Gesture communication: Collaborative and participatory design in a new type of digital communication

Researcher

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• Participated in digital interfaces project for collaborative and participatory design / gamification project at Harvard Design School.

For my final MDesS project, I incorporated research on several memorial design practices and their contributions to human history in terms of dramatic restoration following disaster and trauma. For example, my paper, “Gesture communication: Collaborative and participatory design in a new type of digital communication,” explored how to create socially meaningful tools to enable design development and effective guidelines for communication in the public sphere with two co-advisors (Professor Krzysztof Wodiczko of Harvard GSD and Professor Federico Casalegno of the MIT Mobile Experience Laboratory). This project was sponsored by the MIT Media Laboratory, whose goal is to compile relevant contributions to the fields of communication, human behavior, and interaction with high technology through an interpretive social experience.

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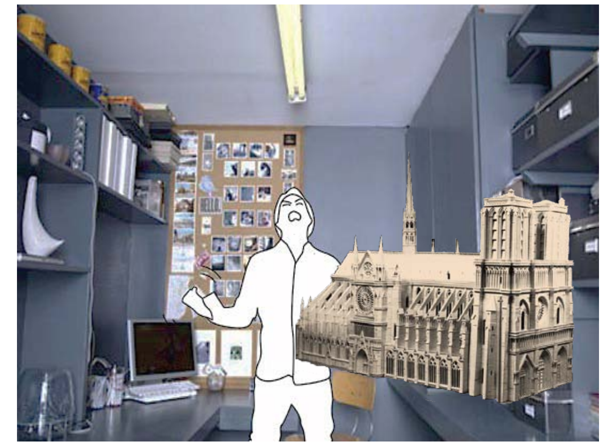
Fig :
Simulation of
User needs
2012



1 Collaboration Paradigms
The first step of my approach was to investigate and attempt to classify the various paradigms in which collaboration is utilized, specifically in the context of content creation. I tried to ask myself when I face the challenge of collaboration in our daily lives, and in what applications that collaboration is most effective.

1.1 True Collaboration
I could first investigate the most obvious case—that of true collaboration for content generation. By this I do not wish to refer to a paradigm in which ideas are thought of separately by individuals and then combined, but rather one in which multiple individuals contribute content to the end product. While their additions are not mutually exclusive from one another, they are nevertheless afforded a degree of independence in their decisions and thereby allowed to build ideas off one another, while bringing their own unique content to the table.

This sort of collaboration can only occur when the problem space is sufficiently large and complex that changes in one area will not directly affect all other areas of the end product. For example, multiple people could be working on a large mural at once or building a virtual city together in a video game such as SimCity or Roller Coaster Tycoon. Conversely, there are many situations in which such a paradigm would fail—such as coding in a computer language (in which case, two people editing a single document would likely cause the code to break), or designing an algorithm. I believe that these scenarios do not lend themselves to true collaboration for content generation, as they typically require each member to individually come up with an idea before all ideas are all presented and combined.

1.2 Independent Collaboration
The second, more typical case in which collaboration is used I deemed independent, as the process of content generation is no longer done by multiple people on one canvas at the same time. Instead, ideas are thought of by individuals separately and then synthesized later into a single final product by taking the best elements from the individual approaches and combining them.

Context

This tends to be the collaboration paradigm that is most often used in group situations during the process of ideation and content creation. For instance, if a group was thinking of a UI design for a web-app, team members would most likely begin by brainstorming individually, and then presenting their own UI designs to the rest of the group, after which the best designs would be picked and elaborated upon. Indeed, this independent approach is used any time the problem space is not large enough for simultaneous content creation—such as coding, wherein only one party can edit one document at the same time, lest the code structure be compromised. If multiple people are slated to work on a single application, the tasks must be broken down into separate independent segments that are as modular as possible, before they can be combined into the full program.

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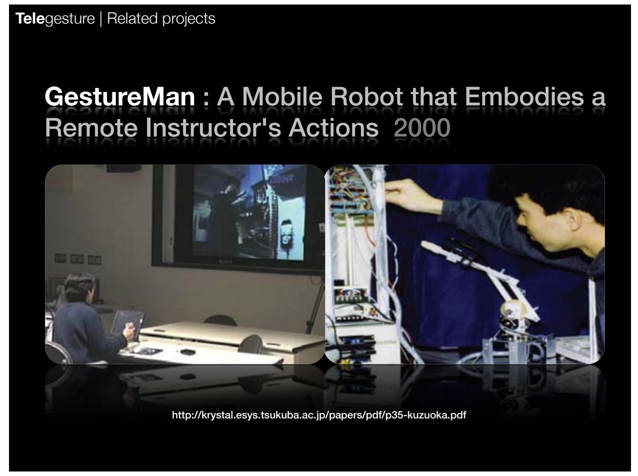
Fig : Related projects Telepointer ,1988

Fig : Related projects Gesture Man ,2000



1.3 Remote vs Local, Asynchronous vs Synchronous

There are also four main types of collaboration schemes with which we can be concerned:

1) Local Synchronous, whereby all team members are in the same physical location at the same time during the process of collaboration.

2) Local Asynchronous, whereby all team members interact with the same object or set of objects in a particular location, yet do so at different points in time.

3) Remote Synchronous, whereby all team members collaborate at the same time, yet from different physical locations.

4) Remote Asynchronous, whereby all team members collaborate from different physical locations and at different times.

1.4 Where TUIs Fit In

After breaking down the problem space of collaboration, I then thought about where a tangible user interface (TIU) could be the most useful. There are relatively few “truly collaborative” problems that are tackled often, which leaves fewer possibilities for a TUI to be of great use. A common idea passed around for this type of problem was that of collaborative 3D modeling and visualization, yet there were several projects such as T(ether) that had attempted to solve problems in this area. In the “independent collaboration” problem space, the most likely place for a TUI to aid in collaboration is in the process of combining various separate ideas into a single idea on which the group can agree. While most TUIs seeking to make an impact in this area would have to be specially tailored for the specific problem type they seek to tackle, there was a possibility to create a product that could help in a wide range of cases.

Fig : Concept

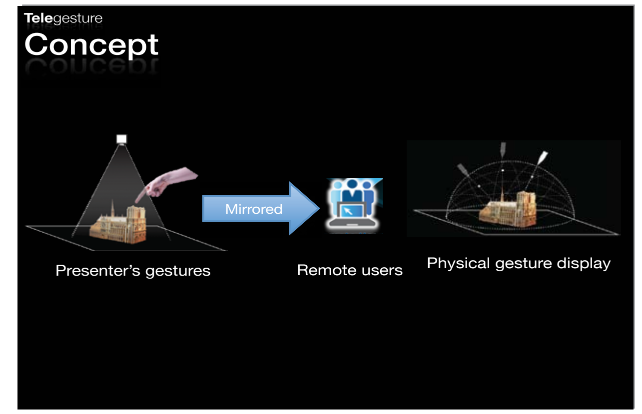
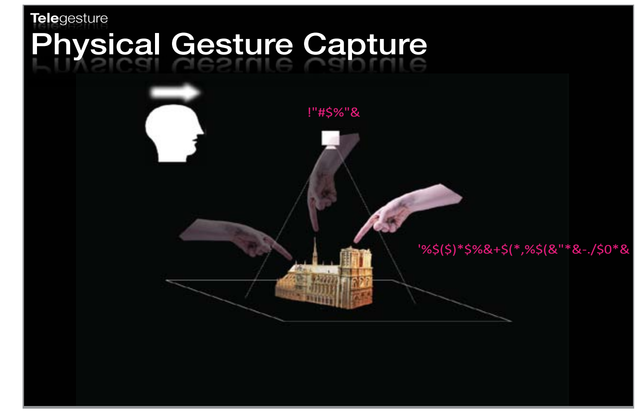


Fig : Physical Gesture Capture's diagram



I quickly narrowed down communication as the most prevalent challenge when a group of collaborators seeks to combine separate ideas into a single one. Often, it helps to have visual representations of one’s idea to present it effectively to a group, whether it is a 2D drawing or image, or a physical 3D model. In the case of a local synchronous regime, this is usually not too much of an issue—I and my advisor can crowd around a 3D model of a new product or an architectural design and communicate with a high level of understanding and throughput. Moreover, for 2D representations, there are few better tangible tools for communication than a whiteboard or a piece of paper. However, I realized that when straying from the local synchronous regime, the task of communication while synthesizing an idea can be very difficult. In local asynchronous, remote synchronous, and remote asynchronous regimes, the “presenter” is not in the same physical location as the representation of the idea he or she is portraying, and can thereby no longer provide physical gestures to aid his or her communication.

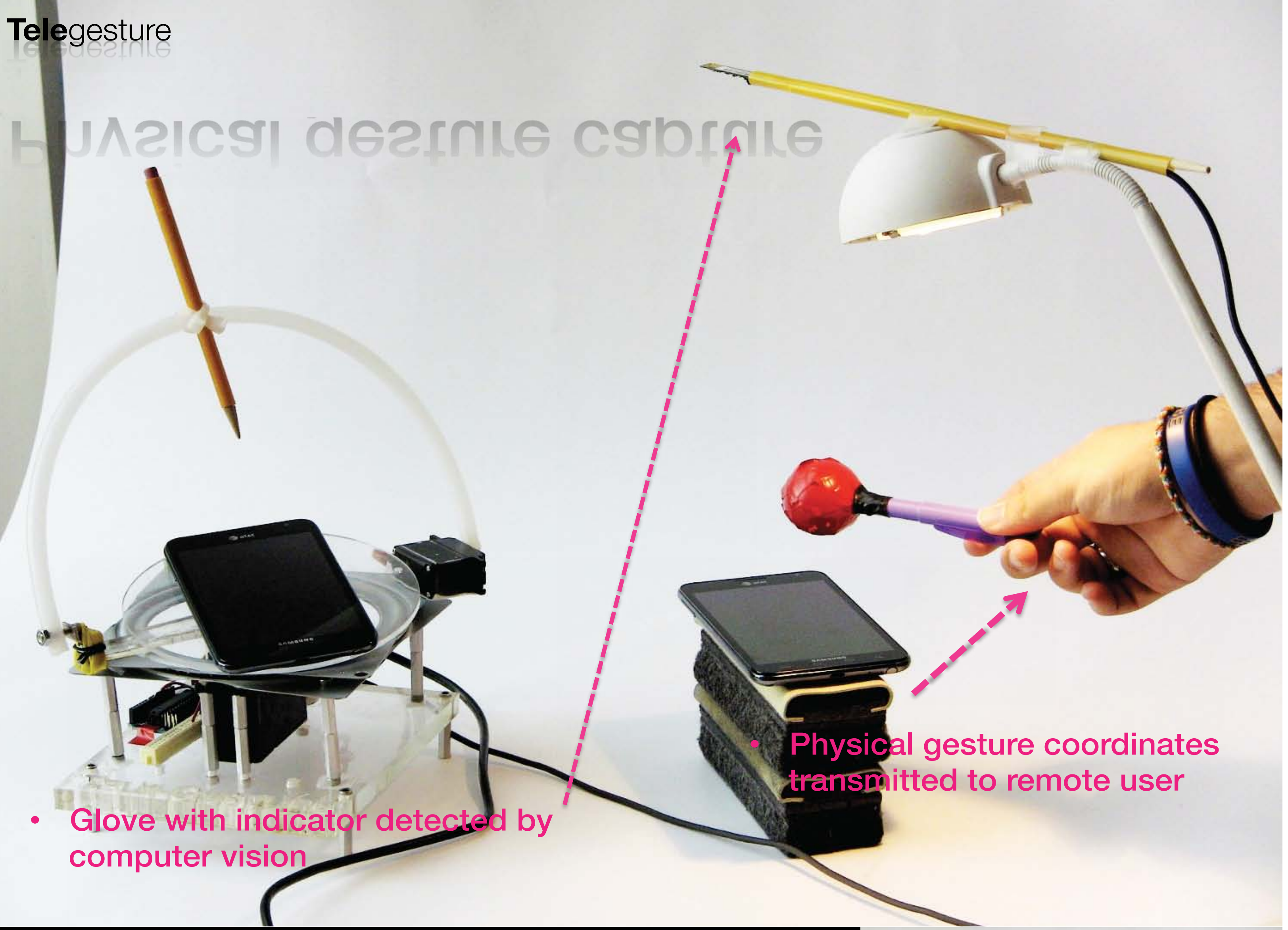
Since physical gestures can go a long way in presenting ideas with less confusion and more efficiency, we decided that this was a problem worth looking into.

2 Tele-Gesture

I decided to tackle the problem of providing gestural communication to independent collaboration settings by developing a TUI for the input and output of gestural information.

2.1 High-Level View

The Tele-Gesture is a TUI device that allows a user to physically point to a 3D object in real life and have their gestures played back by a robotic finger that can point to the same object, either at the same time (synchronously), or at another point in time (asynchronously).



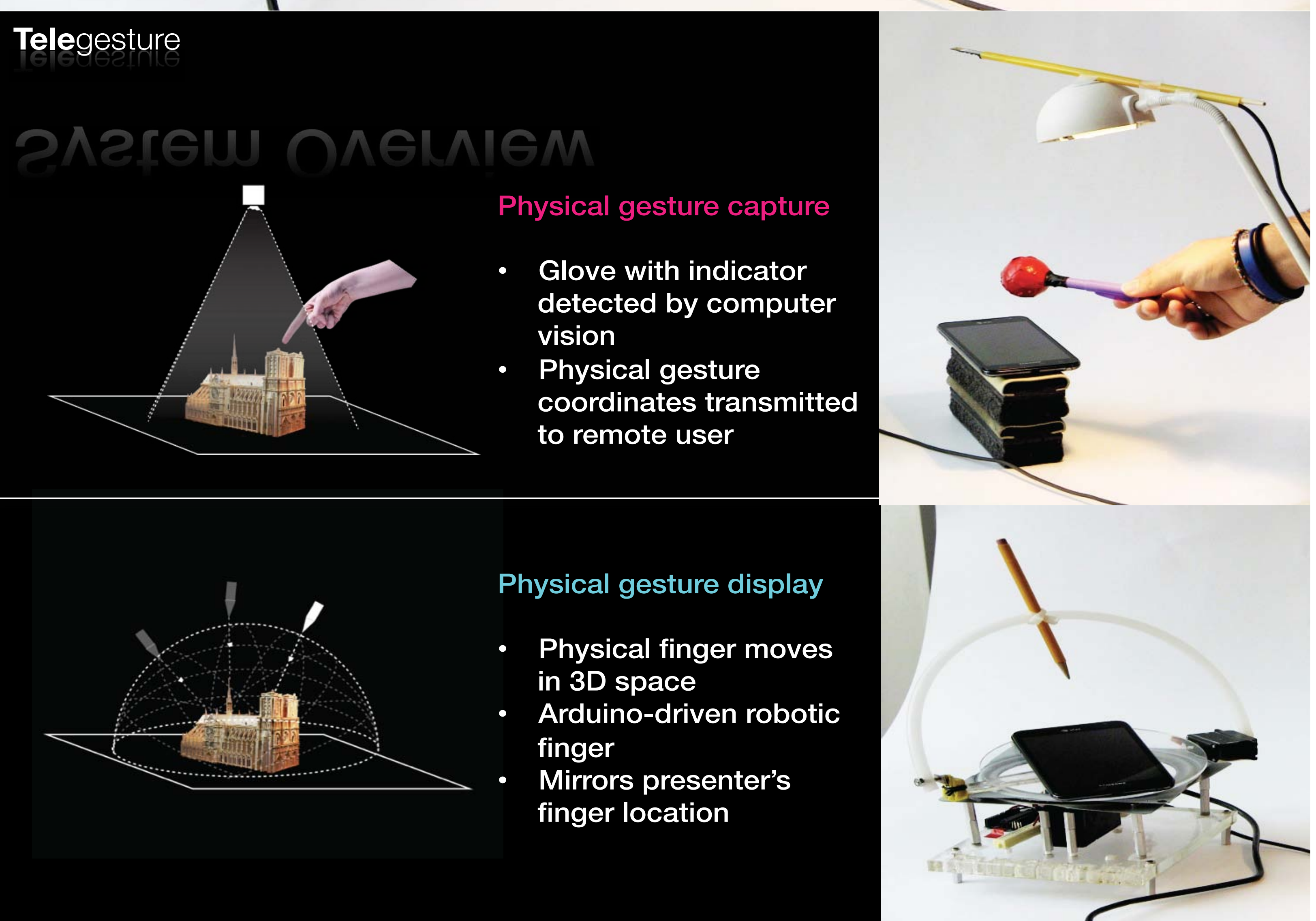
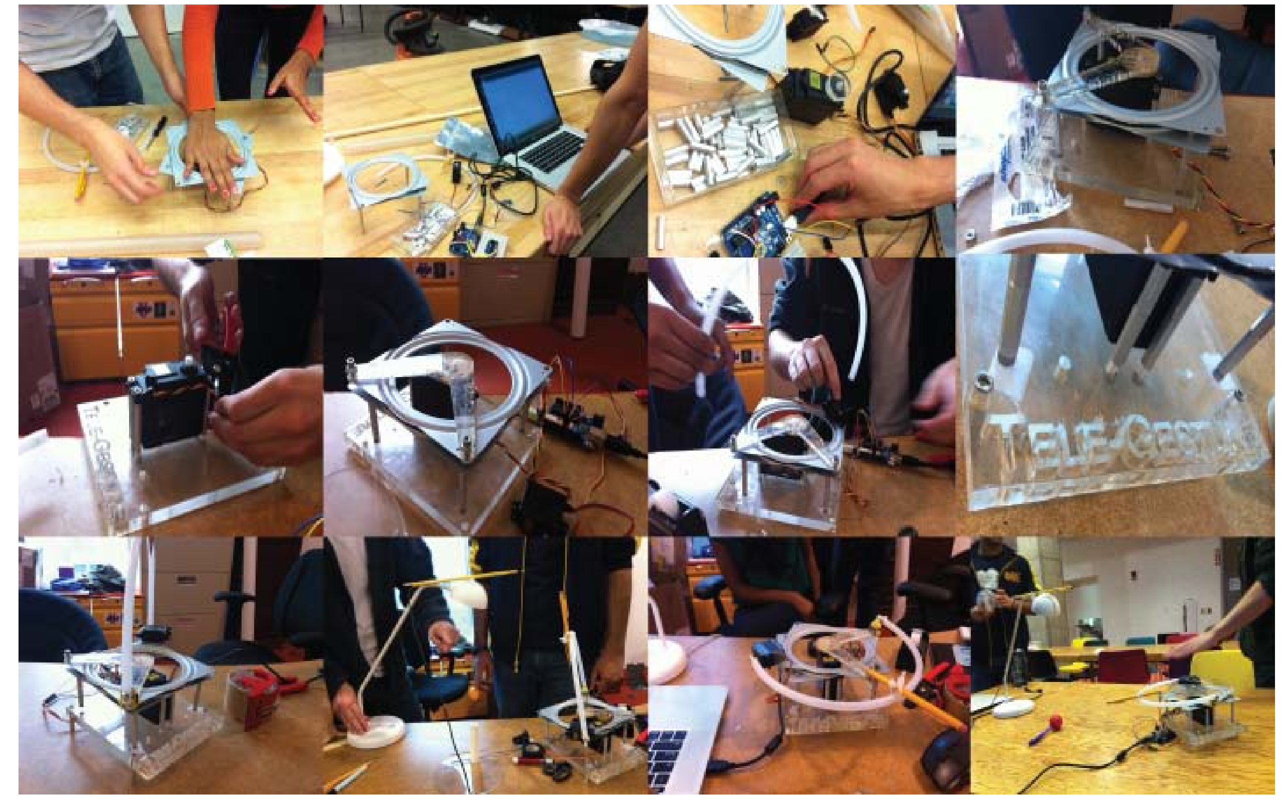
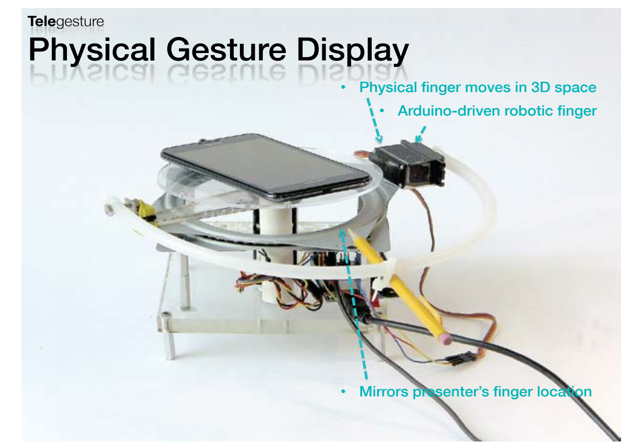


Fig :
Prototyping
2012

Fig :
Physical Gesture
Display's prototyping
,2012



On one end, the presenter uses a finger or a stylus to point to different parts of a 3D model while speaking as part of his or her presentation. Additionally, the presenter may have a slide deck with metadata and other visual stimuli that may work in tandem with the 3D object, such as an image that is overlayed on the object that displays additional information. This could be anything from an image of a cross section to an overlay of labels detailing the names for different parts of the object or data describing its dimensions. This physical pointing ges- ture is captured by a camera above the 3D object, and the video stream is analyzed in real time by a machine vision algorithm that deduces the 3D position and orientation of the pointing device (e.g., finger or stylus).
On the receiver's end, an identical 3D object is placed in the middle of a plat- form that rotates a robotic finger around the object, replicating the 3D position and orientation of the pointing device on the presenter's end. Additionally, the slide deck images are projected onto the space by an overhead projector.



QR codes can be used to obtain the objects' orientation and distance from the camera so that the 3D pointing informa- tion can be replicated more accurately.

2.2 Uses of the Tele-Gesture
I envisioned the Tele-Gesture as a device that could facilitate communication in many different communication regimes, including the following:
1) Local Asynchronous—By having a single setup that contains both the "pre- senter" and "receiver" ends, it would be possible to record 3D gesture information from a presenter, and play it back for an audience at a later time. the web to two Tele-Gesture devices in remote locations.

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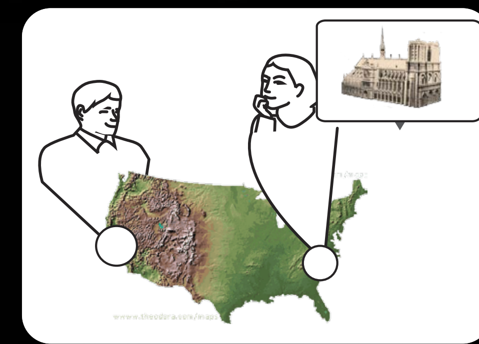
Fig :
In the future, we plan on combining the twitter sentiment analysis and the tree. Using augmented reality, when a user scans a flying bird, he can see the tweet related to this bird on his phone.

2) Remote Synchronous—By having two such setups in remote locations and having them communicate over the web, it would be possible to transmit the information in real time. One might imagine sending a replica object to an audience across the country and then videoconferencing at a set time, with an augmentation in the form of a robotic finger relaying real-time gestural information.
3) Remote Asynchronous—By combining the above two schemes, it would be possible to create a remote asynchronous setup which could record and play back gestural information and communicate this information over the web to two Tele-Gesture devices in remote locations.

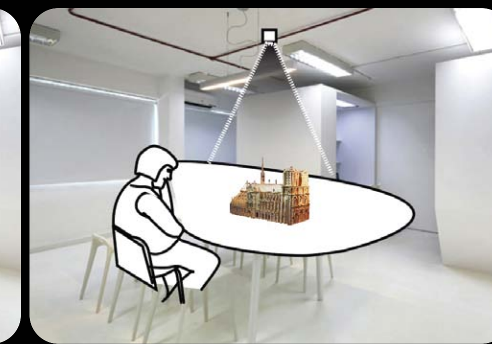
2.3 Implementation Details
To implement my MdesS final project during next semester (2013 spring), I could not complete all aspects of our vision for Tele-Gesture. Therefore, I decided to focus on creating a proof-of-concept device that displayed the central theory of our approach. I implemented a setup that simulated a remote asynchronous regime, whereby movement by a presenter on one end was translated in real time by a robotic finger on the other end.

I used MATLAB to create a machine vision setup to track a red ping-pong ball at the end of a pen (a crude stylus) and obtain its position in 3D space via an overhead camera. The 2D location was simply the ball's centroid in the video feed, and the depth information was extracted from the ball's diameter in the feed. I decided not to worry about the orientation of the stylus, as it pointed to different locations on the 3D object at the centerpiece of the presentation.
On the other end, I developed a robotic finger of sorts with two degrees of freedom. I positioned a stationary table on which the 3D object could be placed, and a rotatable turntable controlled by a servo motor was placed underneath it. On this turntable, an arc was positioned and controlled by a second servo motor. At the apex of this arc was a pencil, representing a finger pointing towards the center of the turntable. In this way, any 3D position on the presenter's end could be represented within 2 degrees of freedom on the receiver's end. (While we could not specify a particular point in 3D space exactly, the pencil was positioned along an axis intersecting the center of the turntable and the point in 3D space specified by the stylus, such that if a laser pointer was placed on the pencil, it would point to the point on the 3D object that the presenter referenced.)



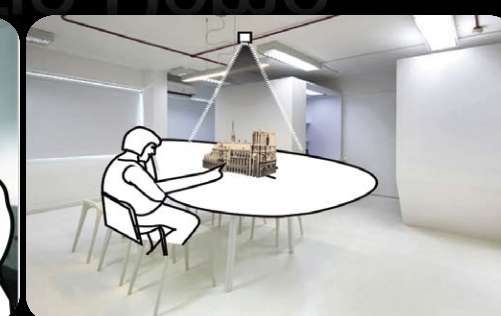
Two architects, Jane and Edward, want to discuss a physical building model, but Jane is located in Boston and Edward is in San Francisco.

Jane emails the model to Edward the day before their video conference so he can 3D print it and they will both have the model in front of them to refer to.



On the day of the conference, Jane wants into the videoconferencing room and places her model on the circular TeleGesture platform on the table of the conference table, under the TeleGesture cameras, and makes the call to Edward.

Far away in San Francisco, Edward places his copy of the model within an identical setup, in the circular TeleGesture platform in his conference room, and answers the call from Jane.



Jane and Edward talk to each other through the regular video conference cameras, but when she brings her near her model, and thus into the view of the TeleGesture cameras, the finger at Edward's location snaps to life and begins matching Jane's movements around Edward's model.

As Jane points to various parts of her model, Edward can see those motions replicated on his model, allowing him to see exactly what features of the model Jane is featuring at while she speaks. Edward can point at the model as well and his motions are recreated by Jane's TeleGesture unit.