CONCEPTUALIZING CONTEXT FOR ADAPTIVE PERVERSIVE COMMERCE

Christine Bauer

What is adaptive pervasive commerce?
The process of context adaptivity

conceptualizing context
context computing
context adaptation
responsive interfaces
What is context?
Existing models (1/4)

- built on enumerations (e.g., Schilit and Theimer 1994, Dey 1998)
- built on choosing synonyms for context (e.g., Brown et al. 1997)

- common categories include a user’s location and environment, identities of nearby people and objects, and changes to those entities (Dey 1998)
- context is anything that is relevant to an entity (Dey and Abowd 2000b)
A Model of Context

We now present a model for context in mobile environments that builds upon the research presented in the previous sections.

We first define three broad categories of context: environment, participants, and activities. This classification follows the Schmidt et al. (1999) model, except that we have reclassified “users” as “participants” to emphasize that while the user is the focus of an information system, there are others that can be part of a given context. Additionally, the model includes any interactions or relationships that may exist between participants, activities, and the environment. This includes the user’s social environment (consistent with Schmidt, Beigl, and Gellersen (1999)). The model is illustrated graphically in Figure 3.

Time is treated in two different ways for the purposes of this model. The three categories are all considered over a timeline of past, present, and future. This allows for a record of past context, which can be used for comparison to the current context, or for predicting future context. The time-related side of context (e.g., season, time-of-day) is treated as a set of relationships between absolute time (along a timeline) and other context characteristics. For example, any point in time has associated with it a value for a day-of-the-week, depending on location. A day-of-the-week may be related to specific user expectations, group dynamics, activities, and events. These time-related concepts are incorporated into the model as interactions.

This results in a “three-dimensional” model with the dimensions of environment, participants, and activities. These categories broadly group together the context factors that deal with the user(s), their activities, and the surrounding environment. This is a user-centered approach that is meant to facilitate the design and analysis of applications in a mobile or ubiquitous environment.

The model assumes that any characteristic (subcategory) can be active or inactive at any given moment for any given situation. While the model presented here does try to include all the possible pieces of context that influence a mobile information system and its use, it seems reasonable to assume that all of these factors may not need to be taken into account for a given application or situation. There may also be a fuzzy scale to this (“degrees of activeness”) rather than a binary condition.

(Tarasewich 2003)
Existing models (3/4)

The integrated model of the usage context in RE4CAWAR iteratively specifies context adaptive systems starting from the user's and business needs and integrating components used to extend systems functionalities are responsible for the retrospectively adjustment of the adaptation logic. Manual because it requires additional user expertise and it is not stimulated by the system itself. System Environment:

- Temperature
- Light
- Humidity
- Noise

Availabilty, orientation of entities, physical factors such as work conditions, devices and communications quality and work context.

Temperature, light, humidity and noise includes aspects such as location of the application, network availability, orientation of entities, physical factors such as work conditions, devices and communications quality.

The Dialog Model represents the interaction between user and system. The User Model represents the activities aspect. The Domain Model represents the participants aspect. It represents the interaction between the user and system.

The Presentation Model characterizes the users and the user groups. Stereo audio elements needed for the interaction.

4.1. Integrated model of usage context

Changing Participants:

- Location
- Orientation

is important for prediction issues in context-awareness. Their interrelated change over time is the time aspect.

Time may also play an important role in that taxonomy. Environments should not be neglected in context modeling. He states that aspects such as participants' activities and environments should not be neglected in context modeling. Environments should not be neglected in context modeling.

Tarasewich argues that context is actually contextual and dynamic with location. In fact, there is more to context than location.

4.2. The core of the methodology

The integrated model of the usage context includes the following dimensions:

- Operational Environment
- Participants
- Activities
- Time

This dimension...
Existing models (4/4)

A Working Model for Context

Discussion of context-awareness suffers from the generality of the concept and the lack of models suited for comparison of approaches. In this section we propose a simple working model for context, primarily as means to position our own work on sensor-based context-awareness. The discussion of a context model is followed by consideration of how context can be acquired, and of how it can be applied in ultra-mobile computing.

3.1 A Working Model for Context

To structure the concept of context we propose the following model:

- A context describes a situation and the environment a device or user is in.
- A context is identified by a unique name.
- For each context a set of features is relevant.
- For each relevant feature a range of values is determined (implicit or explicit) by the context.

In terms of this model, a hierarchically organized feature space for context can be developed. At the top level we propose to distinguish context related to human factors in the widest sense, and context related to the physical environment. For both general categories we propose further classification into three categories each, as shown in Figure 1. We use the six categories at this level to provide a general structure for context. Within each category, relevant features can be identified, again hierarchically, whose values determine context. Additional context is provided by history, that is by changes in the feature space over time.

Figure 1: Context feature space.

Human factors related context is structured into three categories: information on the user (knowledge of habits, emotional state, biophysiological conditions, ...), the user’s social environment (co-location of others, social interaction, group dynamics, ...), and the user’s tasks (spontaneous activity, engaged tasks, general goals, ...). Likewise, context related to physical environment is structured into three categories: location (absolute position, relative position, co-location,...), infrastructure (surrounding resources for computation, communication, task performance...), and physical conditions (noise, light, pressure,...).

(Schmidt et al. 1999)
How useful are these context models?
How can we conceptualize context for pervasive commerce?
Methodology for conceptualizing context
The top-level domain is broken into its compositional subsystems (top-down) while individual base elements are pieced together to form grander systems (bottom-up)
Starting point: Schmidt et al.’s context information categories

(Schmidt et al. 1999)
Schmidt et al.’s model with extensions (in dotted lines) and refinements (in italics)
The gap between situational detail and broader categories requires further structuring.

- we used situational scenarios involving adaptive services
- gap between such situational detail and the broader categories requires further structuring
- we suggest 3 further levels: a *macro*, *micro* and *situational* level
Structuring on 3 levels

**macro level**
- valid for all model applications
- is a further refinement of the information categories, but specific to pervasive advertising in retail
- e.g., a certain city as location

**micro level**
- filters macro level category
- helps to apply it to a specific application environment
- e.g., a specific store in a region that has specific clientele

**situational level**
- describes an ‘adaptive incident’ or ‘moment of service delivery’
- happens in the application environment
- e.g., a certain user in front of a specific display in a particular store
Specifying high level information categories for a context-adaptive service situation
Conceptualized model of context for pervasive advertising

**Macro Level**
- Shopping Basket
- Product and Service Demand

**Micro Level**
- Shopping Basket in a Certain Store
- Stock Availability in a Certain Store

**Situational Level**
- Shopping Basket of Individual
- Stock Availability on Shelves

**Advertiser’s Environment**
- Product and Service Offering
- Stock Availability at Supplier and Manufacturer
- Advertising Campaign

**Physical Environment**
- Region
- Time
- Location
- Non-Manipulable Environmental Conditions
- Manipulable Environmental Conditions

**Consumer’s Environment**
- Stock Availability in a Certain Store
- Stock Availability on Shelves
- Shipping Basket
- Campaign Set for a Specific Store

**Context**
- Advertiser’s Environment
- Physical Environment
- Consumer’s Environment

**Marketing Strategy**
- Region
- Time
- Location
- Non-Manipulable Environmental Conditions
- Manipulable Environmental Conditions

**Task**
- Stock Availability in a Certain Store
- Stock Availability on Shelves
- Shipping Basket
- Campaign Set for a Specific Store

**Consumer Profile**
- Stock Availability in a Certain Store
- Stock Availability on Shelves
- Shipping Basket
- Campaign Set for a Specific Store

**Product and Service Demand**
- Product and Service Offering
- Stock Availability at Supplier and Manufacturer
- Advertising Campaign

**Product and Service Offering**
- Stock Availability at Supplier and Manufacturer
- Advertising Campaign

**Social Environment**
- Social Environment
- Task

**Ad-Hoc Shopping vs. Purposeful Purchasing**
- Task
- Social Environment

**Stable Segment Traits**
- Stable Segment Traits

**Dynamic Segment Traits**
- Dynamic Segment Traits

**Individual’s Stable Socio-Demographics**
- Individual’s Stable Socio-Demographics

**Individual’s Dynamic Socio-Demographics, Behavior**
- Individual’s Dynamic Socio-Demographics

**Public vs. Private Space Perception**
- Public vs. Private Space Perception

**Stage in Buying Process**
- Stage in Buying Process

**Perception of Social Density of a Space**
- Perception of Social Density of a Space

**Individual’s Purchase Objective**
- Individual’s Purchase Objective

**Personality, Sex, Height, Weight, Hair Color**
- Personality, Sex, Height, Weight, Hair Color

**Mood, Emotion, Action**
- Mood, Emotion, Action
Advertiser's Environment

- Product and Service Demand
- Product and Service Offering
- Advertising Campaign

Macro Level
- Shopping Basket
- Stock Availability at Supplier and Manufacturer
- Marketing Strategy

Micro Level
- Shopping Basket in a Certain Store
- Stock Availability in a Certain Store
- Campaign Set for a Specific Store

Situational Level
- Shopping Basket of Individual
- Stock Availability on Shelves
- Actual Advertisement
Physical environment

- **Physical Environment**
  - **Macro Level**
    - Location
    - Non-Manipulable Environmental Conditions
    - Manipulable Environmental Conditions
  - **Micro Level**
    - Region
    - Time
    - Climate
    - Atmospherics
  - **Situational Level**
    - Individual Site
    - Period Phase, Season, Daytime
    - Temperature, Atmospheric Conditions, Humidity, Barometric Pressure
    - Sound, Sight, Smell, Taste, Haptics
    - Position at Site (e.g., at Cashier)
    - Point in Time
    - Weather at the Scene (e.g., 35°C in Store)
    - Conditions at the Scene
Conclusion

Considering the **big picture** instead of individual dimensions only

Viewing various kinds of context from **different angles** and integrating stakeholders’ perspectives.

Higher **degree of precision** (macro, micro and situational level)

Capturing the situational picture from the **consumer’s perspective**.
Thank you for your attention!