Towards a Service Framework for Remote Sales Support via Augmented Reality

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Abstract. Real-time sales assistant service is a problematic component of remote delivery of sales support for customers. Solutions involving web pages, telephony and video support prove problematic when seeking to remotely guide customers in their sales processes, especially with transactions revolving around physically complex artefacts. This process involves a number of services that are often complex in nature, ranging from physical compatibility and configuration factors, to availability and credit services. We propose the application of a combination of virtual worlds and augmented reality to create synthetic environments suitable for remote sales of physical artefacts, right in the home of the purchaser. A high level description of the service structure involved is shown, along with a use case involving the sale of electronic goods and services within an example augmented reality application. We expect this work to have application in many sales domains involving physical objects needing to be sold over the Internet.

Keywords: Augmented Reality, Service User Interfaces, Customer Service Support

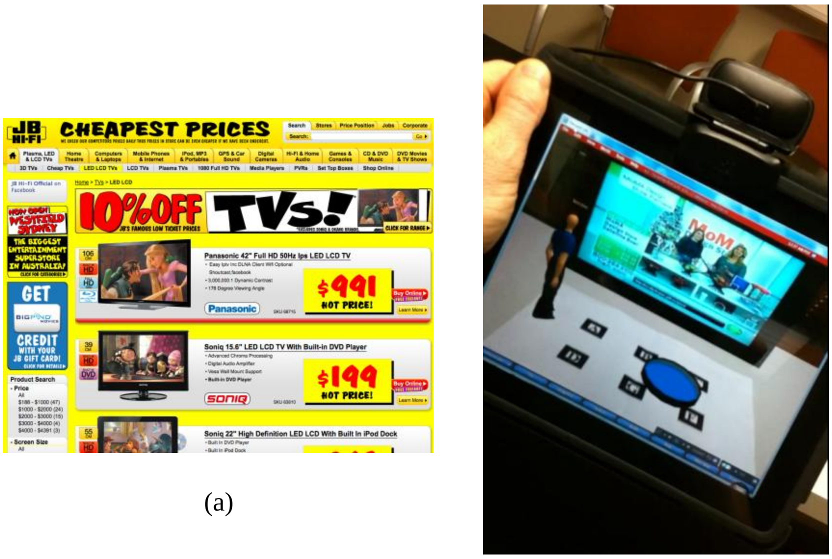
1 Introduction

The explosion of online retail sales has brought with it much convenience for consumers of goods, in particular, digital goods have benefited from their ability to be easily sampled and then purchased, especially in the case of music and video [6]. However, some items remain problematic to sell remotely, due to their inherently spatial nature, requiring physical interaction in order to be sold effectively (for example, cars, musical instruments, clothing, amongst many others). Such physical qualities are difficult, if not impossible, to transmit with the level of immersion available on a flat screen home computer. In such cases, the consumer is forced to visit an actual store to test the artefact they wish to purchase.

Recently, the emergence of the computer game industry has driven the development of graphics and multi-core processing systems, to the extent that high end processing capabilities are available on mobile devices such as phones or tablets [16]. With such computing power comes the possibility to create more immersive environments using Augmented Reality (AR) in order to allow the customer to experience interactively, convincing representations of physical products in their own home, where the products will be juxtaposed with their home environment in order to assist goods selection. Such an AR approach can be positioned as a *Purchase Simulation Service*, providing the user with the ability to perform in-situ analysis of purchases in their home.

AR has been used to provide further synthetic information, overlaid on video feeds of real scenes in order to provide insight into the physical characteristics of information [12], and to assist in remote collaboration [18, 9, 2]. Of particular interest is its ability to provide remote representations that are registered with the physical world, and so facilitate analysis of synthetic representations of objects at the location of the customer. In addition, such environments can be augmented even further with representations of remotely connected sales assistants, who can assist in the explanation and process of explaining the physical device and services needed in the process of the sales transaction [8, 9].

Fig. 1a. shows a typical web-page that displays electronics goods available for sale on the Internet, via an online shop front. We note in this example, that the devices sold are large screen TVs with an online sales option.



(a)

(b)

Fig. 1. Image (a) shows a typical vendor website selling home electronics and related services. Image (b) shows our addition of a spatial context to these representations in order to facilitate decision making by purchasers at home using mobile devices. The image shows a preliminary prototype running an AR application, with a remotely connected avatar demonstrating the features of the TV in the home of the customer.

While such web page approaches are able to present large physical items via images, a number of limitations become evident. Firstly, the customer is unable to examine the product from any angle other than presented in the web page and is unable to see if the product complements the interior décor of their home. In addition, they are unable to determine if it is compatible with other audio or computer devices by inspection; usually this process requires examination of manuals or the advice of a shop assistant in a store. In addition, other services, while easily presented on the web page, may be quite complex to consume (for example insurance) and thus need advice to be presented by a sales assistant. Typical web collaboration tools, such as audio and video environments [14], suffer from problems with a lack of insight into the actual context of actions by the remotely connected collaborator (in this case a sales assistant). The customer may struggle with understanding the actual artefact that is being discussed by the sales assistant, and a lack of relevant gestures and spatial organisation makes the process of service provision by sale staff problematic.

From this analysis we see two main problems with such service provision, the first is the lack of an inherently spatial representation of the product and services, the second is the lack of ability for remote sales staff to adequately interact with customers in order to provide assistance with the product and other aligned services.

In this paper, we present a potential solution to these problems as a novel augmented reality customer sales assistance service framework that provides additional information to a remotely connected customer to assist them with analysis and configuration of their purchase. The key innovation in this paper is the use of a remote representation in a *human-in-the-loop* manner to assist with service discovery and aggregation for a customer engaged in a sales transaction. We show examples from a preliminary AR system we have developed to support these services. We present the framework, the key services offered, interactions within a typical session and illustrate with a use case of a large screen television sale using such a framework. We then conclude with discussion of how this preliminary work may be further developed.

2 Virtual World and Augmented Reality for Sales Services

In order to provide the functionality required for a remote sales service framework, we have built a test system to provide illustrations of the interface components, and to show how a remotely connected avatar can assist with provision of sales services of synthetic representations of physical products. Two major components required are an AR component, to provide the product visualisations, and a Multi-User Virtual World (MUVE) to provide a remote avatar service to the consumer.

The MUVE used in this work was Open Simulator[1], which is an open-source server that allows users to create and deploy virtual worlds over a network. Users are able to connect to Open Simulator servers using a client called a viewer. We use the

[1] Open Simulator - www.opensimulator.org

Second Life viewer[2], which is compatible with Open Simulator. Once the viewer has established a connection with an Open Simulator server, the user receives a figure called an avatar, which the user can personalise and control (see Fig. 1). The avatar serves as a proxy for each user inside the MUVE.

Augmented Reality is an interface mode in which the user is immersed in a world that is real but contains computer generated augmentations. As such it falls in between reality, in which the surrounding environment is completely real, and virtual reality, in which the surrounding environment is completely computer generated [15].

AR systems aim to combine real and virtual world seamlessly in three dimensional space and allow for real-time interactions [1]. They provide information that is not readily available to human senses to facilitate tasks [1]. The video-see-through approach to AR, which we use in our prototype, works by capturing an image from real space then adding the virtual objects and displaying it on some kind of screen, often on a mobile device (refer to Fig. 1). For this method a camera that is positioned and oriented approximately similar to the display in space captures an image of the real space as seen from the perspective of the user. Virtual objects are then drawn into the image with 3D graphics rendering approaches.

To enable the illusion of virtual objects existing in the real space, a consistent registration between virtual and real space is required [1]. Tracking is used to register the positions and orientations of the user and relevant real-world objects in the mixed reality space [24]. We use an icon based tracking approach, as shown in Fig. 5, to perform this registration.

It has been found that AR can help to overcome many of the shortcomings of current user interfaces and allows for more natural interactions and communication between users. This happens because they merge the task, communication and work spaces into a whole communication channel. The position of participants relative to each other is the same in real and the virtual world. Due to these spatial relationships, related communication behaviours, such as pointing and gazes, are supported [3]. Since AR includes images of the real world, users can see each other, which supports body-language communication better [11, 19]. Kiyokawa [11] demonstrated the importance of users seeing each other for collaboration and the position of task space in relation to communication space for task performance. Support of these communication cues decreases interruptions and communication overlap.

Since each user has his own view (7, 19) AR interfaces can also use space more efficiently to place service information around the user and allow private display of information to relevant people. This also allows the use of peripheral senses to perceive information that may contribute to a task, without interrupting the user's focus through data overload, as described by Ishii and Ulmer [10]. In the MagicBook project Billinghurst, Kato and Poupyrev [4] demonstrated collaborative exploration of spaces in a story across multiple reality modes with similar results. All these features have shown benefits to computer supported collaboration in co-located work settings.

In addition, such capabilities are beneficial to remote collaboration as well. Regenbrecht et al. [19] and Uva, Cristiano, Fiorentino and Monno [23] have applied AR to

[2] Second Life – www.secondlife.com

augment co-located as well as remote product configuration and development. Lee, Rhee and Park [12] have applied it to prototyping and evaluation of product design. Billinghurst, Kato and Poupyrev [4] and Regenbrecht, Haller, Hauber and Billinghurst [20] demonstrated the merging of virtual and augmented reality to facilitate both co-located and remote collaboration.

Similar work has been carried out in the space of AR for use in related areas to sales, including sales recommendation systems [8], IT technical help desk systems [9] and ubiquitous house service simulations [13]. In each case, some services are proffered within the application, but what is lacking is the ability of a remotely connected collaborator to discover, orchestrate and aggregate the digital services in real time. This has not been done before to our knowledge, and we believe the use of AR Avatars will facilitate the ability of remote service aggregation by humans in much more intuitive fashion than standard 2D interfaces in such a remote collaborative setting.

Media Rich Theory promotes concepts of immersion and engagement [5] brought about by the closeness of the representations to objects required for the task at hand. We can then postulate that customer purchase intentions may increase in strength by use of immersive technology, due to the closeness of representation providing the ability to support remote decision making in purchases [22]. In addition, due to the digital nature of the presentation, other digital services can be presented in-situ, thus potentially motivating the customer to consume them, as the sense of immersion, on presentation of the service, is not broken.

Therefore, there is a need to provide the ability to present synthetic version of physical objects. Digital sales of products such as music and magazines, are easily assimilated into online delivery channels (for example, iTunes). Other physical object, such as musical instruments, cars, houses, amongst others, do require, in part, a physical intimacy with the object in order to ascertain its suitability to the purchaser.

However, it can be argued that some home products, such as TVs, sound systems, whitegoods, kitchen devices and furniture, fall into a category that may be readily supported by AR sales services. Each of these can be evaluated more for their appearance and functionality in the home of the purchaser, and are less reliant on requiring a physical interaction to be sold. Key to this presentation approach is a number of factors, first the presentation of the product in the home of the user, the explication of the product features and then aligned services to be presented to the consumer. All of these have been utilised in person by other home sales companies (for example, Amway, Avon, Tupperware) but such methods can be expensive and require costly travel and the inconvenience of sales site setups.

The product features can be presented via animations and videos, but the major contribution here is the use of a remotely connected sales assistant to answer questions and engage with the consumer to establish rapport and support the consumer in their purchasing decisions. Our readings indicate that by applying an AR interface to remote services in a MUVE, it should be possible to create a tool that is intuitive to use and supports a high quality, immersive form of remote collaboration to provide services at the point of sale for physical artefacts. We now show a preliminary service framework and AR implementation to support this approach.

3 Prototype AR Service Interaction and Aggregation Implementation

The AR sales service framework consists of the following key components of services, context management and major interactions involved in product configurations. We focus on the product configuration in this paper, as it is the most novel component of our work, and we consider transactional components can be implemented using service structures that have already been developed [17]

3.1 Service Manifest

We have implemented a prototype using a MUVE with added Augmented Reality features in order to facilitate the in-situ discovery and aggregation of services in a 3D graphical manner for point of sale services.

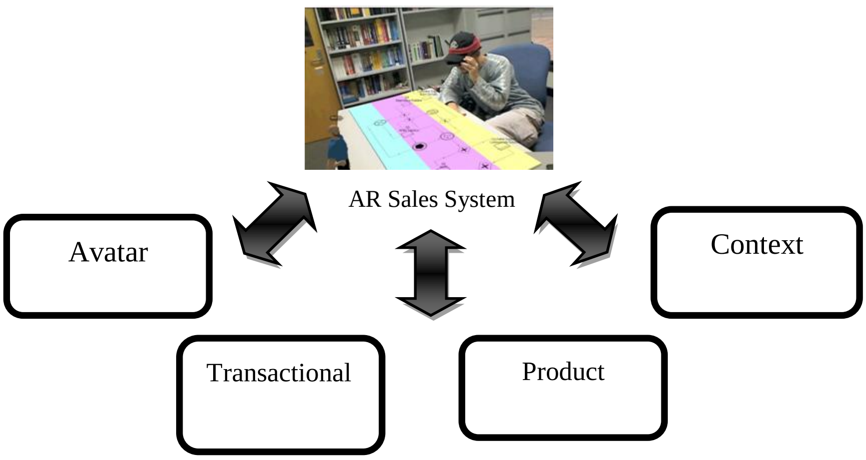


Fig. 2. Illustration of the major components of our AR Service Framework, all of these services are accessed from within the AR Sales System that is used by a customer.

The AR sales service framework contains four major high-level services: Avatar, Product, Context and Transactional, as illustrated in Fig. 2.

- Avatar Service – chat bot or human controlled [21], providing a graphical representation of a sales assistant providing information about product capabilities, service interactions and compatibilities;
- Product – product information, in particular, 3D representations to be sent to the AR application and compatibility information with other available products;

- Context – management of customer account information, including physical location information, relative contexts at the customer location and stored product configurations in previous transactions.
- Transactional – other allied services to the main sales transaction, such as, best price services, credit services, insurance, amongst others;

These services can be offered as a human mediator via remote connected sales personnel, or an assisting chat bot. Each of the services integrates to provide a simulation of purchase, which we believe may increase intent to purchase [22], and is thus could be a potent remote sales delivery concept.

3.2 Context Management

Absolute Context. The absolute context for data in this framework is derived from the customer location. This is the main spatial point from where the transactions occur within the wider geospatial context (see Fig. 3). In the context of our use case shown later, such an absolute context can be considered to be the home address of the person making the purchases, so we name it as a *Customer Context*. This absolute context contains information regarding customer physical location and the set of customer transaction histories and relative contexts within the house.

Relative Context. Our relative context approach is an adaptive spatial subdivision of the house, known as a *Region Context*. This structuring is derived from the observation that the internals of the home of a customer are divided up into rooms and form a natural context for purchases within a house using an AR system. Instantiation of this context occurs when the AR marker pattern is laid on the ground, wall or roof of the room and is annotated with a text tag, for example, "Lounge Room East Wall." Any finer subdivision of the house would be problematic, due to unnecessary redundancy, and follows the structure of other research work in this regards [12].

In addition, there is no real way to identify the exact GPS location down to fine resolutions inside a typical house using present technology. We show, however, that users may tag multiple registration events within a room via a text term, such as, "Lounge-TV-Wall," "Lounge-Table-Centre" and that the high level model allows for merged regional contexts within a tag. The examples in this paper use marker-based AR. Even with the adoption of marker less approaches [24], such a service framework will still require some form of tagging by users to identify a session, so the information requirements remain consistent, no matter the technology used.

The data stored in the region context includes the set of services for the configuration, associations to other region contexts with regards to merging operations and a set of product configuration choices that have been previously created by customers.

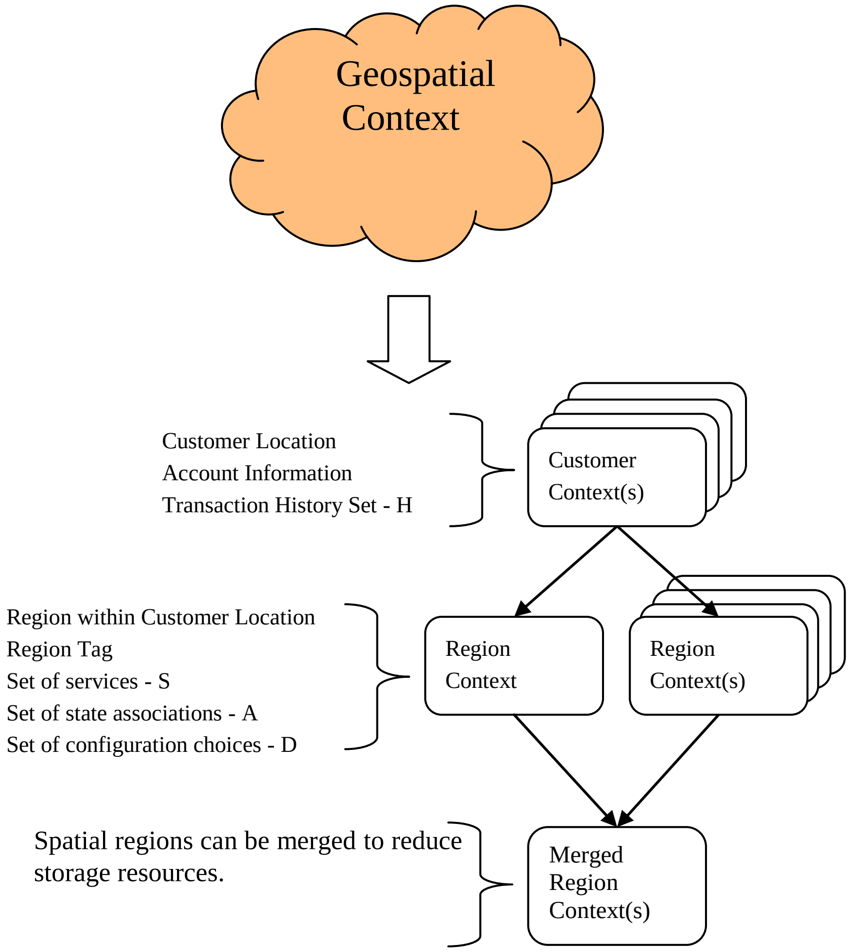


Fig. 3. Illustration of the main components used in context management, viz. an Absolute Context (Customer) and Relative Context (Region). Multiple customers can be allocated to physical locations, with multiple regions used within a house. We control the generation of contexts, by providing a merging capability, to integrate similar relative contexts.

Such contexts are made available via a service to allow for a number of possible configuration modalities. For example, a customer may have already enquired about a product using a mobile phone in a shop, but wishes to check the configuration in their home using the AR application. The contexts are therefore available from other software modalities, such as web-systems and normal mobile applications that are not augmented reality in nature. This allows for the user to load up previous enquiries in the AR application and then view them in-situ, to determine if they should be actually purchased. Our use case will show an AR configuration example only, but it is in principle possible for other methods of enquiry to be integrated into this framework, providing a much more general solution to consumer services using this AR application.

3.3 Service Interactions

In previous work, [21] a five stage model has been developed for the interactions between virtual sales agents and customers. However, their model does not include product configuration as a component, as only single items are sold. Therefore, the interaction model in this framework has been developed to suit the emphasis on product configuration that we wish to describe. The intention is to allow for both software and human agents to interact with customers in the environment to provide a general solution. We illustrate this interaction model below, in Fig. 4. It has two major activities, the creation of the appropriate contexts, related to the marker pattern laid down by the customer in their home, and the process of configuring the product required by the customer, which may be a combination of a number of products in a spatial organization.

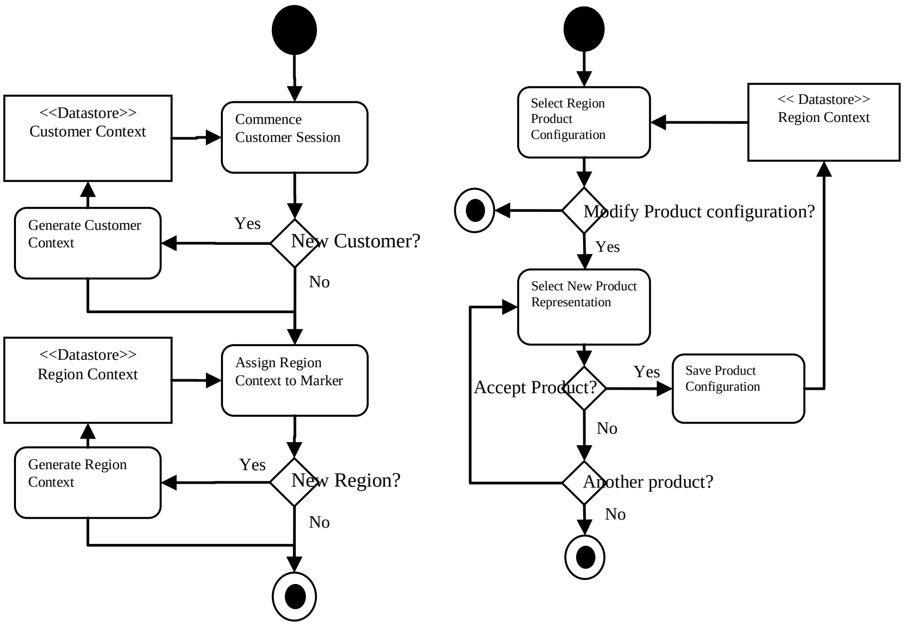


Fig. 4. Service activity diagrams for the use case illustrated, the diagrams illustrate the context creation step (left) and the configuration phase for our particular sales domain (right).

In the above interactions, it should be noted that the avatar is able to support the key decision points in the interactions, either by being a live human directing the customer as a remotely logged in avatar, or by a chat bot service that provides feedback information from a product knowledge base, typically implemented as an expert system [21].

4 Use Case

In this section we use the sale of audio goods to provide examples of the interactions and service aggregations used in guiding the user through a sales transaction, based upon the previously illustrated modelling.

4.1 Scenario

Our example customer is intending to purchase a large screen TV, potentially with related audio equipment and furniture. We present the customer with a front-end selling environment for electrical goods as an application on their mobile device. The customer is at home and places an augmented reality registration pattern onto the ground (see Fig. 5), where the actual television is to be installed. A dialog appears requesting customer information (creating a new *Customer Context* if needed for the customer address) and then asks for a text tag to be applied to the marker location (creating a new *Region Context* if needed). The user tags the marker with "Lounge Floor East." A sales representative is alerted to the creation of a session, and logs in from the other end to assist with any questions.

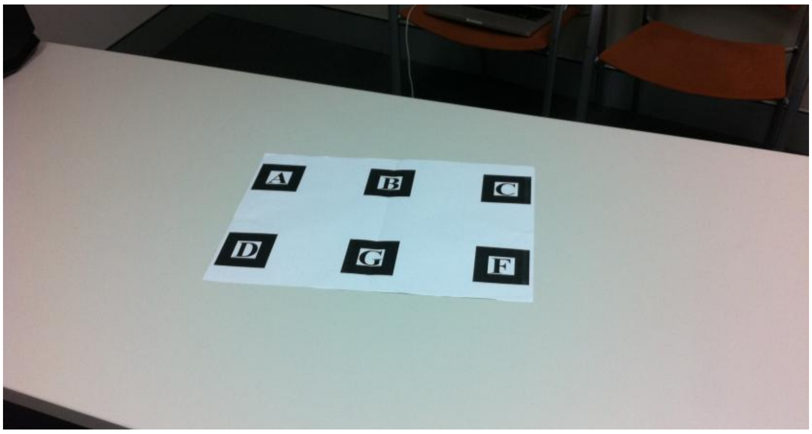


Fig. 5. Illustration of the coordinate system registration marker, which anchors the position of the objects to be sent to the viewer. This marker is placed at a location in the home close to the location of the desired objects and is tagged by the user to identify a Region Context.

The user requests to view large screen televisions from a specified brand available from this seller, along with appropriate entertainment furniture. A large screen television of a brand of interest is brought into the display, which the user can see in their room through the AR application. The remotely connected avatar then demonstrates the features of the new television, see Fig. 6.

Fig. 6. Illustration of an avatar showing the key features of a product; in this case showing the remote control features on a television set.

The sales assistant asks if the customer wishes to see some related furniture and audio equipment, to which the customer gives assent. A selection is provided, that are compatible with the large screen television, and in this case the furniture is compatible to the weight of the television. The audio equipment is inspected for compatibility (such as fiber optic audio) and is also checked via web services shown with the AR view (see Fig. 7).

Fig. 7. In this image the avatar is accessing information services for the customer regarding furniture for the TV using an invoked web service within the application.

The user then asks to see where the best prices are for this device, which is shown on the side of the view as a web page from a best price service (see Fig. 8). In addition, credit services can be displayed displayed along with insurance tie-ins for this company. The purchase is made via linked application for credit, and the session is the ended, with the information saved to a sales history for the *Customer Context*.

Fig. 8. Illustration of an avatar displaying the Best Price service for large screen televisions.

5 Conclusion

In this paper we have outlined a high-level framework for services in customer transactions, mediated by AR technology. A number of novel elements have been introduced and developed. Firstly, the use of AR technology has been explored, with regards to assisting users to simulate their purchases in their own home. Secondly, we have introduced the concept of using an avatar to guide the user through the process of purchase remotely, assisting with interactions with other services that are required in the process. Finally, we have outlined the data requirements to support such an approach, providing high-level definitions for the services, absolute and relative context information and relevant product configuration service interactions. A preliminary implementation of the interface concept was shown to illustrate the service framework via a use case regarding the purchase of electronic entertainment goods.

All the examples in this paper have been shown on a desktop system, linked to a tablet via VNC. Future work will include the implementation of this framework within an appropriate mobile tablet device or smartphone and the full integration of the sales support services. Furthermore, we intend that this framework will be augmented with a purpose built scripting language, which will, in a similar vein to level editing systems in virtual worlds and games, enable the easy creation of sales service scenarios that can be embedded within AR applications.

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