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# Classifying Context Classifications: an Activity Theory Perspective

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In a mobile and ubiquitous computing environment, the interfaces become smaller to disappearing. Moreover, the user's attention may be divided between several activities and devices. Context awareness plays a key role in reducing explicit user input by taking advantage of the changes in information relating to users, devices and environments.

Throughout the context awareness literature, researchers have tried to classify context into different elements that have an influence on a user's activity as shown in *Table 1*. There is a multitude of context classification systems, all of which are partial, covering both similar and different elements. Reported context classifications cover different types of context largely depending on their implementation. For the most part, however, context aware applications have utilized only isolated subsets of their context, such as a location or a device's state, e.g. [1,2]. From the different classification systems, we purpose that the context classification system should cover five key elements; information about user, tools, social, physical environment and time.

| | Location | Conditions | Infrastructure (Computing Environment) | Information on User | Social | User Activity | Time | Device Characteristics |
|---|---|---|---|---|---|---|---|---|
| [Benerecetti *et al.* '01] | Physical Environment | | | Cultural Context | | | | |
| [Schmidt *et al.* '99] | Physical Environment | | | Human Factor | | | X | |
| [Lieberman and Selker'00] | User Environment | Physical Environment | X | User Environment | | | X | |
| [Hull *et al.* '97] | | Physical Environment | | X | | | | X |
| [Chalmers and Sloman'99] | X | | X | | X | X | | X |
| [Lucas'01] | Physical Environment | | Information context | | | | | X |
| [Schilit et al'94] | Physical Environment | | X | User environment | | | | |
| [Abowd and Dey'99] | X | | | Identity | | X | X | Identity |
| [Chen & Kotz'00] | Active/Passive | | | | | | | |

**Table 1 Past context classification systems**

Apart from previous partial context classifications, there is also lack of research in exploring the relationships between different types of context and how these relationships can affect the efficiency of context aware applications. These relationships are important in the use of context to represent the user world and to better understand the user's activities and intentions. This is because humans assimilate multiple items of information to perform everyday tasks. Moreover, the exploration of these relationships may bring together context awareness projects that focus on one or two types of context.

From our point of view, a truly context aware system needs to take into account the wide range of interrelated types of context and the relationships amongst them. As a precursor to implementing such systems, we need an approach to modelling context that takes account of this complexity.

The main aim of this research is to provide an operational context classification and use it to build a context aware system that it is easy to use by reducing explicit input from the user. We are attempting to investigate these similarities and differences and develop a more extensive theoretical model, which is currently lacking in this field. It should cover key elements of context that influence user activity. Moreover, it should explain the relationships between each element and how elements influence the user's activity in real situations. This model can then be used by context aware systems to better understand the user and will also serve to improve communication amongst researchers in the field, bringing researchers together in order to further the field of context awareness.

Having done literature reviews in various fields such as context awareness, human factors and artificial intelligent, we have considered using Activity Theory for the purpose of classifying context and attempting to relate existing partial classifications of context. We have developed our approach based on Activity Theory because of its three main characteristics. Firstly, it provides a standard form for describing human activity. As it is hard to model in full the richness of human activity, we propose that a sufficiently comprehensive context classification may be developed using the relatively simple standard form that covers the key elements. Secondly, it relates individual human activity to society as shown in *Figure 1(A)* where there is a relationship between subject and community. Lastly, it maps the relationships amongst each element of a human activity model.

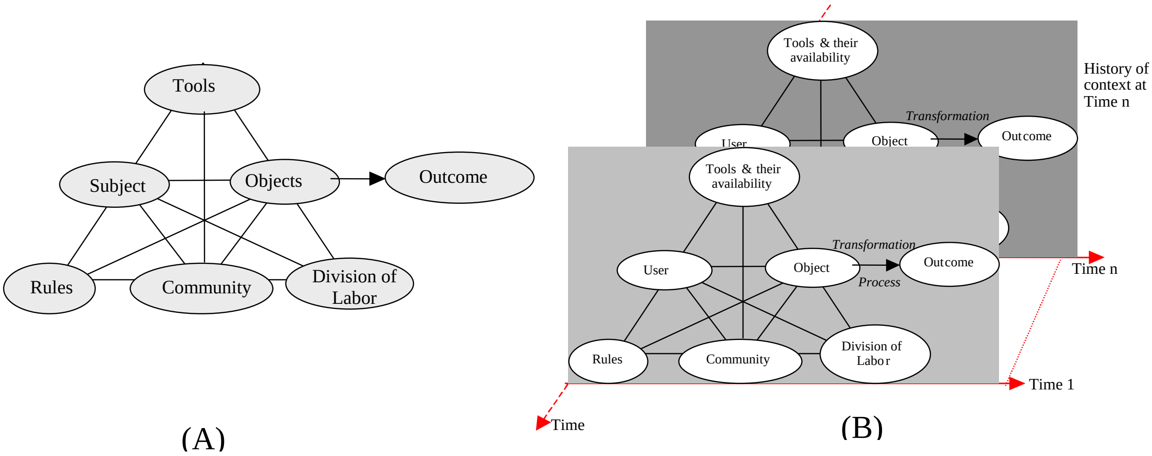


**Figure 1 (A) Activity Theory Model, (B) From Activity Theory to Context Model.**

However, this model lacks a representation of time. Time is a crucially important part of context. This includes not just current time, but also past time (contributing a history element to the context) and future time (that allows for prediction of users' actions from the current context).

We propose the context model illustrated in *Figure 1(B).* It covers the four key features (user, tools, social, time) identified in *Table 1* and the relationships between the elements to provide a better understanding of the user's behaviour. Our current model (*see Figure 1(B)*) brings together into one context model research focused on using information about user's location, on role-based access control and on resource discovery. However, the relationship to the physical environment is not clear with our current model.

This is a first attempt at modelling a comprehensive context classification based on Activity Theory. A cycle of application, evaluation and iteration is required to ensure that the classification covers key elements in context awareness and identifies relevant relationships. Our next step is to produce and then evaluate a more comprehensive context classification model. There are three approaches to be taken in order to achieve this. Firstly, scenarios need to be generated in order to revise the elements in the model. Secondly, we need to study other theories, such as distributed cognition, in order to have a better understanding of human behaviour. Lastly, questionnaires of different situations need to be generated so that the real users' ideas about context can be gathered. Our model will then be evaluated by using results from these approaches to compare its efficiency with previous models. It can then be used as a framework for implementing a context aware system architecture. The system will then be tested with real users and evaluated to see if it reduces the user's explicit input and provides the user with ease of use.

## References:

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[2] Brunato, M., et al. (2003). PILGRIM: A Location Broker and Mobility-Aware Recommendation System. IEEE PerCom2003, Texas.