

We have conducted a total of four user studies to the system. The initial design ideas of the guidance mode (1<sup>st</sup> study) and the authoring mode (2<sup>nd</sup> study) were evaluated in two parallel studies. Design improvements were made to the system and both modes were evaluated again (3<sup>rd</sup> study). The 4<sup>th</sup> study focused on comparison between the guidance mode and two conventional guides. Based on



*Figure 1: SLAM map creation phase (left). The 2D overview picture and two marked areas (middle). AR view of a marked area showing two annotations (right).*

these studies, we have found several important design factors, which are related to real-virtual relationship, instructions, feedback and user interface (UI) design. The relationship between a virtual annotations and real world object in 3D space must be very clearly visualized to the user. Clear instructions and feedback in the SLAM map creation phase are essential and compared to conventional methods, the guidance mode has higher requirement for feedback. It is important to consider alternative UI's for situations where AR is not needed. Also, users strong focus on the AR content should be taken into consideration in the design and layout of the 2D UI elements.

## CONCLUSION

We have described the iterative design and evaluation process of the SLAM-based HAR guidance and in situ authoring prototype system. We have also presented important general and SLAM-related design guidelines for HAR guidance and in situ authoring based on the lessons learned from the conducted user studies.

## REFERENCES

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