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Master Thesis 2022

XR in the industrial environment - User-centered analysis of different implementation concepts

User Interface of the developed application

Abstract

The ongoing digitization of industry within the framework of "Industry 4.0" is trans-forming and digitizing processes. Based on the digitized processes, new technologies such as augmented and virtual reality can be used to support employees in various areas of the company. Nevertheless, there are still some hurdles in the way of their use in industrial companies. One major challenge in the industrial sector, for exam-ple, is the localization of the person using the technology, known as tracking.
This thesis investigates the suitability of different tracking methods in the industrial environment. Using the human-centered design process, a prototype of an augmented reality application was developed. The three tracking methods marker track-ing, SLAM tracking and area targets were evaluated in terms of accessibility, feasibil-ity and usability.
The central finding of this work is that there is currently no ideal tracking method for industrial use. All three methods show weaknesses in at least one of the above mentioned categories (accessibility, feasibility, usability). However, the potential, especially of innovative tracking methods like area targets, is enormous. The current state of the art as well as inconsistent data management and missing interfaces be-tween individual systems limit the industrial use of augmented reality.

Special Focus

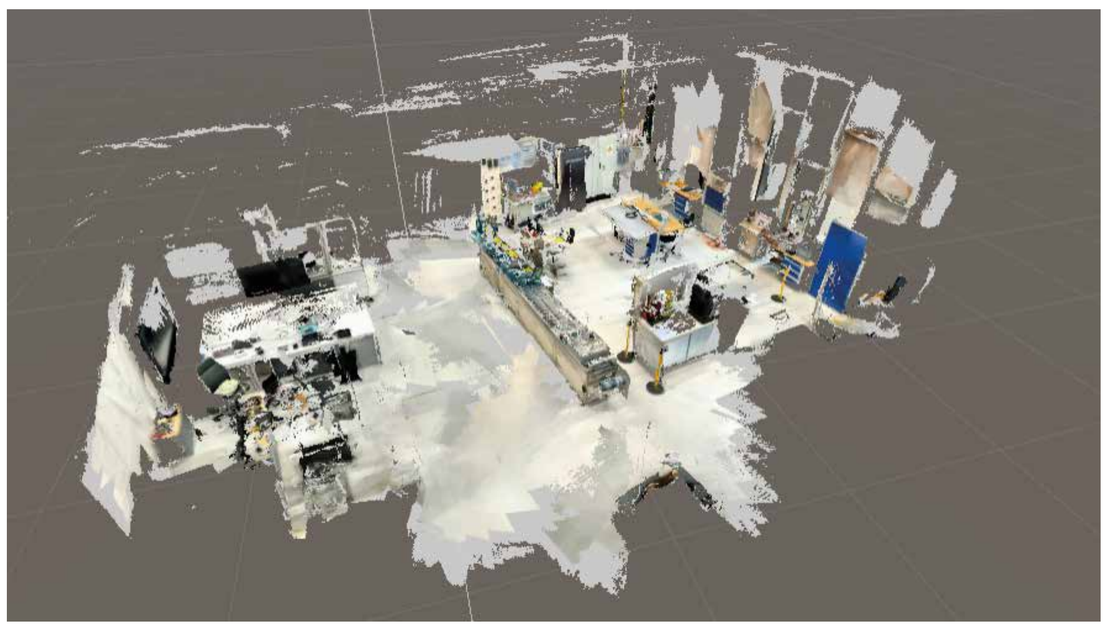
The aim of this master thesis was to evaluate individual tracking methods with regard to their suitability in an industrial environment.
For this purpose, the state of the art of AR in the industrial environment was presented first. A lack of tracking methods for the industrial use of AR could be identified. Based on the research of different tracking methods, the three potentially suitable methods marker tracking, SLAM tracking and area targets were selected and implemented prototypically. With regard to innovative area targets, the creation of three different output devices was also examined. On the one hand, area targets were created with an iPad Pro and on the other hand with laser scanners like the Leica BLK360 and the NavVis VLX. Thus, additional knowledge about the creation and implementation of area targets could be gained.
Both the realization of the application and tests with potential users of the application subsequently provided important insights for the evaluation of the individual methods with regard to their accessibility, feasibility and usability.
Based on the insights gained, it was possible to derive instructions for action for industrial companies that want to deal with AR technology. The guidelines refer on the one hand to the introduction phase and on the other hand to the concrete implementation phase of AR applications in companies.

Marker-Tracking
visual, marker-based

SLAM-Tracking
visual, markerless

Area Target
visual, markerless

Selected and implemented tracking methods



Area Target in Unity project

Result and Future Work

At present, there is no optimal tracking method for use in industrial environments, especially in production halls. No method is inexpensive and easy to implement and at the same time delivers stable and user-friendly results.
The existing marker and SLAM tracking methods are primarily suitable for the visualization of smaller objects, such as individual components or smaller plants. The visualization of large, several meters long plants in production halls brings both mentioned methods to their limits at the moment.
Marker tracking in particular nevertheless offers potential for industrial use. Entry barriers are very low compared to area targets. At this point, it is necessary to compare the required and desired degree of innovation with available resources in the form of time and money.
Area Targets have the potential to add tremendous value. They generate an extremely reliable and stable visualization of virtual content. However, the technological implementation is currently too complex and error-prone. Interfaces need to be created to simplify the creation. Innovation in the field of AR is currently severely limited by the state of the art.
The added value created by the use of AR can increase enormously in the future through the combination of innovative tracking methods, such as area targets, with BIM models.

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