

# EUDCASys: a Proposal to Introduce End User Developable Context Aware System

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**Abstract.** Context Awareness (CA) is an important capability needed in devices in a ubiquitous computing environment. Ubiquitous computing devices use different types of sensors along with the user's interaction histories to collect and store data. This data is then used to adapt the user's behavior to suit the current environment. End User Development (EUD) capability is an essential part of any flexible ubiquitous computing system. When EUD based systems are well designed they allow users to add functionalities that were not, and in many cases, could not have been anticipated by the system's designers. This enables users to benefit fully the possibilities ubiquitous computing offers. In this research paper the author would like to propose a system that is context aware on one hand and end user developable on the other – End User Developable Context Aware System (EUDCASys). The proposed EUDCASys will be both adaptive and adaptable in nature.

**Keywords:** End User Developable Context Aware System (EUDCASys), Context Aware Adaptable System (CAAS), End User Development (EUD), Context Awareness (CA), Ubiquitous Computing.

## 1. Introduction

Context Awareness (CA) is the most important feature of the ubiquitous and pervasive computing [1] [2]. It simplifies the interfaces, which are presented to the mobile users by adapting them to the current situations [3]. Context awareness is also the key characteristics of new smart and context aware information services. It includes all kinds of situational properties like spatial and temporal aspects, task context, collocation context, historical context, etc. Context aware systems exploit their surrounding context to increase the suitability of a service or an application to the user's needs.

Although some of these ambiguities of the sensed contexts from the real world may be resolved using automated problem solving techniques, in many cases the user is required for correct handling of ambiguous context [4]. This leads to system approaches that have to be both adaptive and adaptable.

The new design challenges in context aware systems are to interpret the context correctly not only to inform adaptive services, but also to empower the end users to understand and configure the behavior of the system [5].

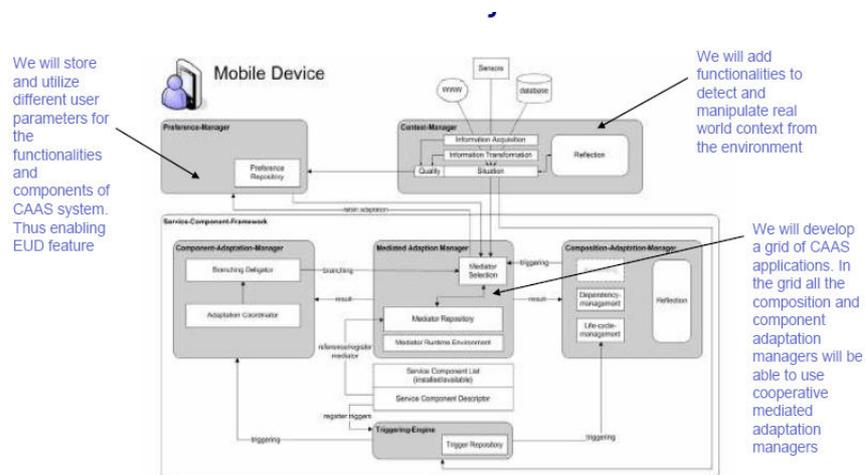
The research field of End User Development (EUD) has empowered the end users to adapt their own computer systems [6] [7] [8]. This approach offers the most radical form of personalization of context aware system [9]: EUD techniques place the task of constructing applications into the hands of users. Several styles of end user development exist, for example, programming by demonstration, programming by specification, etc. in Programming By Demonstration (PBD) users train a system to carry out desired actions by manually demonstrating the actions [10] [11]. In Programming by Specification (PBS) users provide high level description of desired actions [12].

In this research paper we would like to propose End User Developable Context Aware System (EUDCASys), a system that is context aware on one hand and end user developable on the other. The proposed EUDCASys will be both adaptive and adaptable in nature.

In the next section the proposed architecture for EUDCASys will be described.

## **2. End User Developable Context Aware Adaptable System (EUDCASys)**

We are planning to further develop the Context Aware Adaptable System (CAAS) architecture [13] by expanding Preference Manager, Context Manager and Mediated Adaptation Manager functionalities. Our plan is to first expand CAAS architecture by further developing the functionalities. During this process a number of prototypes will be improved (Ambient Service, Personal Digital Trainer) and a number of new prototypes will be developed. After the developments and improvements of prototypes they will be evaluated. Based on the results of improvements / developments of prototypes and their evaluation, the design principles and general architecture of EUDCASys will be determined.



**Fig. 1:** Proposed developments of Context Manager, Preference Manager and Mediated Adaptation Manager functionalities of CAAS architecture to develop EUDCASys architecture.

## 2.1. Context Manager

The Context Manager provides the application with a rich context manager and associated quality information. It is responsible to acquire context information from various sources and through a variety of communication protocols. Such context sources only provide a subset of the variety of contextual information that is relevant to a specific application. A significant increase in the expressiveness, complexity, and quality of the represented context can be achieved by transforming the acquired context data in several ways. Common context transformation techniques are fusion, derivation, aggregation and interpretation.

In Ambient Service (AS), the major CAAS application, the context manager functionality has not been implemented yet.

In the EUDCASys architecture will implement a fully functional context manager. Such a context manager will acquire context information from various sources in the environment and process the acquired information in the form, which is useful to the EUDCASys application.

In one of the prototypes of CAAS architecture, namely Personal Digital Trainer (PDT), real world context information was acquired. In PDT the context information was in the form of body movements of the user, which were detected by mechanical sensors. However, the PDT prototype was written in Visual Basic 6.0 programming language. We would like to rewrite the prototype in Java programming language, so that it would be integrated in the Ambient Service application. As a result the context manager functionality of EUDCASys application will be developed.

We will also investigate on how to integrate RFID technology in the EUDCASys context management functionality.

We are planning to use the Context Toolkit (developed by A. K. Dey et al.) [14] in our EUDCASys application for context management functionality. The Context

Toolkit uses the concepts of widget, server and interpreter to acquire and manipulate context information. The reason for choosing the Context Toolkit is that it is the most frequently used and cited context acquisition mechanism.

## **2.2. Preference Manager**

The Preference Manager accounts for retaining concluded adaptation processes. It maintains a repository of user preferences. Each preference takes the form of a named pair consisting of a scope and a scoring expression. The scope describes the situation in which the preference applies. A situation is described in predicate logic and may evaluate to true or false. A preference is considered applicable within a given context only if the scope expression is true. The scoring expression assigns a score to a choice, which is a numerical value in the range [0 to 1], where increasing scores represent increasing desirability.

In the EUDCASys architecture we will further develop the preference manager functionality. To do this development we will add program creation and modification features in the preference manager functionality. Program creation and modification activities imply some changes in the program, aiming at creating from scratch or modifying the existing functions/compositions and/or components of the existing functions/compositions. We can add different user preference parameters to the functions/compositions and components of the EUDCASys architecture by assigning different values to the parameters to different functions/compositions and components. End users will be able to modify the functions/compositions and components to different situations.

## **2.3. Cooperative Mediated Adaptation Manager**

The Mediated Adaptation Manager is responsible for delivering appropriate mediators in both adaptation phases, namely composition adaptation and component adaptation. Every adaptable service component lists required mediators in its descriptor. For more specific mediations it is also possible for service components to contribute component specific mediators in the mediated adaptation manager.

The selection of a mediator depends on the triggering and branching from components, user preferences, the adaptation description of the service component and the situation. During the mediated adaptation process respective mediators are instantiated from the mediator repository and placed into the runtime environment. After the process is completed, the mediated adaptation manager returns the result to the initiating component and retains the adaptation process through delivering the weighting of the user to the preference manager.

In the EUDCASys architecture we will further develop the mediated adaptation manager functionality. We will extend the concept of mediated adaptation management to Cooperative Mediated Adaptation Management.

In the proposed EUDCASys system we will develop a grid of end user developable context aware applications. Each of these applications will contain context manager, preference manager, composition and component adaptation managers, and mediated

adaptation manager. In the grid all the composition and component adaptation managers will be able to use local and global mediated adaptation managers. The cooperative mediated adaptation managers will be connected to each other too. As a result, the EUDCASys applications in the EUDCASys grid will be able to implement the concepts of end user development and context awareness in local and global levels.

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