Summer 10-6-2011

CONCEPTUALIZING CONTEXT FOR ADAPTIVE PERVASIVE 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

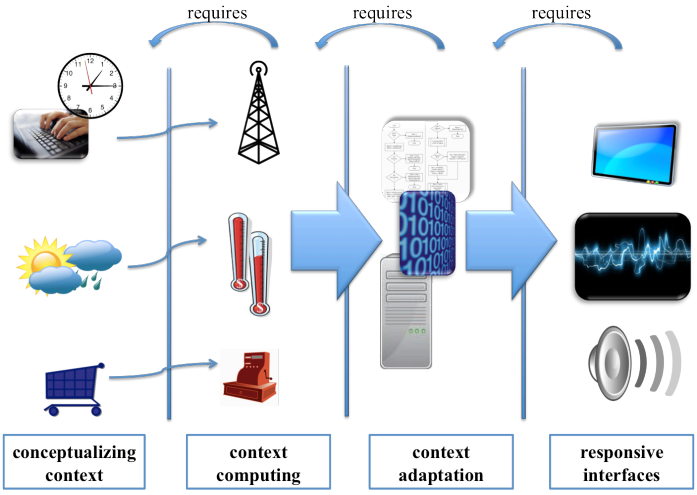

Figure 1. The process of context adaptivity

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).

Tarasewich (2003) differentiates three categories: environment, participants, and activities. Representative characteristics of environment are location and orientation of objects, physical properties, brightness and noise levels, as well as availability and quality. Participants are characterized by their location and orientation, personal properties, mental state, physical health, and expectations. Activities are described by tasks and goals of participants as well as events in the environment such as weather. For all three categories the model considers time with respect to present, past, and future. Sitou and Spanfelner (2007) are quite close to Tarasewich's taxonomy. They differentiate the operational environment, participants, and activities. The time aspect is modeled as the three categories' interrelated change over time. Black et al. (2009) define context with three items: task, location, and objects. Schmidt et al. (1999) proposed a comprehensive working model for context in the field of mobile systems. They basically distinguish context information as relating to two domains: to human factors and to the physical environment, both in the widest sense. On a second level they distinguish three information categories per domain. Human factors are operationalized as information on users, the social environment and tasks. The physical environment is described by conditions, infrastructure and location. They refer to lower than second levels as 'context feature space' and exemplarily mention specific features for illustration. Bradley and Dunlop (2005) take a multi-disciplinary approach to context, integrating linguistics, psychology and computer science. They distinguish the 'user' and the 'application's' world and consider 'incidental' and 'meaningful' context. In a circular layer that surrounds the user and application's world, they integrate a 'contextual' world, which they break down into six dimensions: task, physical, social, temporal, cognitive and application's context.

Against the background of this literature, it appears that existing work takes a more intuitive approach to context rather than following a systematical and methodologically sound procedure. Particularly, approaches from the perspective of service operators are a missing link. For application in retail, the retailer's perspective is, however, of utmost importance. What context has to be considered to achieve a retailer's business goals?

Conceptualizing context for retail involves thinking about the context of shopping (i.e., at a POS) and the specific information needs consumers could have depending on where they find themselves in their individual buying processes. Conceptualizing context for retail also means to identify and structure the potential context variables that could be the basis for adaptive services.

In Section 3 we will suggest and demonstrate one methodology we used to conceptualize the context for pervasive adaptive advertisement services. This approach may be reused for other application domains and can amend and replace existing information categories.

2.2 Context computing

After all potential variables of context adaptivity are listed, context computing is responsible for the actual identification of context sources and the collection, transformation, interpretation, provision and delivery of context information (Dey, 2001). To identify and collect relevant information sources, sensors and other context sensing technologies (Pascoe, 1998) such as RFID or eye-tracking are used. Contextual sensing is the most basic level of context computing (Pascoe, 1998). Low-level context information obtained must be transformed, structured, aggregated and interpreted (context transformation) to be represented in an abstract context world model (context representation). The context information is stored in a centralized or decentralized fashion and is used to trigger context events (context triggering) (Ferscha et al., 2004).

The following example illustrates this phase in the context of pervasive commerce: A person is identified via a loyalty card, which is scanned by a cashier. The company-owned databases are searched for relevant information about that particular consumer. Using an eye-tracker, the system recognizes that two eyeballs are looking at the display next to the cashier. Combining the information from the loyalty card scan and eye-tracking, the system could then, for example, trigger a response such as the display of a specific, tailored advertisement.

2.3 Context adaptation

Context-adaptivity mechanisms take the 'results' of context computing and 'react' to this context based on defined algorithms. Many scholars refer to the tailoring to consumer needs as 'personalization'. Kim (2002) defines personalization as providing – from a large body of information sources – only the part of information that is relevant to an individual or to a group of individuals. Personalization is thereby a means to better satisfy consumer needs and to increase customer loyalty (e.g., Riecken, 2000). On the Web, the technique is typically based on consumer information (Adomavicius and Tuzhilin, 2005), such as specified preferences, past purchases, search terms used, historical visit patterns or click stream data. And as we will see later, corresponding 'physical' datasets may be used in order to realize adaptive commerce at the POS (e.g., contents in a shopping cart).

Personalization as it is lived in electronic commerce contexts today spans a wide range of approaches, techniques, and applications. Tuzhilin (2009), for instance, differentiates between personalized search, personalized content, personalized recommendation, personalized pricing and personalized communication. Any of theses services could be transferred to the world of advertising in physical outlets. For example, a terminal in a supermarket could be used to search for products. Search results may be tailored to the contents of the consumer's shopping cart. An electronic leaflet on a shopping cart could adapt its contents based on consumer preferences such as a desire for organic food. Displays may be used to recommend products based on a consumer's past purchases. Digital price tags may present personalized pricing based on the number of articles in a consumer's shopping cart. And displays may adapt advertising based on a consumer's mood. Realizing these context-adaptive services, however, entails new challenges such as dynamic data exploitation and real-time adjustment to contextual factors such as consumer preferences and behavior (Eriksson and Åkesson, 2008).

2.4 Responsive interfaces

We can differentiate between two kinds of interfaces in the environment: those for input and those for output. For context-adaptive systems, the input is context. In the field of human-computer interaction (HCI), we identify context as something that can be obtained through explicit interaction or implicit interaction. Explicit interaction relies on explicit input and output by the user (e.g., scanning a loyalty card). Implicit interaction, in contrast, occurs without the user's explicit awareness (Ju and Leifer, 2008); the system 'understands' an action as input also when the user's primary aim is not to interact with the system (Schmidt, 2000) (e.g., eye-tracking).

The output of a context-adaptive system targets one or more of the five human senses: sound, sight, smell, taste, and haptic perception. Output systems of devices have greatly improved in recent years; notable features include stereo audio output and high-resolution color screens, even on mobile phones or display systems for wearable computers (Schmidt, 2000).

3 Our approach to conceptualizing context

We believe that the full business potential of an adaptive service can only be recognized when this full spectrum or 'information landscape' is available (see Figure 2 for an overview) because one is only in a position to select the most relevant context variables when being aware of the full spectrum. We methodologically conceptualize context for pervasive commerce and thereby show how this exercise promotes meaningful understanding of an adaptive service environment (before delving into prototyping).

Our approach to conceptualizing context is both top-down and bottom-up. The top-down approach is informed by a literature review and involves reflecting on the overall dimensions of the system under review. In contrast, the bottom-up approach considers information types and availabilities in each of the identified dimensions.

3.1 First phase of model development: Working model creation

Our first step was to identify relevant literature from the multidisciplinary (human-computer interaction and computer science) domain of context. Then we continued with brainstorming and in-depth group discussion in order to evaluate existing approaches. We started out from the established context model by Schmidt et al. (1999), as it appeared to be the most comprehensive one and subsumed the generic dimensions of other authors (see Section 2.1). As shown above, Schmidt et al. (1999) distinguish context related to human factors and to the physical environment. We then amended this model with the specific top-level category of the particular domain we study: pervasive commerce. We needed to amend the top-level hierarchy with the category 'retailer's environment' as our model is specific to retail. Furthermore we refer to the category 'human factors' as specifically the 'consumer's environment' to make the semantics more explicit.

On the second level of model abstraction, we equally use the six information categories proposed by Schmidt et al. (1999) (consumer profile, social environment, buying process, infrastructure, location, and conditions), but again rename and amend them. In doing so we find that Schmidt et al.'s framework probably lacks a class of information we call 'manipulable' and 'non-manipulable' environmental conditions. 'Manipulable' refers to conditions, which we can influence (e.g., light conditions in a shop). 'Non-manipulable' conditions are given by nature and cannot be manipulated (e.g. outdoors temperature).

The next step was to render the 'human' category (which we term 'consumer profile') more specific. Humans (in our case consumers) have 'stable' and 'unstable' traits within their profile. A stable user profile is made up of variables that are valid for a rather long period of time, including, for instance, sex, personality and height. In contrast, other variables may change within seconds (e.g., mood).

Finally, we needed to add one additional dimension to the framework that specifically reflects the 'space ownership' in which the context adaptivity takes place – in our case the retailer. Three further information categories emerged, which belong to the retailer's environment category: shopping basket information, stock availability information, and advertising campaign information.

Specifying and amending generic context models does not produce a sufficiently thorough conceptualization of context. To specify on a more specific level, we need to understand context from the user's situational perspective. Accordingly, we consider the specific situation in which the adaptive advertising service is provided to the consumer and try to consolidate all the specific information types needed to support service adaptivity. Since Schmidt et al. (1999) only gave examples for this level of context feature space, we identified new items (based on other context models as well as brainstorming and group discussion), taking a bottom-up approach.

To inform discussion about the specific information units needed for service delivery, we used situational scenarios involving adaptive services. However, the gap between such situational detail and the broader information categories identified made plain that conceptualization of context requires further structuring. For this purpose, we suggest to structure the described information categories further on three levels: a *macro*, *micro* and *situational* level. The *macro* level is valid for all model applications (e.g., a certain city as location). It should be considered as a further refinement of the information categories, but specific to the pervasive advertising in retail. The *micro* level then filters this macro level information category and helps apply it to a specific application environment (e.g., a specific store in a region that has specific clientele, etc.). The *situational* level describes an 'adaptive incident' or 'moment of service delivery' that happens in the application environment (e.g., a certain user in front of a specific display in a particular store). For context adaptivity, the situational level is eventually determining, as systems have to adapt to the actual conditions at the scene at the moment of service delivery. Still, understanding the micro and macro level has proven useful for identifying the full spectrum of available information sources.

The first phase of brainstorming and group discussion was iterated several times.

3.2 Second phase of model development: Working model verification

The second phase of model development aimed to verify the working model by applying a strict methodology. We invited five experts from the academic field of information systems for think-aloud protocols and card sorting. The protocols were audio taped with a total length of 191 minutes and transcribed (orthographic transcription) with a total of 12,848 words. On a plain wall, the context model was depicted with sticky notes, with each model item written on a single note. Participants were briefly informed about the context of the research, the first level of the model and the concept of the macro, micro and situational level.

Participants were first asked to interpret the overall working model (top-down conceptualization) while thinking-aloud so that their thoughts could be captured. They were also instructed to rearrange the sticky notes or introduce new ones until they were satisfied with the model.

In a second exercise, were asked to classify a specific advertising adaptivity situation according to their rearranged working model (bottom-up approach). For this purpose, we asked them to recall one of their last shopping experiences in a physical store and imagine that they encountered a context-adaptive advertisement. Again, they then had the opportunity to rearrange the sticky notes or introduce new ones until they felt that they could accurately classify the situation.

The insightful expert interviews led to rephrasing of many categories. For instance, we renamed manipulable and non-manipulable consumer profile to 'stable segment traits' and 'dynamic segment traits': "*One can probably manipulate personality. Sex – even that is manipulable. Those are, let's say, at least long-term. This is nothing that one can change within the next five minutes. [...] There are states that may change dynamically and other that are rather long-term – rather stable.*" Marketing policy was integrated into advertising campaign, as suggested by the interviewees. The category infrastructure was then omitted. Section 4 presents the consolidated end result of the model (Figure 2).

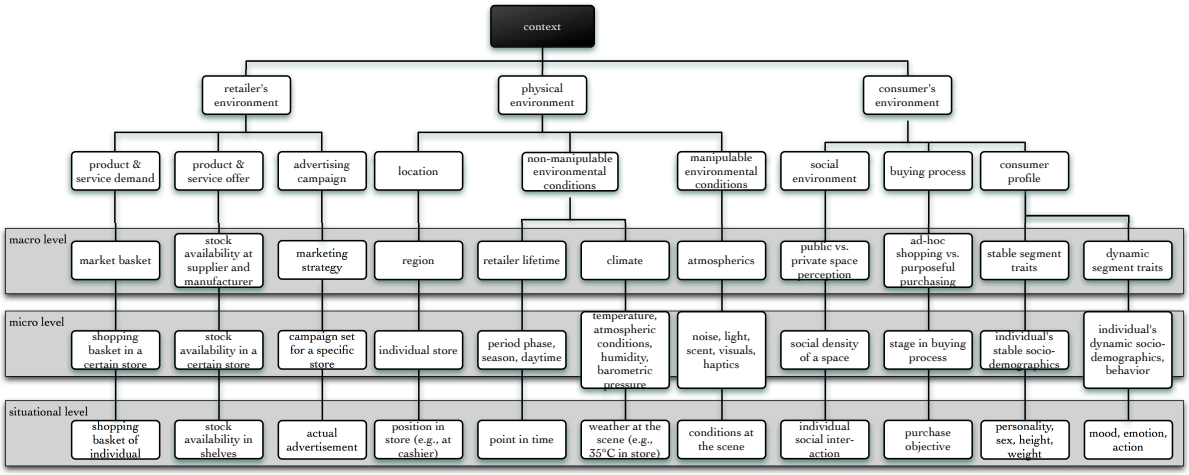

Figure 2. Conceptualized model of context for retail

4 A context model for adaptive pervasive commerce

In describing the context model's detail we presume that networked digital displays are spread throughout the retailers' POS and are used as the interface to transmit highly personalized messages. Digital displays can be mounted onto shelves, hang from ceilings, be part of a shopper's cart or meet consumers at waiting points, such as sales counters and checkouts. We also presume that many current hurdles associated with reliable data collection and aggregation as well as dynamic content delivery have been resolved. So, what information and data logical shall be applied to realize adaptivity? The following information classes may help.

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 toeholds 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 then 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.

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