A Semantic Reasoning Engine for Context-Awareness: Detection and Enhancement of 3D Interaction Interests

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ABSTRACT

We propose a semantic reasoning engine for context-awareness in classic VR environments. It is currently used to automatically detect user's interests and manage visual enhancements depending on the user's movement.

Categories and Subject Descriptors

I.3.6 [**Methodology and Techniques Subjects**]: Interaction Techniques; I.3.7 [**Computer Graphics**]: Virtual reality; I.2.4 [**Computing Methodologies**]: Knowledge Representation Formalism and Methods

Keywords

Context-awareness, 3D interaction assistance, Adaptive 3D interaction,

1. INTRODUCTION

Tasks in immersive virtual environments are associated to 3D interaction (3DI) techniques and devices. As tasks and environments become more and more complex, these techniques can no longer be the same for every application. Our work focuses on 3DI assistance by adding adaptivity depending on the interaction context. To reach context-awareness, an engine has been designed, implemented with the Amine platform and tested with a Virtools application.

2. A SEMANTIC REASONING ENGINE

The engine uses rules to take decisions regarding a stored context (knowledge, events etc.). Context and decisions concern the user, the interaction and the environment. They communicate with the engine through a set of tools with a semantic description by using Open Sound Control. Tools can be actuators with perceivable multimodal effects (environment modifications etc.) or sensors that retrieve information (by monitoring the interaction, etc.). The engine uses Conceptual Graphs (CGs) which provide a good expressiveness and usability. CGs link concepts with relations, both classified in an ontology. They are used to describe rules and facts. Decision request seeks a true reaction applicable by a tool. Then, the engine aggregates its global *confidence* (degree of sureness) and *impact* (degree of perceived repercussion). A CG global *confidence* depends on all paths leading to a true expression of the described situation using facts, events and rules. A CG fact is certain by default or can supply its own *confidence* (e.g. provided by a sensor). Events *confidence* decreases with the ratio of their remaining validity. Rule effects *confidence* is equal to the rule causes average *confidence*, times the rule *confidence* itself. Finally the global *confidence* of a CG expression is obtained by a fusion function. With n paths and $Mean$ as their average confidence value: $Globalconfidence = (1 - Mean) \times (1 - \frac{1}{n}) \times Mean + Mean$.

Next, the engine aggregates the decisions *impact*. Each tool has an initial *impact* which can be modified given specific cases. Initial *impact equals* to 0 (without any impacts) or 1 (with the most impact) are not modified. Otherwise at each applicable case, the *impact* is altered with a weight (W, 25% if not valued) $impact(n) = impact(n-1) - W \times impact(n-1)$ for a decrease or $impact(n) = impact(n-1) + W \times (1 - impact(n-1))$ for a increase. An acceptable total *impact* limits the decisions that can be made, which induces a knapsack problem as a last classification.

3. 3D INTERACTION ASSISTANCE

The engine is applied in a case study to automatically acquire and enhance user's interests. Sensors describe user movement, gestures and Zones of Interest (ZOI) content. Actuators create the ZOI, change objects color or add an attraction. The engine triggers adaptations using internal rules and those tools. Thereby, a object is colored red when the user passes by or points at it and reset when the user moves far away or after time. An attraction is added to the virtual hand when the object is detected several times as an interest or when the user stands next to it and removed when the user tries to resist. Attraction can not be added again for a time while coloring reactivations occur as the decision has less impact. An object (e.g. suddenly abandoned by the user) can flicker for a while. This is an unplanned mean to attract the user attention: the object is both still interesting enough to be colored and not enough to avoid the color reset. When several objects are close to the hand, a group logic usually emerged by distributing the available impact using the less impacting adaptation (coloring) on a maximum of objects. Thus the rules are combined, with outcomes not fully planned. In fact, the engine can release the designer from the prediction of every situation. Besides, it acquires and manages context to assist the user. This work is supported by the AP7 DigitalOcean project.

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