SimCon: A tool for modeling context sources for rapid evaluation of pervasive applications using virtual reality.

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Abstract **- Here we present the SimCon tool to enable evaluators of pervasive applications to rapidly place and configure context sources within a Virtual Reality Environment to conduct repeatable evaluations early in the development life cycle.**

Index Terms – Pervasive computing, ubiquitous computing, context-aware computing, user-centred design and evaluation, 3D virtual environment.

1. INTRODUCTION

Pervasive applications aim to do the right thing at the right time automatically for users [1]. To meet this requirement, a pervasive application must match its own view of context with that of the users. That is, if a user perceives a change to their situation[1] [2] differently than the pervasive application perceives this change, (either due to delays in the process of context delivery to the application, sensor inaccuracy or incorrect inference) then the context aware application may adapt its behaviour at an inappropriate time or in an inappropriate way.

To illustrate the point, consider an automatic door which makes use of proximity based location context to open and close when a user is in proximity. A user may be forgiving of a slight lag in this situation because they are quite familiar with the workings of automatic doors. In the case of a user who is unfamiliar with the behaviour of the adaptation and when the value of that adaptation is not immediately apparent (as the need to enter a room), they may be much less forgiving and simply reject the behaviour. These kinds of issues only become evident during rigorous user-centred evaluation.

For evaluators of pervasive applications which interact with pervasive environments and users, there must be consideration of a number of issues in the process of context delivery[1], from the effects of noise on the accuracy of context produced by context sources (e.g. sensors)[3], to delays introduced by context processors through communication and fusion of context. In addition, the building of ubiquitous environments involves the acquisition, installation and maintenance (cabling, power and configuration) of context sources within those environments, presenting a considerable financial risk to both developers and evaluators.

Field-based evaluation itself may also require coordination of a number of participants moving around large environments, interacting with heterogeneous context sources and pervasive applications. These are both time consuming to organise and difficult to maintain unobtrusively [4].

For evaluators these issues can present a serious challenge and due to time and financial constraints in the development life cycle of context-aware applications, they often do not have the opportunity to conduct the kind of user-centred evaluations required to assess pervasive applications effectiveness in a wide range of situations [3].

To cut costs and time to deployment, a number of virtual reality simulation platforms have been identified for rapidly developing and evaluating such systems early on in the development life cycle [7], [8], and [9].

Here we present the SimCon Tool Set. By hiding the underlying complexity of pervasive environments, the SimCon Tool enables evaluators to easily and rapidly configure context sources and place them within a Virtual Reality (VR) Environment [10]. It also provides novel visualisation of location based context within those environments to enhance the evaluation process of location based pervasive applications. It does not set out to replace real world evaluations with real world context sources, but rather, through the use of VR, provide a means for rapid, repeatable evaluations over a range of situations and environments.

2. SIMCON TOOL SET

The SimCon Tool Set allows an evaluator to conduct rapid evaluation of a pervasive application when faced with

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[1] *A situation is a higher abstraction of context.*

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varying degrees of fidelity. This is done by increasing or decreasing the fidelity (delays, inaccuracies) exhibited by a particular context source. A context source is defined as a geographical bounded area within the environment.

The Virtual Reality Environment and associated location context is provided by the Half-Life 2 game engine [10] which has been modified to enable extraction of information from the environment. The game engine generates context in the form of an XML encoded message containing information related to the event, e.g. location, username, orientation.

A context source is described using SimconXML. SimconXML is an XML description of the basic attributes of a context source, e.g. origin, bounded area, delay, inaccuracies, battery strength, and steady state response. SimconXML descriptions can be loaded into SimCon or defined using the SimCon Configuration Tool (Fig 1).

Gaussian distributions are used to introduce noise to the location context [5] and transforms to create an appropriate output for specific context sources. This can be done to different levels of granularity around the origin of the context source.

Currently 3 types of context sources are configurable: The Ubisense Real Time Location System, ZigBee Transceivers for Signal Strength proximity detection and pressure mats.

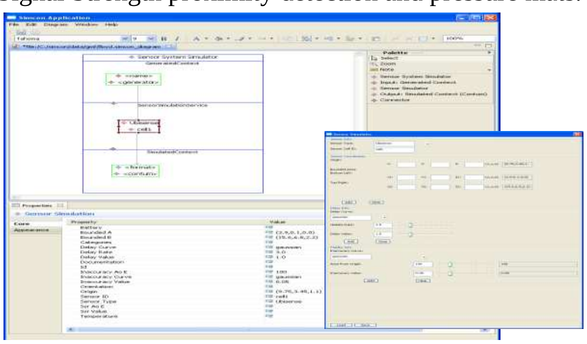

Fig 1 SimCon Configuration Tool

The front end of the SimCon Configuration Tool is implemented using the Eclipse Graphical Modeling Framework (GMF) which provides a generative component and runtime infrastructure for developing graphical editors based on the Eclipse Modeling Framework (EMF) and the Graphical Editing Framework (GEF).

GMF offers a powerful set of tools for building UML style graphical user interfaces useful for capturing context-delivery in a flexible and extensible manner with the potential for integration with a range of other eclipse tools and java libraries. GMF together with the Eclipse Rich Client Platform (RCP) provide the means to create stand alone applications with a rich set of GUI components and forms that have the look and feel of an Eclipse application.

The SimCon Visualisation Tool (Fig 2) improves context source placement within the Virtual Environment by visualising the boundaries of those context sources. Secondly it provides real time feedback of users locations as they move around the environment, both their actual location and sensed location.

The SimCon Visualisation Tool is built upon Java's SWT (Standard Widget Toolkit) bindings for Java OpenGL (the Open Graphics Library). OpenGL provides an open source API for creating 2D and 3D graphics. By using the SWT bindings, it will be possible to integrate this with the GMF for a more integrated tool set. Currently though the Visualisation Tool is a standalone application.

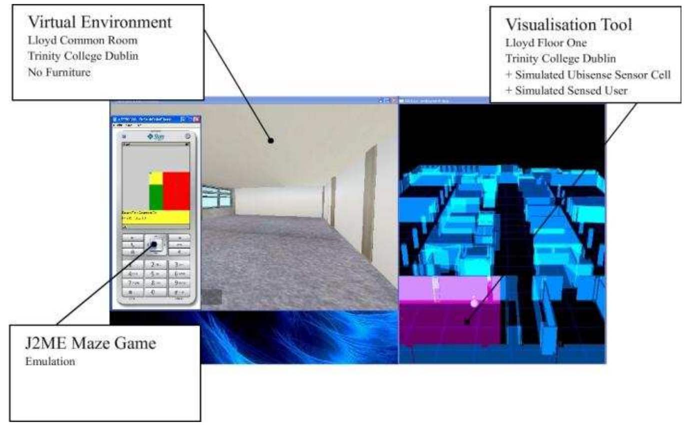

Fig 2 Virtual Environment, J2ME Emulation, Environment and Context Visualisation Tool.

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