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CONCEPTUALIZING CONTEXT FOR ADAPTIVE PERSVASIVE COMMERCE

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Abstract

In retail, demographics are currently regarded as the most convenient base for successful personalized marketing. However, signs point to the dormant power of context recognition. While technologies that can sense the environment are advanced, questions such as what to sense and how to adapt context are largely unanswered. In this paper, we analyze the purchase context of a retail outlet and suggest a context model for adaptive pervasive commerce. Furthermore, we introduce one approach how to conceptualize context that may be applied to conceptualize context for adaptive pervasive advertising applications so that they really deliver on their potential: showing the right message to the right recipient at the right time.

Keywords: context-adaptive systems, contextual advertising, pervasive commerce, context.

1 Introduction

‘Pervasive Commerce’ promises retailers the ability to reach out to customers electronically, at any time and anywhere in physical space. Vendors’ goals are to influence consumers’ purchase decisions at the right moment and in an efficient way. Because the point of sale is still the site for 91% of earned revenue (compared to only 9% in web-based electronic commerce) (Handelsverband, 2010) and 75% of purchase decisions (42media, 2010), advertising within retailers’ business premises is key for marketing success.

Still, reaching out to the customer in the right spot (where he or she makes a purchase decision) may not be enough. In recent years, advertising effectiveness has suffered dramatically. Consumers have become blind to promotional messages as they are overwhelmed by their quantity. Only personalization mechanisms seem to promise the ability to break through the information clutter. Based on socio-demographic customer-segmentation and market basket analysis, products, services or content are tailored to consumer needs (Mulvenna et al., 2000). Yet, current approaches to personalization have their limits, because the resulting segments are too broad to be effective. Every person has different needs in distinct situations, what is not considered by socio-demographic segmentation. Here, the power of context recognition for personalization may remedy the situation, because a wide variety of situational variables come into play.

Online (e.g., Adomavicius et al., 2005) and mobile (e.g., Yuan and Tsao, 2003) personalization mechanisms have used contextual information for years. Recommender systems like Amazon’s ‘customers who bought’ suggestions are popular (e.g., Yuan and Tsao, 2003, Adomavicius et al., 2005); one of Google’s key success factors is that it can powerfully adapt advertisements to a user’s context (e.g., language, location, current search interest, etc.). Consumers’ particular behavior in different contexts could therefore become key for how advertisements are designed and placed in the future also at the point of sale (POS) (Rehme, 2010, Smith, 2004). Yet, applications for context-adaptive advertising in the technology-enhanced ‘offline world’ – such as adaptive digital display advertising (often coined ‘signage’) (e.g., Müller et al., 2009, Goldmedia, 2009) or ambient shopping environments (e.g., Maass and Janzen, 2007) – are rare exemptions.

System designers find it difficult to elicit user requirements; they are challenged what context information they should collect and how they should combine them in a way that creates a meaningful adaptive service. A common method to gather information is to interview users about their tasks. But what should users be asked in the field of advertising?

Against this background the present article pursues three goals: First, we propose a high-level process model for context-adaptive service development. This model provides a structured overview of the step-by-step challenges involved in the provision of pervasive commerce services (Section 2). We then turn to pervasive commerce as a key field for adaptive future services. We suggest one possible methodology how context models could be developed in a meaningful way. This methodology may be used as a set of guidelines to systematically conceptualize context before developing an adaptive service (Section 3). Third, we propose a context model for adaptive pervasive commerce that needs to be addressed if adaptive pervasive commerce was to become a reality (Section 4).

2 The process of context adaptivity

Context-adaptive systems have been studied from myriad angles with researchers employing various terminologies. However, it is often unclear whether ‘context-aware’ or ‘context-sensitive’ systems are the same as ‘context-adaptive’ ones. Computer science researchers in the field tend to give different names to similar problems while concentrating on working architectures, prototypes and toolkits (Baldauf et al., 2007, Hong et al., 2009, Dey and Abowd, 2000a) and data capture and aggregation challenges (Ferscha et al., 2002). Little systematization of these diverse activities has occurred. As

real-world deployments emerge, a more structured view of the field's activities and achievements may be beneficial.

We therefore set out by proposing a process model for context adaptivity that integrates the different research threads of context-aware computing; this model also provides an overview of the sequence of challenges engineers face when designing a fully functional and meaningful adaptive service (such as contextual advertising). As depicted in Figure 1, there are four phases of challenge

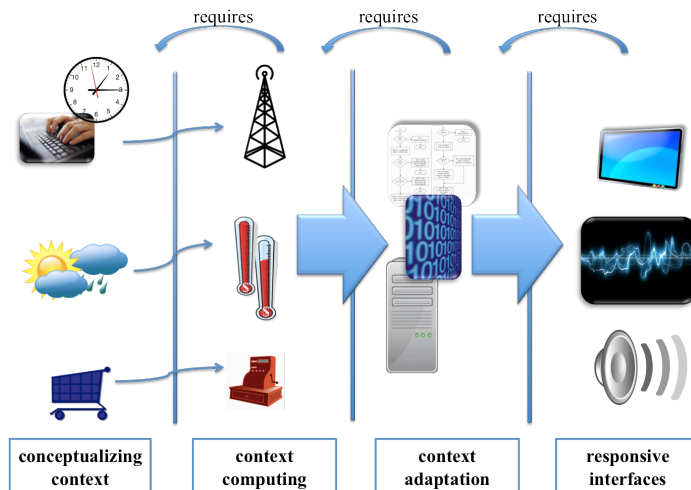


Figure 1. The process of context adaptivity

The first step is to ‘conceptualize context’: to systematically identify the full spectrum of context variables that can be used to meaningfully interpret a specific adaptive service. In later sections of this article we will focus on this step of ‘**conceptualizing context**’ for adaptive pervasive commerce and demonstrate the complexity of detecting meaningful context variables. In the second step of the process, ‘context computing’, relevant sources of context information are identified and collected. The goal of the next phase is to intelligently adapt to the context that has been detected. Adaptivity mechanisms then use algorithms to translate the captured context into the desired action. For instance, a system may automatically tailor content to users. Finally, in the responsive interfaces stage, the computed personalization action is operationalized and presented.

In the following sections, we describe the four phases of adaptive service engineering in more detail and comment on what these phases imply for the realization of pervasive advertising scenarios.

2.1 Conceptualizing context

To seamlessly support a user's activities, one must understand context from various viewpoints (Bradley and Dunlop, 2005). “How are dimensions of context identified, quantified, and interrelated for each situational purpose?” (Bradley and Dunlop, 2005). The first step to answering this question is to conceptualize context. We define context conceptualization as *the process by which a personalization situation is deconstructed into measurable and logically disjunctive information units, all of which must be combined to create an adaptive service.*

Some scholars in the field already proposed models for context, primarily as a mean to position their own work. Many existing definitions of context are built on enumerations of examples (e.g., (Schilit and Theimer, 1994, Dey, 1998)) or on choosing synonyms for context (e.g., Brown et al., 1997) (cf. Dey and Abowd, 2000b). Common categories include a user's location and environment, identities of nearby people and objects, and changes to those entities (Dey, 1998). A very generic definition of context, for instance, implies that context is anything that is relevant to an entity (Dey and Abowd, 2000b). In contrast, other definitions are highly specific to a certain application (e.g., Müller and Krüger, 2009).

4.1 Retailer's environment

4.1.1 Product and service demand

On the macro level of consumers' product and service demand, the typical shopping basket consists of a set of items purchased by an average customer during an average shopping occasion. The methodological toolbox that enables researchers to study the composition of such product bundles is referred to as market basket analysis. It is typically done at the national level (Mild and Reutterer, 2003, Manchanda et al., 1999). Based on purchase information at a certain store, the shopping basket can be broken down for a certain store (micro level). On a situational level, measurements can relate to an individual shopper; for instance, one can measure the actual contents of a shopping cart.

In one scenario, a market basket analysis computes high demand for rye bread by an average customer. The system recognizes that a particular customer does not have rye bread in her shopping cart. In a next step, based on a certain algorithm (predefined in the adaptivity phase), the system presents an advertisement for rye bread on a nearby display.

4.1.2 Product and service offer

The macro level describing a retailer's offer should typically recognize the availability of goods and services. Sophisticated contextual advertising could automatically adapt to the stock. General availability on the market (at the macro level) may be more abundant than availability at a specific site (micro level) or on a shelf (situational level).

This factor can be operationalized in an advertising scenario; for example, a woman who wears size 4 shoes enters a shop and sees a pair of red shoes. The system is aware that this shoe model is out of stock in shoe size 4 in this particular shop. In a next step, the adaptivity algorithm could then, for example, cause the display to show an advertisement for a similar red-colored shoe model that is available in size 4.

4.1.3 Advertising campaign

An advertising campaign is a series of advertisements that share a single idea and message. It includes the information that is adapted to the context in contextual advertising.

On a macro level, we consider a retailer's marketing strategy, which provides the frame for any kind of advertising activities. The micro level involves the campaign for a specific store. It has to consider which advertisements (out of the set of advertisements of a whole campaign) should actually be displayed and controls for possible restrictions. This level considers which advertisements (out of the set of advertisements of a whole campaign) should actually be displayed and identifies controls for possible restrictions. The situational level deals with the actual advertisements displayed. For example, there may be a reduced price policy for products nearing their expiration date. In a purchase situation, a consumer may encounter one advertisement of this campaign.

4.2 Physical environment

4.2.1 Location

We take a sociological approach to location. A store in Vienna very likely looks different to a store by the same retailer in Paris. Even two stores of two distinct districts within a city may largely differ as the subcultures visiting these stores vary (Schaninger et al., 1985).

On a macro level, we view location from a regional perspective, considering the people and their preferences in stores in the particular region. On a micro level, we then distinguish a specific site within a region by identifying its particular 'microcosm' (Anderson et al. 2000). For instance, a specific store may correspond to the average store in the region or be an 'outlier'. On the situational

level, we are even more specific within the microcosm and refer to the actual position of a consumer in the store at hand (e.g., in front of the cashier, next to the refrigerated display case). A consumer will respond differently to impulse advertisements in front of cashiers than to the same advertisements in one of the aisles where no impulse goods are sold.

4.2.2 Non-manipulable environmental conditions

Time: Temporality can refer to particular points in time or general time periods. A point in time – for instance, 7 p.m. on a particular day – can inform the characterization of an advertisement situation. On a higher level, relevant time periods include seasons (e.g., summer, winter, Christmas, Easter) and special time periods such as Valentine’s Day.

The conceptualization of a system may consider time of day as a relevant parameter. In a later step – the phase of context computing – a system could be equipped with a clock. The adaptation mechanism could then act on a schedule.

Weather: Weather is most commonly associated with temperature, rain and wind force. However, weather refers to more factors than just these three. On a macro level, we consider climate as a generic, broad factor. On a micro level, we may consider a wide range of variables such as temperature, wind force, wind-chill factor, air humidity, barometric pressure, cloudiness, rain or snowfall; we may also consider forecasts for changes in any of those variables. On a situational level, the weather determinants act in combination. While the micro level still considers the factors generally, in this level we observe the situation in a very specific setting (at a particular site at a particular point in time). While, wind force, for instance, may be weak in a region, it might be much stronger right in front of an advertising display.

4.2.3 Manipulable environmental conditions

Atmospherics is perhaps the most studied manipulable contextual element for retail environments (Bitner, 1992). It can affect consumers’ attitudes in various ways. For instance, retailers seek to create an atmosphere that promotes cross-buying (Puccinelli et al., 2009). Cross-buying is defined as buying other products and services as opposed to buying more of what a consumer bought before. We consider atmosphere at the macro level of our conceptualization. On a micro level, we include atmospheric determinants in a store including (in-house, i.e. manipulable) temperature, air quality, sound, (functional) music and odor (Bitner, 1992). On a situational level, again, these determinants act in combination at a particular site at a particular point in time. For instance, the system may detect that the consumer in front of a display is in a bad mood. Accordingly, it spreads ethereal scents to set her in a happy mood.

4.3 Consumer’s environment

4.3.1 Social environment

Social environment refers to an individual’s perception of a space. On a macro level, we consider whether a space is perceived as public or private (cf. Hillier, 1999).

On a micro level, we refer to the social density of the respective space. A very strong aspect of how people perceive a space is whether other people are around. If other people are around, their number and level of interaction with an individual influences that individual’s perception of the space. On a situational level, we consider an individual’s interaction with co-shoppers or the retailer’s employees as situational context. For example, a system detects that a couple is gazing at a display and is aware that they sympathetically interact. Accordingly, it presents an advertisement showing a couple (thus representing a similar situation) and introducing a new product. This form of adaptivity mechanism can only be implemented when social density had been considered during the phase of conceptualizing context.

4.3.2 Buying process

On a macro level, we consider the task a consumer is engaged in when viewing a display. In retail, this task naturally is shopping. In a shop, the consumer might want to buy something specific (purposeful purchasing) or might just be looking around, the latter of which could lead to an ad-hoc purchase.

On a micro level, we consider the buying process (needs recognition, information search, evaluation, purchase, post-purchase). Every stage of a buying process (needs recognition, information search, evaluation, purchase, post-purchase) defines different consumer goals (i.e., shapes a different context) and triggers different consumer behavior (Puccinelli et al., 2009). Consequently, the footholds for effective advertisements are distinct in each stage of the buying process. On a situational level, we consider an individual's purchase objective, such as the specific product sought.

For instance, when a system may detect that a consumer is in the stage of evaluation. Accordingly, it can replace advertisements of specific products on a display with showing an overview of a scale of fitting products with detailed properties. For this example, it is crucial to consider the stages of the buying process during context conceptualization. Context conceptualization is the basis for the identification of adequate measures in the context computing phase.

4.3.3 Consumer profile

Stable segment traits: On the situational level, stable traits include those variables of a profile that cannot be changed in a specific adaptive advertisement moment (e.g., sex, height) or evolve very slowly over a consumer's lifetime (e.g., personality traits, age, social status). On the micro level, we consider the consumer profile of an advertiser's target group. This profile characterizes the typical audience of the advertiser. For instance, when a consumer gazing at the display is a male adult, the system should show advertisement for men instead rather than for women. In this case, the thorough conceptualizing of the 'stable segment traits' variable strongly contributes to the development of an effective adaptivity mechanism.

Dynamic segment traits: Puccinelli et al. (2009) argue dynamic factors such as affect, mood, emotions, and feeling clearly influence all stages of the consumer buying process. They further claim that consumer affect may trigger affect-congruent memories. Pervasive advertising can call on this influence by manipulating such factors to its advantage. On the macro level, we refer to the dynamic traits of the (market) segment. The micro level includes the unstable traits that a retailer's customers may encounter. Such traits include socio-demographics and individual behavior. On a situation level, we consider all unstable parameters – such as mood – that may vary while a consumer is visiting a store. For instance, when the system becomes aware that a consumer is very emotional at the moment, it may display emotional advertisement for a hedonistic product instead of product information.

5 Conclusions

In today's advertising industry in retail, context plays an increasingly important role. Existing adaptive advertising systems tend to account for individual dimensions without considering the big picture.

The key is a thorough conceptualization of context, considers the various aspects of context information. Taking a top-down and bottom-up approach, we have demonstrated the importance of viewing various kinds of context from different angles and integrating stakeholders' perspectives. Additionally, we found that context variables have to be considered at a higher degree of precision (macro, micro and situational level) than existing context model did. Conceptualizing context this way allows capturing the situational picture from the consumer's perspective. Applying this model will enable researchers to get a broader picture of their applications. System designers will be able to select the most relevant ones from the full scope of context variables.

Among academic experts, the model has proven useful and coherent. In a next step, we will evaluate whether this model can be meaningfully applied. The methodology description should inspire scholars

to take a similar approach for system design. Future research will include a third phase of model development where retailers and store managers (actual future applicators of such a system) will be invited to evaluate the model. Having a comprehensive model like this raises research questions about how different contextual factors across the model might interact, how systems might be designed to adapt to multiple contextual factors, and how additional response devices (other than simply visual displays) can be used to react to contextual factors.

While we will never be able to compile a complete list of context variables, research needs to undergo a continuous process of conceptualization. We have provided a basis for pervasive advertising. For further advancement, researchers are encouraged to apply our context model for pervasive advertising to other adaptive advertising applications in retail.

References

- 42media (2010). MediMax: Der moderne Vorreiter der Elektronikfachmarktbranches.
<http://www.42mediagroup.de/MediMax.147.0.html>.
- Adomavicius, G. et al. (2005). Incorporating Contextual Information in Recommender Systems Using a Multidimensional Approach. *ACM Transactions on Information Systems*, 23 (1), 103-145.
- Adomavicius, G. and Tuzhilin, A. (2005). Toward the Next Generation of Recommender Systems: A Survey of the State-of-the-Art and Possible Extensions. *IEEE Transactions on Knowledge and Data Engineering*, 17 (6), 734-749.
- Baldauf, M. et al. (2007). A survey on context-aware systems. *International Journal of Ad Hoc and Ubiquitous Computing*, 2 (4), 263-277.
- Bitner, M.J. (1992). Servicescapes: The Impact of Physical Surroundings on Customers and Employees. *Journal of Marketing*, 56, 57-71.
- Black, D. et al. (2009). Supporting the Supermarket Shopping Experience through a Context-Aware Shopping Trolley. In *Proceedings of the 21st Annual Conference of the Australian Computer-Human Interaction Special Interest Group: Design: Open 24/7*, p. 33-40, Melbourne.
- Bradley, N.A. and Dunlop, M.D. (2005). Toward a Multidisciplinary Model of Context to Support Context-Aware Computing. *Human-Computer Interaction*, 20 (4), 403-446.
- Brown, P.J. et al. (1997). Context-aware applications: from the laboratory to the marketplace. *Personal Communications*, 4 (5), 58-64.
- Dey, A.K. (1998). Context-Aware Computing: The CyberDesk Project. In *Proceedings of the AAAI '98 Spring Symposium*, p. 51-54, Palo Alto, CA.
- Dey, A.K. (2001). Understanding and Using Context. *Personal and Ubiquitous Computing*, 5 (1), 4-7.
- Dey, A.K. and Abowd, G.D. (2000a). The Context Toolkit: Aiding the Development of Context-Aware Applications. In *Proceedings of the Workshop on Software Engineering for Wearable and Pervasive Computing (SEWPC 2000)*, part of ICSE 2000, Limerick.
- Dey, A.K. and Abowd, G.D. (2000b). Towards a Better Understanding of Context and Context-Awareness. In *Proceedings of the Workshop on The What, Who, Where, When, and How of Context-Awareness*, part of CHI 2000, The Hague.
- Eriksson, C.I. and Åkesson, M. (2008). Ubiquitous Advertising Challenges. In *Proceedings of the 7th International Conference on Mobile Business (ICMB '08)*, p. 9-18, Barcelona.
- Ferscha, A. et al. (2004). Context Awareness for Group Interaction Support. In *Proceedings of the 2nd International Workshop on Mobility management & wireless access protocols in conjunction with MobiWac'04*, Philadelphia, PA.
- Ferscha, A. et al. (2002). Ubiquitous context sensing in wireless environments. In Kacsuk, P. et al. (eds.) *Distributed and parallel systems: cluster and grid computing*. Springer, New York, NY.
- Goldmedia (2009). Digital signage becomes ubiquitous.
<http://www.goldmedia.com/en/news/archives/info/article/digital-signage-becomes-ubiquitous.html>
[Accessed 12 August 2010].
- Handelsverband (2010). Distanzhandel gewinnt an Bedeutung
<http://www.handelsverband.at/16238.html>.

- Hillier, B. (1999). The common language of space: A way of looking at the social, economic and environmental functioning of cities on a common basis. *Journal of Environmental Sciences (China)*, 11 (3), 344-349.
- Hong, J.-y. et al. (2009). Context-aware systems: A literature review and classification. *Expert Systems with Applications*, 36, 8509-8522.
- Ju, W. and Leifer, L. (2008). The design of implicit interactions: making interactive systems less obnoxious. *Design Issues*, 24 (3), 72-84.
- Kim, W. (2002). Personalization: Definition, Status, and Challenges Ahead. *Journal of Object Technology*, 1 (1), 29-40.
- Maass, W. and Janzen, S. (2007). Dynamic Product Interfaces: A Key Element for Ambient Shopping Environments. In *Proceedings of the 20th Bled eConference eMergence*, Bled.
- Manchanda, P. et al. (1999). The "Shopping Basket": A Model for Multicategory Purchase Incidence Decisions. *Marketing Science*, 18 (2), 95-114.
- Mild, A. and Reutterer, T. (2003). An improved collaborative filtering approach for predicting cross-category purchases based on binary market basket data. *Journal of Retailing and Consumer Services*, 10 (3), 123-133.
- Müller, J. et al. (2009). ReflectiveSigns: Digital Signs That Adapt to Audience Attention. In *Proceedings of the Pervasive 2009*, p. 17-24, Nara.
- Müller, J. and Krüger, A. (2009). MobiDiC: Context Adaptive Digital Signage with Coupons. In *Proceedings of the 3rd European Conference on Ambient Intelligence*, p. 24-33, Salzburg.
- Mulvenna, M.D. et al. (2000). Personalization on the Net using Web Mining. *Communications of the ACM*, 43 (8), 123-125.
- Pascoe, J. (1998). Adding Generic Contextual Capabilities to Wearable Computers. In *Proceedings of the 2nd International Symposium on Wearable Computers*, p. 92-99, Pittsburgh, PA.
- Puccinelli, N.M. et al. (2009). Customer Experience Management in Retailing: Understanding the Buying Process. *Journal of Retailing*, 85 (1).
- Rehme, F. (2010). From Challenge to Chance: Challenges in a Changing Society. In *Proceedings of the Innovative Technologien im Handel*, St. Wendel.
- Riecken, D. (2000). Personalized Views of Personalization. *Communications of the ACM*, 43 (8), 27-28.
- Schaninger, C.M. et al. (1985). French-English Canadian Subcultural Consumption Differences. *The Journal of Marketing*, 49 (2), 82-92.
- Schilit, B.N. and Theimer, M.M. (1994). Disseminating Active Map Information to Mobile Hosts. *IEEE Network*, 8 (5), 22-32.
- Schmidt, A. (2000). Implicit Human Computer Interaction Through Context. *Personal Technologies*, 4 (2-3), 191-199.
- Schmidt, A. et al. (1999). There is more to Context than Location. *Computers & Graphics Journal*, 23 (6), 893-902.
- Sitou, W. and Spanfelner, B. (2007). Towards requirements engineering for context adaptive systems. In *Proceedings of the 31st Annual International Computer Software and Applications Conference (COMPSAC 2007)*, Beijing, China.
- Smith, S. (2004). Sharing the Wealth: Is Contextual Advertising the New Gold Rush for Content Providers? *EContent* [Online], 27 [Accessed 23 July, 2010].
- Tarasewich, P. (2003). Towards a comprehensive model of context for mobile and wireless computing. In *Proceedings of the Americas Conference of Information Systems (AMCIS 2003)*, p. 114-124, Tampa, FL.
- Tuzhilin, A. (2009). Personalization: The state of the art and future directions. In Adomavicius, G. and Gupta, A. (eds.) *Business Computing: Handbooks in Information Systems*. Emerald, Bingley.
- Yuan, S.-T. and Tsao, Y.W. (2003). A recommendation mechanism for contextualized mobile advertising. *Expert Systems with Applications*, 24 (4), 399-414.