**Title**: Escape from Virutality – A user-defined escape room system using object recognition and spatial reasoning in CogSketch

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**Abstract**

Cogsketch, a sketch understanding system, encodes object representations and spatial relations for two-dimension images based on OpenCyc and supports further knowledge-based reasoning. The current proposal uses Cogsketch as a platform to develop Escape from Virtuality, an escape room system open to user customization. Built-in levels will be provided as games but users are welcomed in designing their own stages, which are processed under the spatial representation system of Cogsketch. In this proposal, we introduce the basic requirements of knowledge representation and reasoning, ways of implementations and related limitations.

**Introduction**

Suppose you wake up from a start and find yourself locked in a defunct psychiatric hospital. Surrounded by ghostly moaning noise that comes from nowhere, you wish to rush out of the room as soon as possible. Fortunately, under the dim green light you spot the key in a plastic jar hanging below the ceiling fan beyond your reach. What would you do? A rational reasoner needs to identify tools to solve the situations, but this requires an accurate but flexible representation of the scene and objects at hand and a series of reasoning steps to decipher the puzzle. Further suppose it is so cognitively and emotionally taxing that any reasoning is beyond you at the moment, you will definitely wish you have downloaded the knowledge-based automatic spatial reasoning software that is proved rational in this emergency.

Of course, this won’t happen to you in reality (or so we hope), but it is always convenient and instrumental to have a reliable spatial reasoning system that solves everyday spatial tasks. Towards this goal we wish to develop an Escape from Virtuality (EFV) system that is game-like in format, but could be customized to support real case reasoning. EFV will incorporate both built-in levels and grounds for user customization. For the built-in levels, the system is provided a simple scene and needs to reason with the available objects and their spatial relationships (e.g., a key inside container needs to be taken out first) to unlock the door and escape the room. For customization, it is our intention to achieve other goals besides opening the door such as simple fetching or solving spatial puzzles, all involving object representations and spatial reasoning.

EFV heavily relies on CogSketch, a sketch understanding system that represent both objects and relations between them for images [1]. Relations include relative positions such as above and to the left of, topological positions such as inside, and configural relations such as grouping of objects. Objects could also be manually labeled to provide more accurate representations. Representations in CogSketch draw upon OpenCyc, a knowledge base of comprehensive ontology for everyday basic concepts and rules about how the world works. Inference in this system thus follows logic vigor but also commonsense. Further reasoning requirements, such as pattern matches, will be based on tools such as structure-mapping engine [2], an analogy system consistent with human psychological intuitions [3]. Cogsketch has been used for both research and education purposes and found consistent and predictive with human’s representations of spatial structures [4, 5]. It is also argued to enhance student’s spatial learning and classroom efficiency [6].

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