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Updated Project Description

The goal of the project is to create a user interface through a smartphone application that can be used to get inputs from the user including touch gestures, voice capture, and movement. Our secondary goal will be to have an input device such as a camera that will monitor the user's movement and transform accordingly. The end goal is to use the input data that we capture from the user and translate it to a program called Grasshopper via Firefly that will change a 3D-modeled wall in Rhino based on variations in our input.

The goal for the smartphone application is to create a way for the user to easily interact with the wall based on different actions that they will be able to take. Our initial goal will be to design touch controls that will be implemented to allow the user to manipulate sliders in the application that will result in changes to the wall such as its size and shape. Our secondary goals for the user application are for the user to be able to talk to the app and the app recognize voice commands that will then be translated to different actions that will change the wall. Lastly, we may be able to translate phone movements using a smartphone accelerometer into movements on the wall in the Rhino model.

Our secondary goal for receiving user input will be to have a camera somewhere in the room or on a wall that will have facial detection and movement tracking. The intent here is to allow a user to look into the wall and have the wall change in shape when a face is detected, and when the user moves.

Additionally, we will need to build a server that will serve as a medium between the data gathering tools (smartphone app, sensors, etc) and Grasshopper via Firefly. This server is required for devices to interact with the wall when the devices themselves are not hooked up to the computer that is running the wall using Rhino and Grasshopper.

Complete List of Client and Stakeholder Requirements and Needs

The client and stakeholders laid out a series of requirements that the project needs to accomplish in order for the it to be usable in the future. The client has asked for the adaptive self-adjusting building to be responsive based off of input from sensors placed in the real world. These sensors will cover a variety of inputs such as touch, voice, and motion tracking.

Our first task is to relay touch to the wall, and for this the client has asked for the creation of a cell phone application that has the ability to collect touch inputs from the user. This application will be built for phones running Android and will incorporate sliders that will send data to the wall's software. The application will be running on the user's phone, but Grasshopper needs to run on a separate computer that will ideally be inside the user's home. For this reason, we will be developing a web server that can be used to communicate with both the app and Grasshopper, that will connect the two computers through the internet. The phone application also requires the creation of a backend that will parse the data so grasshopper can process it.

As for incorporating the sight, the client requires that the adaptive self-adjusting building will use cameras that will use the user's eye as a way to determine where on the wall the user wants to

interact. Finally, the client requires voice input into the cellphone app and for certain commands to be recognized so that the physical wall can adjust accordingly.

Broader Impacts Considerations

This project has the potential to revolutionize the way people think about and react to their work environments. Currently, homes and office spaces are largely static environments. The layout is designed to be efficient at the time it is built, but it is unable to adapt to needs that may arise later in the company's life cycle. In cases where the office environment can be manipulated, it often involves a fair amount of work to do so (e.g. moving a divider to separate or open up a room).

SHAPE's technology would allow people to think of a desired change in their environment and then, without any other action required, have the environment make that change, removing the middleman between thought and action. For example, a worker in a cubicle may want to ask a question to his coworker one cubicle over. Instead of getting up and walking around the divider between the two of them, he could glance over and have the divider open up automatically. This would not only be more convenient for the worker, but it would also clearly signal to the coworker that his assistance is needed. An environment as dynamic as this one does not exist right now, but the emergence of one could open the door to a world of possibilities.

Mapping Requirements to Technical Specifications

- Creation of server that can host data. This server will allow devices not directly connected to the computer that is controlling the wall to interact with the wall through the internet.
- A Back-End that takes Firefly data and converts it into a usable format for grasshopper.
- Android app that collects touch and voice input, then formats data properly to an xml file stored on our server. The immediate goal is for this app to allow us to modify the wall via touch.
- A script that runs on a laptop or Arduino that takes data from a camera. The script will take the camera data and format it into an XML doc and send it to the server. This script and camera will allow for motion to modify the wall.
- A script that runs on a laptop, Arduino, or cell phone that takes data from a microphone. The script will take the microphone data and send it to a 3rd party voice recognition engine and then send the results in a XML doc to the server. This script and microphone will allow for motion to modify the wall.

Summary of Target Technical Specifications

For this project, there will be a number of technical components. Our first major component will be a server that will act as the backbone for our project. The server will run Apache and host an XML file containing data that will be used to change the shape of the wall. Additionally, the server must have a php script to write to the XML file and receive data from the various data input applications. To translate the data from the XML file and firefly, a translator must be written

to import the data to Grasshopper in a usable form. To send data to the server, we will use various sensors to detect touch, motion, and voice.

The touch sensor will be an Android app written in Java that we will develop using Android Studio as well as existing API's to communicate with the web server. The camera and voice sensors will be either be standalone sensors or will use the hardware in the user's cell phone and interface with the cell phone application. Another option for the sound input will be using Amazon's Alexa voice recognition device and software, this would allow for very intuitive input commands. Lastly the camera will likely be a Microsoft Kinect as it is relatively cheap while providing top of the line motion tracking and camera detection.