Augmented Reality: Principles and Practice

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Abstract

This tutorial will provide a detailed introduction to Augmented Reality (AR). AR is a key user-interface technology for personalized, situated information delivery, navigation, on-demand instruction and games. The widespread availability and rapid evolution of smartphones and new devices such as Hololens enables software-only solutions for AR, where it was previously necessary to assemble custom hardware solutions. However, ergonomic and technical limitations of existing devices make this a challenging endeavor. In particular, it is necessary to design novel efficient real-time computer vision and computer graphics algorithms, and create new lightweight forms of interaction with the environment through small form-factor devices. This tutorial will present selected technical achievements in this field and highlight some examples of successful application prototypes.

Keywords: Augmented Reality, mixed reality.

Index terms: H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems–Artificial, augmented, and virtual realities

Introduction and Target Audience

The target audience includes everyone with an interest in developing AR applications, academic and industrial professionals and students alike, from beginner level onwards. They will receive a thorough overview of AR technology illustrated with many practical examples. A background in computer graphics and computer vision will be useful, but is not strictly necessary.

The tutorial will be conducted with a mixture of slide presentation, video clips and live demonstrations. Audience members will be engaged in an active dialog and will be able to ask questions at any time during the tutorial. Participants will learn a broad foundation of the components and terminology used in developing AR on smartphones, so they can perform their own investigations. They will also gain appreciation for what is currently possible and what to expect from future research.

History

Dieter Schmalstieg and Tobias Höllerer have taught various tutorials related to Augmented Reality, including SIGGRAPH 2001, VR 2002, SIGGRAPH 2004, ISMAR 2008, VR 2012, SIGGRAPH 2016 and ISMAR 2016. This tutorial is based on AR courses created over the past three years and a textbook [1] published in June 2016 by the two presenters (Fig. 1). It will have a special emphasis on mobile computing and therefore have a new composition of content. It is not a repetition of previous activities at IEEE VR. Free teaching materials can be found on the book's companion website [2.]

References

[1] Dieter Schmalstieg, Tobias Höllerer. *Augmented Reality – Principles and Practice*. Addison-Wesley Professional, 2016..

[2] http://www.augmentedrealitybook.org

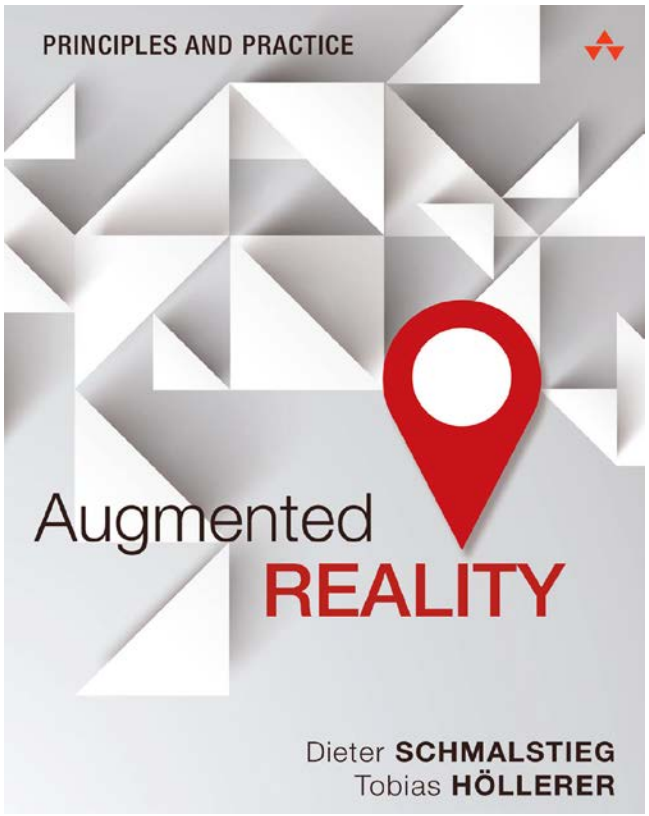

Fig. 1: Book cover

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APPENDIX: COURSE SYLLABUS

Session 1 Introduction
Dieter Schmalstieg, 60min
- Definition and scope
- Brief History
- Applications
- Tools and software

Session 2 Displays
Tobias Höllerer, 60min
- Visual Perception
- Display characteristics
- Spatial display model
- See-through displays
  - Near eye see through (optical and video based)
  - Handheld displays
  - Stationary displays
- Projected displays

Session 3 Tracking
Tobias Höllerer, 60min
- Calibration and registration
- Tracking system characteristics
- Stationary tracking
- Mobile sensors
- Optical tracking
  - Model based tracking (markers, feature models)
  - Model free tracking (SLAM)
- Sensor fusion

Session 4 Coherent Rendering
Dieter Schmalstieg, 60min
- Occlusion
- Photometric registration
- Image based lighting
- Common global illumination
- Diminished reality

Session 5 Interaction
Tobias Höllerer, 60min
- Augmentation placement
- Gestural input
- Tangible interfaces
- Augmented surfaces
- Embodied agents

Session 6 Conclusions
Dieter Schmalstieg, Tobias Höllerer, 15min
- Future directions
- Final Q&A session