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Chalktalk VR/AR

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ABSTRACT

When people want to brainstorm ideas, currently they often draw their ideas on paper or on a whiteboard. But the result of those drawings is a static visual representation. Alternately, people often use various tools to prepare animations and simulations to express their ideas. But those animations and simulations must be created beforehand, and therefore cannot be easily modified dynamically in the course of the brainstorming process.

Chalktalk VR/AR is a paradigm for creating drawings in the context of a face to face brainstorming session that is happening with the support of VR or AR. Participants draw their ideas in the form of simple sketched simulation elements, which can appear to be floating in the air between participants. Those elements are then recognized by a simple AI recognition system, and can be interactively incorporated by participants into an emerging simulation that builds more complex simulations by linking together these simulation elements in the course of the discussion.

.CCS CONCEPTS
•Human-centered computing → Mixed / augmented reality
KEYWORDS
Virtual Reality, Augmented Reality

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1 INTRODUCTION

There has been much work in recent years in supporting Virtual Reality (VR) and Augmented Reality (AR) display and interaction, but the bulk of this work has focused on individual users, or on interaction between people who are remotely located. Chalktalk VR/AR [1] [2]is a system for supporting face to face brainstorming between people in the context of VR/AR, who can be physically co-located.

Traditionally, when people want to brainstorm ideas, currently they often draw their ideas on paper or on a whiteboard. But the result of those drawings is a static visual representation. Alternately, people often use various tools to prepare animations and simulations to express their ideas. But those animations and simulations must be created beforehand, and therefore cannot be easily modified dynamically in the course of the brainstorming process.

Chalktalk VR/AR allows participants to draw their ideas in the form of simple sketched simulation elements, which can appear to be floating in the air between participants. Those elements are chosen from a large vocabulary of available simulation element types. Each individual sketch element drawn by a participant is recognized at run-time by a simple AI recognition system, and converted to the corresponding simulation element, which can be interactively incorporated by participants into an emerging simulation, in the spirit of [3]. In this way, participants can collaborate to build complex simulations by linking together individual simulation elements in the course of their discussion.

2 CHALKTALK VR/AR DESIGN

Chalktalk VR/AR is an approach to shared virtual and augmented reality that begins with the concept that people communicating with each other in a shared VR or AR experience can talk to each other face-to-face while using a paradigm of creating "smart drawings" in the air.

The shapes that are drawn by participants are interpreted to find the closest match within a dictionary of known glyphs, see Figure 1. Those drawings can "come to life" and become active simulations. Those simulation objects can be joined together to create composite simulations to support complex expressions of collaborative thoughts and brainstormed ideas.

(a) original drawing **(b) result after drawing**

Figure 1: Pendulum example.
(a) shows the original hand drawing in mid-air and (b) shows what it will evolve to after recognition.

Once a drawing has been recognized, the specific geometric variations in how the participant draw the shape can be used to customize its resulting simulation object in ways that influence how that simulation will behave. For example if a participant draws a pendulum, then the length of the pendulum shaft and the size of the bob are reflected in the simulated pendulum, see Figure 2, in such a way that the

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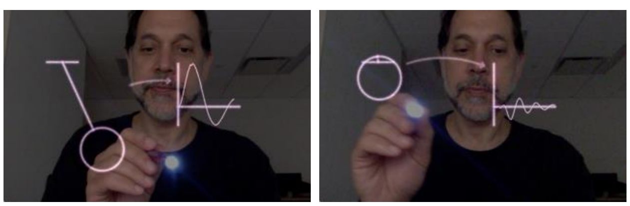
physics of the swinging pendulum properly reflects the shape that was drawn, see Figure 3a and Figure 3b.

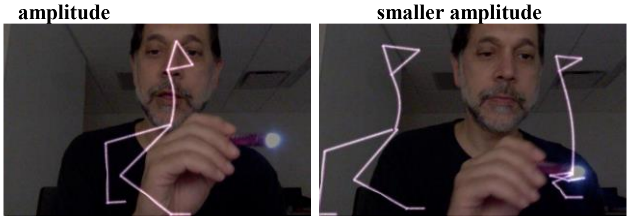
(a) pendulums **(b) shoes** **(c) dinosaurs**

Figure 2: Geometric variation in drawing multiple glyphs
(a) The left glyph shows a pendulum with longer shaft and smaller bob, meanwhile the right glyph indicates a pendulum with shorter shaft and larger bob, which will affect their physical behavior.
(b) The upper glyph shows a shorted fish with larger head and the lower one shows a fish with longer body and smaller head. The length of the body will lead to different swimming speeds.
(c) The dinosaur in the left has longer legs than the right one. Therefore the left one will walk faster than the right now.

Similarly if a participant draws a walking creature, than the proportions of the different parts of the creature, such as its torso length the size of its legs, are recognized by Chalktalk and are used to modify the way the creature walks and otherwise behaves, see Figure 3c and Figure 3d.



(a)Longer shaft leads to larger amplitude **(b) Shorter shaft leads to smaller amplitude**

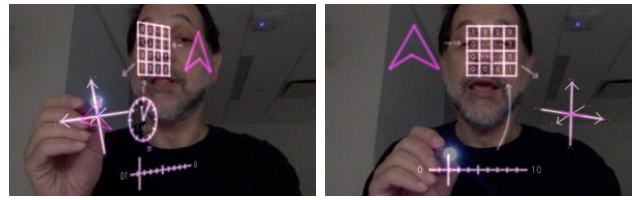


(c) Longer legs lead to larger movement **(d) Shorter legs lead to slower pace**

Figure 3: How physics of the swinging pendulum properly reflects the shape that was drawn

A fundamental decision was made that all drawing by participants be performed in a virtual plane that floats at a fixed distance in front of that participant, so as to best build upon our human ability to draw accurately in two dimensions. In contrast, the resulting recognized simulated objects exist in three dimensions, see Figure 4.

For example, a participant can make a drawing of what looks like an image of a hypercube. Then once that drawing has recognized by Chalktalk, the resulting interactive simulation object behaves just like a mathematical projection onto a three dimensional space of a four dimensional hypercube, see Figure 5.



(a) The polygon in coordinate system is three dimensional **(b)The whole AR scene is three dimensional**

Figure 4: See the objects in three dimensions

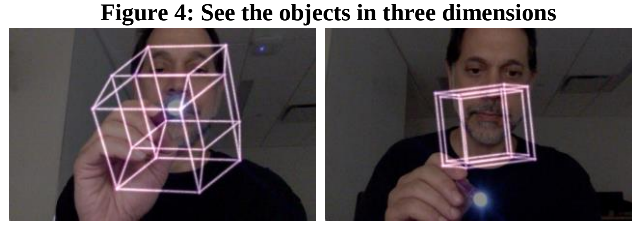


Figure 5: Looking into a hypercube in three dimensions

3 CONCLUSION AND FUTURE WORK

We have introduced Chalktalk VR/AR, a dynamic sketch-based simulation tool for face to face brainstorming in VR and AR. This approach preserves the immediacy of face to face collaboration. It also allows sophisticated simulation elements to be invoked and included in an emerging larger simulation. This approach of using freehand sketching to invoke simulation elements is well suited to the brainstorming process, as compared with less socially oriented approaches such as typing or choosing from menus. Also, the use of freehand sketching as an input modality allows participants to customize the properties of simulation elements during the course of their conversation, without needing to interrupt the flow of conversation to do so.

One potential drawback of Chalktalk VR/AR, as opposed to menu based approaches is that it requires participants to have a certain level of shared expert knowledge of the sketch language. However, we maintain that as VR and AR become more ubiquitous parts of our everyday communication, this general “language based” approach to visual support for face to face communication will become increasingly the norm, rather than the exception, in much the same way that natural language itself is a powerful and ubiquitous form of communication that relies on shared expert knowledge of the language being spoken.

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