Context-aware delivery of interaction tutorials in ambient spaces

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Abstract—Over the past years, the amount as well as the provided functionality of (smart) devices raised, with increasing tendency. In terms of ubiquitous computing and smart home solutions, systems get more embedded into ambient spaces. Recent studies showed, that users are often overwhelmed even in interacting with everyday objects, which can be applied to smart objects and gesture control as well. In addition to an insufficient design a lack of documentation is responsible for this. In this paper we present an approach to create a framework based on formal descriptions of interaction, space and objects to allow a context-aware delivery of interaction tutorials, based on the users needs and preferences.

I. INTRODUCTION

Contingent on further research and development in the area of information and communication technology (ICT) – esp. in Ambient Assisted Living (AAL) and smart home – the number of eletronical devices in households increases steadily. According to a study of BITKOM [1] in 2011 each german household owned 50 electronical devices, with increasing tendency. Additionally, a variety of nonelectronical everyday objects are used in daily live. While users are familiar with interacting regularly used items in households, the large number of required interaction paradigms poses a problem for many. In addition to the quantity of devices and the offered functionality, the associated effort to learn interaction increases [2], which severely impacts the usability [3]. Although, some manufacturers are mindful of consistency and descriptions, but operational concepts don’t follow a common pattern. This divergence in usage can be illustrated by the example of time change. Different mechanisms in clocks to adjust time offer different interaction modalities, which challenges users regularly [4]. Similar complications in interaction have been demonstrated with other household appliances. According to a study, they require tacit knowledge about usage and were poorly documented [5]. While disciplines like UX and industrial design try to counteract this, a large part of today’s objects aren’t developed user-centered and require an explicit description of their interaction possibilities. At the same time and in terms of ubiquitous computing, embedded systems continually moving into daily life [6]. Hereby, half of household appliances in Germany will be connected to each other until 2018 [7]. Since there are issues in self-description of interaction possibilities of everyday objects, those problems will continue due to the progressive usage of smart objects and the possible control by gestures [8][9]. Unfortunately, no gesture alphabet was standardized until now, as well as gesture control has a lack of feedback. As a result, gesture control in general is not necessarily a natural interaction technique and needs an explanation of usage [10].

II. PROBLEM DESCRIPTION

In Living with complexity Norman distinguishes difficulty in accessing interaction with everyday objects, whether it’s the objects complexity (states and transitions) or the interaction is complicated (psychological state of the person, which tries to learn interacting with) [11]. This barrier of complicatedness may be due to several facts. Therefore, users are potentially more familiar with the interaction of objects in environments where they frequently stop (workstation, private residence, etc.), than in environments in which they operate less frequently (hotel rooms, public places, etc.) and have to relearn interactions. As described, this requires a certain degree of autodidactic abilities. Therefore, trial and error is a popular approach to associate an interaction in combination with the systems reaction to the users intention. However, this is an inefficient strategy to learn. Especially in view of medical devices in safety-critical environments this may cause far-reaching effects. According to a study 70% of surgeons and 50% of nursing stuff have problems to use a medical device correctly in OR [12]. 40% have witnessed multiple harmful situations caused by lack of knowledge and missing instruction about correct usage. Something similar may be applied to the context of smart home or Ambient Assisted Living, where users are not aware of device connections [13]. One possible cause of the depicted scenarios is a lack of conceptual mapping of functionality to interaction possibilities [14], which results in complicatedness.

III. PROPOSED APPROACH

In order to prevent incorrect operation, the users cognitive load should be reduced by diminishing the complicatedness accessing interaction with everyday objects and devices. A suitable description and illustration of interaction capabilities and possible state transitions of an object might be helpful for users. In addition, a supportive function after (repeated) incorrect operation of a device could contribute to completion and optimization of a users mental model. Simultaneously, esp. in the context of smart home and Ambient Assisted Living a visual comprehensibility may explain interconnection.
between objects, as well as the consequence of a planned action. Overall, a self-description of interaction modalities and objects interconnections by delivering a suitable representation may compensate deficits in usability inadvertently, before an operating error happens. Established forms of representing and guiding interactions are tutorials or documentations. If those are provided in different types of media, an adaptive delivery depending on the abilities and needs of the user is conceivable. However, an automatic processing is only possible by having machine-readable and structured descriptions of involved components. Therefore, the following descriptions are relevant parts of this approach.

Providing a formal description of interaction possibilities not only on a semantic, but also on a syntactical level might allow an automatized generation of interaction tutorials. Current approaches are limited to the semantical level of interaction [13] [15].

Describing the objects and output devices characteristics as well as interconnections to other objects and features including the connection to interaction descriptions, provides the possibility for enhanced tutorial delivery of smart objects in space.

Allowing a spatial alignment of objects as well as dynamical reconfiguration by adding or removing an object assumes, that the available space with all characteristics is described as well.

Based on that, a modular framework including a protocol for data communication between object, space and output device regarding digital self-description could be defined. Context-aware delivery of documentation respective tutorials may assist users in situ [16]. While providing framework and description languages for spaces, objects and interactions are achievable targets, the use of the strengths of different areas of competence for documentation and interaction definition is necessary. As the designer knows both the complete functionality, as well as the proper interaction, the provision of the objects description and interaction superficially fits within the competence of the developers profession. However, the definition of context, moment of delivery and representation of a medial support, could be the area of responsibility of media- or cognitive psychology. While the adaptive delivery of multimedia content takes place in the context of human-computer interaction, the delivery of the object and interaction description could also allow machine-machine interaction. Using the same technology not only physical, but also in virtual space is a possible extension. Supporting the use of gesture-based input devices to control a PC program might be done, based on a context-aware delivery of such tutorials.

**REFERENCES**