

# ThoughtPlay: Studying Cognition through Augmented Reality Interaction

Iulian Radu  
Georgia Institute of Technology

## Introduction

Virtual environments provide opportunities for studying how cognition is affected by the interaction with external representations of knowledge. Through this project, we have built a 3D brainstorming environment where users map abstract concepts to concrete objects. Structural knowledge can be depicted in this environment through intuitive interactions such as spatial organization, hierarchical grouping and visualization of relationships. The intent of this work is to evolve a platform for depicting abstract thoughts as tangible entities.

## Virtually Tangible Thinking

This family of environments could improve design cognition by allowing the combination of tangible physical objects and dynamic representations, enabling:

**Natural interaction:** removing the traditional computer interface, spatial cognition may be enhanced while cognitive load and interference are reduced

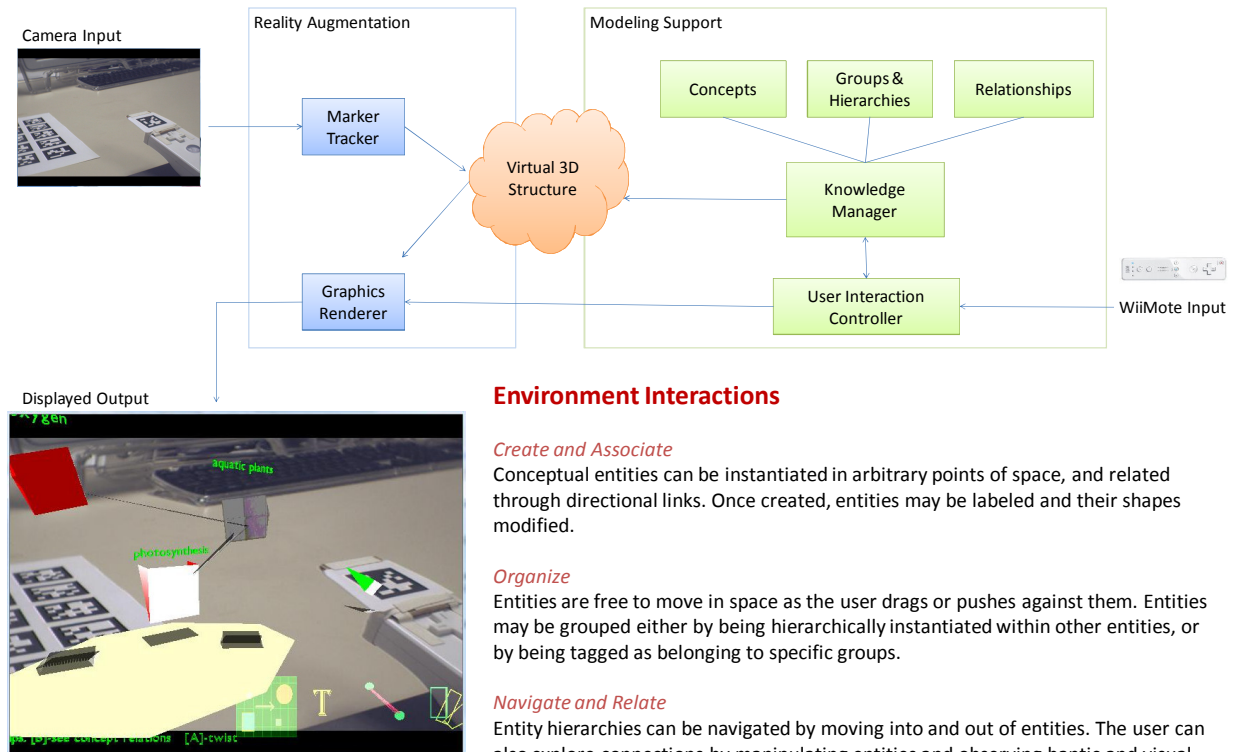
**Physical representations:** virtual objects are seemingly embedded in the real world, allowing designers to work within one integrated context

**Malleable representations:** entities can be easily modified by the user as the design evolves; conversely, the knowledge space could modify itself to suit the user's context

**Tangible exploration:** exploration of the knowledge space may be enhanced through dynamic interaction with the virtual objects

**Remote collaboration:** the virtual nature of the representation allows it to be concurrently shared between remote collaborators

## Prototype System Architecture



## Environment Interactions

### Create and Associate

Conceptual entities can be instantiated in arbitrary points of space, and related through directional links. Once created, entities may be labeled and their shapes modified.

### Organize

Entities are free to move in space as the user drags or pushes against them. Entities may be grouped either by being hierarchically instantiated within other entities, or by being tagged as belonging to specific groups.

### Navigate and Relate

Entity hierarchies can be navigated by moving into and out of entities. The user can also explore connections by manipulating entities and observing haptic and visual feedback of causal relations.

## Future Directions

### Brainstorming and Collaboration

Enhance fluidity of brainstorming environment, providing gestural interactions with rich media, context-aware content adaptation, and facilities for remote collaboration.

### Education

Provide visual representations of knowledge for student-driven exploration. Educational toys can also be prototyped through this environment, as well as educational methodologies biased toward visual communication.

### Systems Modeling

Facilitate cognitive modeling and simulation of complex systems by specializing toward a modeling framework.

### Embodied Cognition

The system can be extended to study how cognition is affected when abstract ideas are represented as part of the physical world. How does thinking change when we can touch our thoughts? What are the metaphors operating between mental representations and perceptual reality, and how can these inform design?