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## 3D Interaction Assistance Through Context-Awareness

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newly integrated information and trigger a decision request in an automatic mode. The time manager role is to check the validity of the needed facts. When a decision with an associated tool is true, the engine aggregates its belief and risk from facts, events' timing and rules. The user cognitive load is represented by an acceptable total risk, which induces a knapsack problem as a last classification.

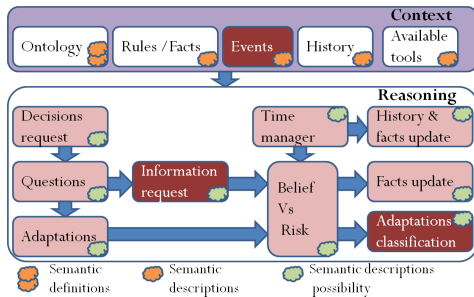


Figure 2: The Engine - forms of context and reasoning

Context and reasoning blocks (as shown in Figure 2) can also be grouped by their role in the engine as shown in Figure 3. The situation progresses with two roughly separated interlaced processes : decision and comprehension. The decision process goes from representing the situation to reasoning (KR & R), and transforming simple facts beliefs into the best reaction bet. The comprehension process goes from identifying the situation to understanding how to assist (the two CA trends) and transform simple data to a full plan of the situation. The decision set is extended as the comprehension progresses (e.g an acquired interest can unlock a reactive adaptation)

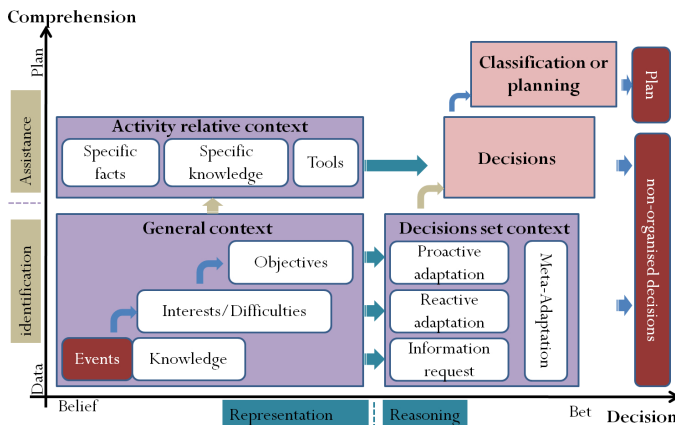


Figure 3: Hierarchy in the engine - Towards an assistance plan bet

We use Virtools as our scene graph manager and the Amine platform [6] (a Java open-source multi-layer platform for intelligent systems) for the engine. This platform offers an ontology manager and a FOL backward chaining engine that handles CG :Prolog+CG.

We are testing the engine on a small scenario. However, even simple cases pose several open questions: What items of information are pertinent? How to balance decisions risk and belief? How to best express a rule? How to monitor the user's intention?.

The engine core combines general rules with scene tools and specific rules. We test the engine and those rules with a first case study: to try to automatically acquire some user's interests and enhance them. We first focus on interests linked to the user's hand. Thus the only specific rule is to monitor the "hand" object and to set a cognitive load. Then, several tools may help. We started by defining:

- a Zones Of Interest (ZOI) sensor that attaches auras to objects and report their content
- a object's movement sensor (movement is high/low, local/global)
- an actuator to change the color of an object

- an actuator to add a haptic or visual gain to an object

The engine's first reaction is to activate the sensors on the target "hand". Those sensors send events to the engine, e.g an event that describes an object inside the hand's ZOI. Events trigger a reaction request that finds adaptations with corresponding available tools: e.g both precedent actuators, with two uses for activation and deactivation. Some of the needed general rules are :

- Define interests (e.g in a ZOI)
- Try to enhance an interest.
- Associate possible enhancements in this situation : e.g object visual modifications through color change, as well as interaction modifications through gain (visual or haptic).
- Manage adaptations states (possibly with previous decisions)
  - remove added visual modifications if object is not an interest.
  - remove a gain if an object is an interest and the movement is abnormal (e.g local+high=the user is "stuck").

Next, the engine calculates the decisions' belief and risk from the initial risk supplied by the tools and possibly beliefs for sensors events. Each rule has a belief transfer rate. This rate for a color change is greater than the one for a visual gain, as it is usually more suited with only the "enhancement will" context. Finally, we add rules to manage risk:

- increase decision risk if some concepts are used (e.g haptic gain risk > visual gain risk > object visual modification risk)
- increase decision's risk if present in history (e.g avoid activation/deactivation cycle)
- decrease interaction modification's risk if movement is local

As a result, the rules combine themselves as expected. Passing by an object makes its color red, while standing next to it makes it also attractive. Colors are reset when we move far away, while attraction is removed when we try to resist it. When it has been deactivated, gain cannot be reactivated for a time corresponding to history memory. Some reactivations can occur for coloring as the decision is initially less risky. Those results depend on the initial risk, belief and cognitive load values. More complex situations occur when several objects are close to the hand: e.g only the less risky adaptation is applied to a maximum of objects.

The setting up and implementation of an intelligent 3D interaction assistance and context manager with Amine platform and Conceptual Graphs is promising, and we are now improving it by reflections on examples. The engine aims to allow a semantic reasoning and the reuse of tools in a non-semantic environment to help the 3D interaction. We propose an engine core with a semantic base to achieve adaptation, which could be directly addressed by sensors, designers or users. Context and adaptations to be considered for virtual reality along with the user's degrees of appreciation and control are open questions which will guide the engine evolution. The next major step is to obtain enhanced user's intention hints.

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