WizARd: A No-Code Tool for Business Process Guidance through the Use of Augmented Reality

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Abstract

Complex and extensive processes often cause a decrease in process compliance within an organization. The use of Augmented Reality in process guidance systems offers enormous potential to increase process compliance by providing employees with information at the exact time and location where they are working. For this purpose, we present WizARd, a no-code AR authoring tool in an advanced stage of development for use in business process management, focused on physical processes. WizARd enables the use of AR for both modelling process guidance systems and executing them, and both on the same device.

Keywords

Business Process Management, Process Guidance Systems, Augmented Reality Authoring, No-Code Development

1. Introduction

As part of the ongoing digital transformation of the work environment, employees are confronted with increasing process complexity as more and more sophisticated technology is integrated into work processes [1,2]. The rapid speed of new and further development of products and processes within the business also contributes to this growing complexity [2].

In situations when employees are confronted with extensive and complex written process documentation and process diagrams, they do not consider them useful or even deny using them. Therefore, process guidance systems (PGS) are needed to ensure that employees work in a process-compliant manner [3].

To help organizations manage this complexity, Augmented Reality (AR) technology can be used as part of PGS to provide employees with additional information while performing work tasks [4]. The performance of dangerous, complex or costly work processes could be augmented with contextual visual information provided by a mobile phone, tablet or head-mounted display [5]. The use of AR offers potential for organizations to optimize their work processes in terms of factors like effectiveness and process compliance [5,6]. It could also reduce the need for cost-intensive training for employees [7].

AR is still far from being a mainstream technology in BPM and mainly used in pilot projects. We believe that one main reason for this is the difficulty of developing AR-based business process guidance systems [8,9] . The use of AR in this context requires both programming skills and complicated AR authoring tools as well as extensive knowledge and understanding about the processes that are to be modelled [10].

For these reasons, we are currently investigating the use of AR for the support of service-related business processes to ease process modelling and process guidance. We therefore developed an AR authoring tool called WizARd[2] that enables users to easily model business processes guidance systems and to provide on-site assistance to workers to increase process compliance during their work.

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[2] The tool, a demonstration video and further information are available at https://wizard.tu-dortmund.de/index.php/bpm22/

2. Innovation, Functionality and Characteristics

A major barrier on using common AR authoring tools such as Vuforia Studio or RE'FLEKT One in BPM is the fact that they require expert skills to operate. Due to their large set of features, AR authoring and 3D modeling expertise is needed to develop AR applications with those tools. In general, the development of AR applications is time-consuming and expensive. At the same time, employees who are skilled in AR authoring are not necessarily the same ones who are knowledgeable about BPM, which leads to further problems when attempting to implement the use of AR in PGS.

WizARd is an easy-to-use, no-code tool to facilitate the use of AR in BPM by making written procedural instructions or process diagrams more tangible for employees while they work, in order to increase process compliance by providing visual information [4,11]. As depicted in Figure 1, WizARd can be integrated into the BPM lifecycle to model and execute AR-based process guidance systems. In the first stage, the processes modeled with the BPM can be reproduced in AR through the use of WizARd. In the next step, these processes can then be implemented to support the operators in executing their daily work.

WizARd is not intended or capable of being used as a replacement for standard process modeling languages such as BPMN 2.0 or eEPK but rather to supplement processes already modeled by enabling the use of AR for PGS. We deliberately chose to limit the feature set of WizARd compared to the aforementioned AR authoring tools in order to reduce the complexity of modeling business process guidance. Our no-code AR authoring tool WizARd can be learned quickly and does not require programming knowledge or previous experience with AR.

WizARd is a standalone tool, executed on a tablet computer, with no need to install additional software or plugins or deploy additional hardware. The tool is built using Apple's AR development framework ARKit as well as the 3D engine Unity. These two technologies allow the placement of virtual objects in the real world. As WizARd is designed as a no-code tool, the user interface does not allow users to implement their own code. WizARd runs on Apple iPads driven by iOS 11 or higher. It is strongly recommended to use an iPad with both an Apple A12Z or faster CPU and a LiDAR sensor to get the best AR experience possible when using WizARd. A support of a wider range of devices and operating systems, i.e. Android, is planned.

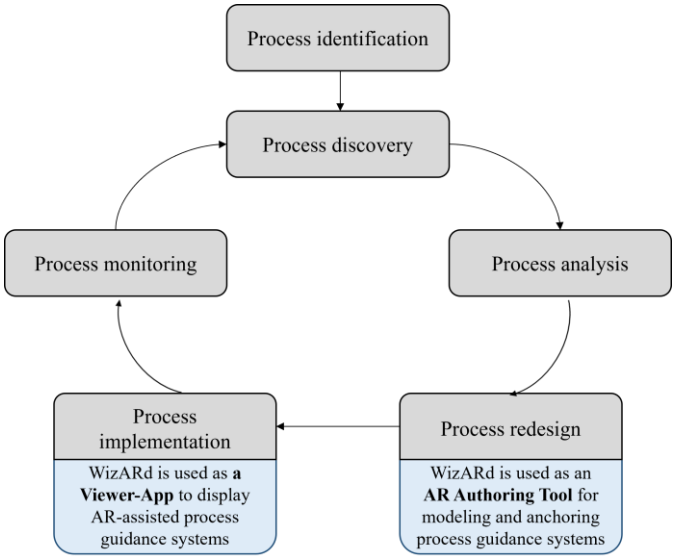

Figure 1: WizARd integrated into the BPM lifecycle. Figure adapted from Dumas, 2017, p. 23.

Thus WizARd, unlike other AR authoring tools, can be used by domain experts to model processes guidance systems with AR on site, rather than requiring AR authoring developers to model AR-based PGSs. Process Guidance can be modelled with WizARd through an easy-to-understand interface that is controlled through buttons and drag-and-drop functionality. Figure 2 shows the process overview interface where each step that needs to be modelled is defined as an individual instruction node. Nodes are

connected into a process sequence by linking them with lines, the order of the nodes can be rearranged through drag-and-drop.

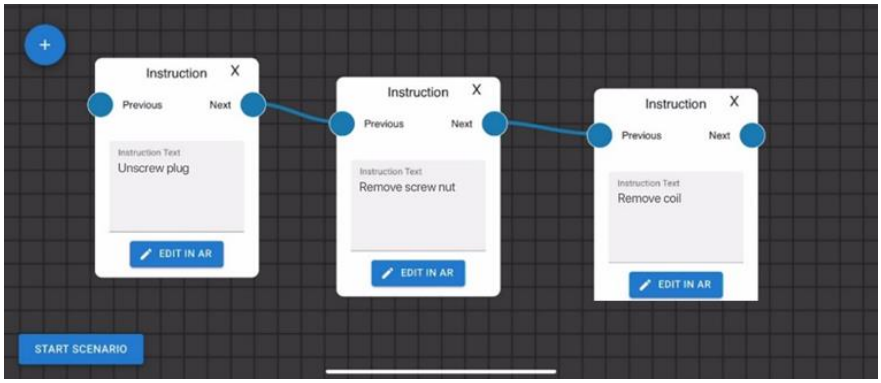

Figure 2: WizARd 2D Instruction node interface

With the button '*Edit in AR'*, WizARd changes into an AR view where users may add both 2D and 3D elements to the environment for each corresponding step. While typical process modelling tools mainly uses 2D content like text, symbols and pictures to depict a process on a piece of paper or computer screen, WizARd also enables the use of 3D elements for PGS. 3D elements are superimposed to objects in the real world in AR. Examples for 3D elements that may be used are arrows, tethers and point of interests (POI) that serve as an in situ guidance to help users navigate to a specific position in their work environment. As demonstrated in Figure 3, a 3D tether may be used to highlight a particular spot on a machine in the real world, i.e. the location of a connector that needs to be removed as part of a maintenance process.

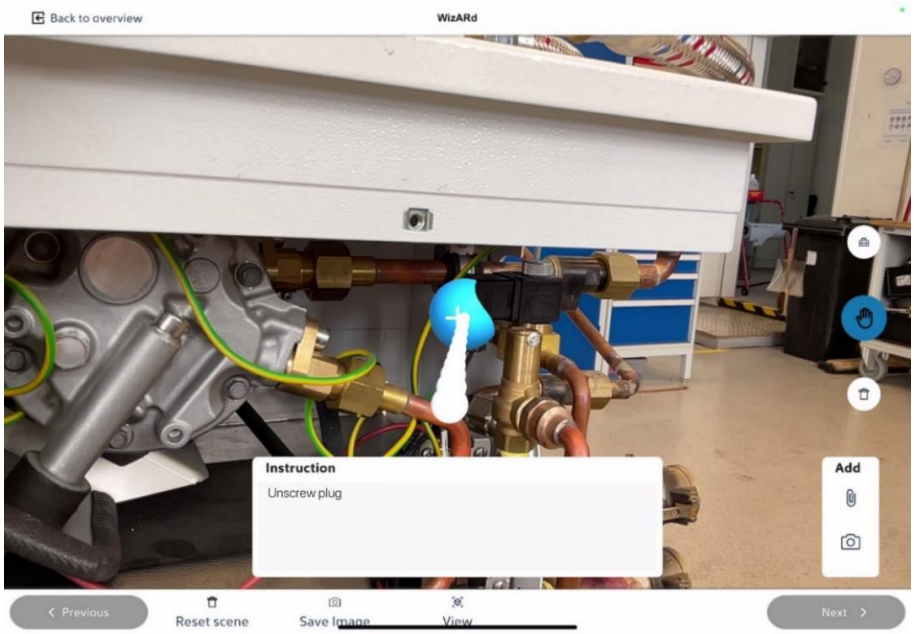

Figure 3: Use of a 3D tether to highlight a specific spot on a machine using AR in WizARd

To start executing pre-recorded process guidance systems, users press the button '*Start Scenario'* to switch into an AR view. They then intuitively follow a previously modelled PGS displaying information step-by-step in AR when and where it is needed, as it is assigned into the user's perception of their real-world environment. They may control the display of information by using the '*Previous'* and '*Next'* buttons, as shown in Figure 3. This AR-based information helps preventing employees from using non-

compliant workarounds instead of following company-defined processes for their work [13]. In particular, the execution of physical work PGS, such as the maintenance of a machine, benefits from AR-based guidance as addition to complex process diagrams and written instructions.

When the decision to use AR is made, the ability to do both modelling and execution of AR-based PGS on the same device is another important feature of WizARd. This also allows the creation of new PGS and improvement of existing PGS by a user directly at the work site.

3. Maturity of the tool WizARd

The tool WizARd is in an advanced prototype stage. As part of a larger project, we have been conducting several forms of evaluations both in an artificial laboratory setting as well as in a naturalistic field environment. The overarching project is embedded in a large-scale, long-term Design Science Research [14,15]

In the naturalistic field evaluation, we verified the ability of our tool to be applied in real organizations within all the complexities of human practice. We employed think-aloud workshops including video and screen recordings and expert interviews with seven participants in industrial service processes on-site at an industrial company. For that purpose, we provided participants with a pre-built AR-based PGS to change a Schrader valve on an energy system to introduce them to WizARd's functionality and operation. After that, participants were given the task of using the tool to create an AR-supported process guidance for different physical process of the same machine. Thus, for example, a service technician modelled a step-by-step PGS on how to change a coil on that machine.

Experts rated WizARd as useful and helpful. All participants understood how to use the tool quickly, both for modelling and executing process guidance systems. The participants appreciated the clear, step-by-step and context-dependent visualization of information required for the process in the form of text boxes, images as well as other 2D & 3D elements such as arrow and tethers. Participants believe that for complex processes, replacing the traditional documentation by using AR-based process guidance systems can come with advantages, not always, but in most cases. In addition, experts stated that training measures required for workers for physical business processes can be reduced through the use of AR-based process guidance but not completely replaced. Though working directly on a machine with AR guidance generates a much greater learning effect than theoretical training.

A detailed step-by-step tutorial, a video demonstration, a download link of the tool, and further information as well as a preview of the results of our evaluation presented in this section are available online at: https://wizard.tu-dortmund.de/index.php/bpm22/

4. Conclusion and Future Work

With this paper we presented WizARd, a tool that enables both the modelling and execution of AR-based process guidance systems for physical processes. Supported by WizARd, users without programming knowledge are able to model their own AR-based PGS without prior programming or 3D modeling expertise. This will help testing whether the use of AR is suitable for BPM in various companies and use cases.

WizARd is an advanced stage prototype, most features that are essential for BPM are already implemented. By using this tool, both modelling and execution of process guidance systems with AR are possible. In addition, data management has been implemented, which entails that modelled AR-PGS can be saved and reloaded via a selection menu.

Future features include (1) increasing the range of components available for process modelling in WizARd, e. g., enabling the import of 3D models and scans such as a 3D model of a screwdriver, (2) enable the use of AR anchors like QR codes in WizARd to allow the transfer of modelled AR-PGS to different environments, and (3) we plan to develop an in-app tutorial that explains the core functions of WizARd within the app using pop-ups, info-boxes, and/or videos.

Initial results from our field evaluations and laboratory experiments currently being conducted as part of a large-scale Design Science research project show that the use of AR with WizARd offers great potential for the area of business process modelling and process guidance. In the near future, we will

present the findings of an evaluation conducted with a large number of participants to examine the usability of WizARd.

5. Acknowledgements

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