

AR and Maintenance - Visualization of Process Data and Engineering Information

Sven Buyer^(✉) and Carsten Wittenberg

Robotics and Automation, Heilbronn University, Max-Planck-Str. 39, 74081
Heilbronn, Germany

{sven.buyer, carsten.wittenberg}@hs-heilbronn.de

Abstract. Nowadays the trend in the industry is to centralize production systems. For example almost autonomous power plants will be spread over the regions. In case of malfunctions the maintenance staff has to react very fast to reduce downtimes and costs. Based on a user analysis, different requirements such as fast information gathering and straightforward handling have been determined. Required documents are often spread across the company. This leads to time-intensive searching and obtaining. Modern technologies like Augmented Reality (AR) can support the staff. AR-applications have great potential for practical use, however, essential parts of today's popular desktop-based interaction concepts have to be redesigned. Computer games provide solutions for presenting complex information in a way that is easy to understand. Anforderungen an AR-Anwendungen in der Instandhaltung.

Keywords: Augmented reality · User interface · Maintenance · Mobile devices

1 Introduction

A service technician in industrial maintenance area is a self-sufficient and responsible team member of a workgroup. The basic activities are system checks, fault identification, fault analysis and problem solving. This generally requires the use of maintenance- and system documentation, process data and communication with remote specialists. An exploratory survey ($n = 25$ participants) gives rise that the kinds of information gathering and quick analysis of this information on site be regarded as a fundamental criterion of effective maintenance. This is confirmed by responses of the subjects on the question of the principal proceed in obtaining a contract for maintenance of a system with following points: "Use technical documents", "carry out a target-performance comparison "such as" Acquaintance with the system". A problem often turn out is a decentralized storage of required documents (see Fig. 1). This leads to time-intensive searching and obtaining the documents before it can be effectively started on the appropriate system.

Due to the above mentioned points of the document-retrieval, information seeking and the subsequent transfer of that information in real conditions, the focus of this study is on the information presentation and transfer in productive AR applications.

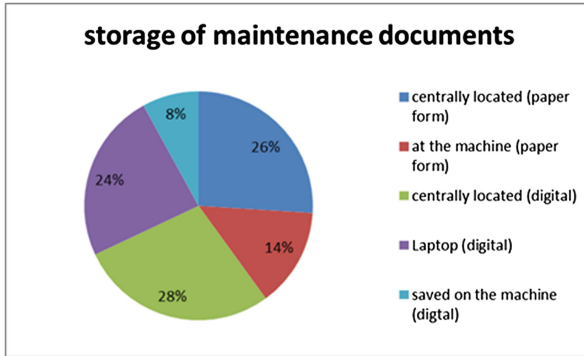


Fig. 1. Storage of maintenance documents

2 Game Design Pattern for Analysis of Digital Games

Heuristics and game design patterns for computer games are becoming more extensive and detailed. Korhonen and Koivisto [4] described heuristics which are developed in an iterative design process of a game for mobile devices. With regard to the requirements of the Augmented Reality supported maintenance it is important to provide adequate information and to integrate the menu into the gameplay. In addition there are approaches to investigate the relationship between games and application software.

Game Design Patterns on the other hand are used to describe models of game mechanics [5]. The aim is to split the game into components from which patterns can be obtained. These mechanisms are recorded and evaluated with help of a unified scheme. Collections of game design patterns allow comparison of concepts and their effects on the game play [1]. The pattern “information” deals with the flow of information within computer games and the possibilities to provide access to this information. Subcategories were dealing inter alia with tooltips, Dialogue designs or information passing. The latter deals with the intuitive transfer of information from a character or object within the game world and is an important criterion of an immersive virtual world.

An example is the use of avatars, which often provide information by changing their appearance, behavior or position in implicit form or as visible entities. Further menu options and selection function can be seen as objects of the gaming world. Thus, a context-dependent representation of these objects also represents an information transmission. It makes sense that the player knows depending on the user interface in which game context he is located on and what further options are available. This context-appropriate information is often used in strategy games to view additional actions. That means for AR there are only information or control options displayed for objects, which are in direct view.

A real transfer between the knowledge from the computer game research and the augmented reality area remains less evident in practice. Thus, research in the area of interaction design for AR applications is focused mainly on showing annotations on the display. White et al. [6] and Zhang and Sun [7] investigate the potential use of virtual

hints in the form of text, diagrams or animations, as well as the spatial orientation and assignment of virtual information to real objects. Henderson and Feiner [2] are showing the overlay of three-dimensional tools as additional support for some production steps. The problem here is the occlusions of the real world and the visualization of correct spatial depth.

3 Implementation in Augmented Reality

One possible approach for an intuitive information management system in augmented reality applications is shown in Fig. 2. The user's attention in the augmented world is controlled with the help of an avatar. The reaction change of the avatar presents the user with an invalid system state and draws attention to the appropriate object. Detailed information can be found on an object associated visualization surface. For Example a digital multimeter symbolizes a bad value. Thus eliminates decoding errors manually or with help of external tools and provides relevant information at first glance.



Fig. 2. Dragging the virtual multimeter as an active object

For further information the user can to drag and drop the virtual multimeter on the real PLC module (Fig. 3).

The functionality is based on the object-object scheme known from simulation- and strategy games. Selecting inherent menu items of the active object can trigger other functions such as graphical representation of measured values. As played here from a bird's perspective, usually many objects are present on the playing surface and can be applied in accordance with each other. An active object (multimeter) is applied to the passive object "S7-module". Other functions such as the graphical representation of a measured value can be triggered by selecting appropriate menu items of the active object.

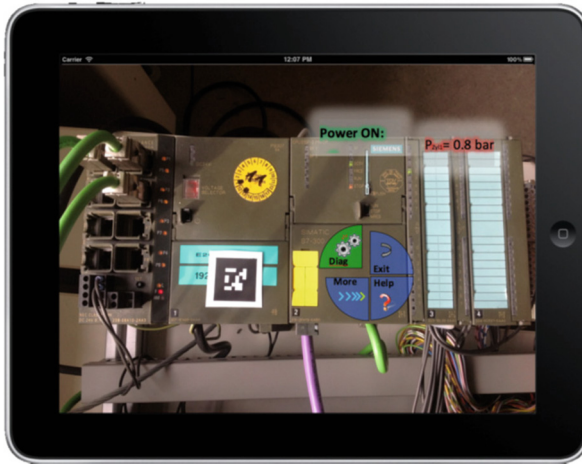


Fig. 3. Selecting module-item to diagnose the S7-EA-Modul the S7-EA-Modul to open module-items for measuring.

References

1. Björk, S., Holopainen, J.: Games and Design Patterns. The Game Design Reader. MIT Press, Cambridge (2006)
2. Henderson, S., Feiner, S.: Exploring the benefits of augmented reality documentation for maintenance and repair. In: IEEE Transactions on Visualization and Computer Graphics, pp. 1355–1368 (2011)
3. Kallergi, A., Verbeek, F.J.: Video games for collection exploration: games for and out of data repositories. In: Proceedings of the 14th International Academic MindTrek Conference: Envisioning Future Media Environments, pp. 143–146. New York, NY, USA (2010)
4. Korhonen, H., Koivisto, E.M.I.: Playability heuristics for mobile multi-player games. In: Proceedings of the 2nd international conference on Digital interactive media in entertainment and arts, pp. 28–35. ACM, Perth (2007)
5. Koster, R.: A Theory of Fun for Game Design. Paraglyph Press, Arizona (2005)
6. White, S., Lister, L., Feiner, S.: Visual hints for tangible gestures in augmented reality. In: 6th International Symposium on Mixed and Augmented Reality ISMAR, pp. 47–50. Nara, Japan (2007)
7. Zhang, F., Sun, H.: Dynamic labeling management in virtual and augmented environments. In: Ninth International Conference on Computer Aided Design and Computer Graphics, p. 6. Hong Kong, China (2005)