AN EXPLORATION OF MECHATRONIC DEVICES FOR PHYSICAL DISPLAYS OF DATA STREAMS AND ENVIRONMENT INTERACTION

ABSTRACT

In this age of paperless records and LCD displays, the days of physical data records and tangible graphics seem to be becoming a thing of the past. With the accelerating pace of technological developments moving quickly from the physical to the virtual, there has been a lack of development of methods integrating both of these sides of data collection and representation. The objective of this project is to develop a device integrating the precision and complexity of computer generated graphics and the intrigue of kinetic sculpture with a physical method of recording and displaying information.

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BACKGROUND

As we move into a progressively more digital world, the amount of data collection and storage has grown at a rapidly increasing rate. All around us data is being collected, analyzed and reorganized to communicate trends and patterns. We have started to leave the days of physical ledgers, handwritten records and poster board presentations in the past and move into a world of exclusively electronic data storage and dynamic data graphics. But as digital representations of information have become the standard, a void has emerged surrounding the integration of both digital and physical means of communicating ideas.

The proposed project seeks to explore this area of overlap and investigate the potential for using electronic and mechatronic methods of producing physical representations of information, images and ideas. Our current focus is on an idea melding the traditional methods of handwriting with the precision of computer controls and the artistry, elegance, and intrigue of kinetic sculpture. The first goal of the project is the creation of a hanging vertical plotter consisting of a stylus suspended from two cables. The ends of each cable are attached to spindles mounted to stepper motors that are placed on a wall and controlled by a micro controller with motor shield. The microcontroller is fed vector commands, or GCode, from a serial port which is then converted into instructions on how to move the stepper motors. The motion of the stepper motors controls the position of the stylus, which results in the formation of graphics or images drawn on the wall.

Once this phase is completed, the project can move in various different directions and the real exploration begins. The device would allow the user to take any image that has been turned into a vector graph, and plot it onto any flat wall. Using data taken from sensors or pulled from the internet, it could also be implemented as a public display of information, ideas or messages. Instead of prescriptively defining the work's content, our team will investigate the implications of this device as a new type of communicative media; exploring novel relationships between mechanical mark-making and content.

CURRENT STATE OF THE PROJECT

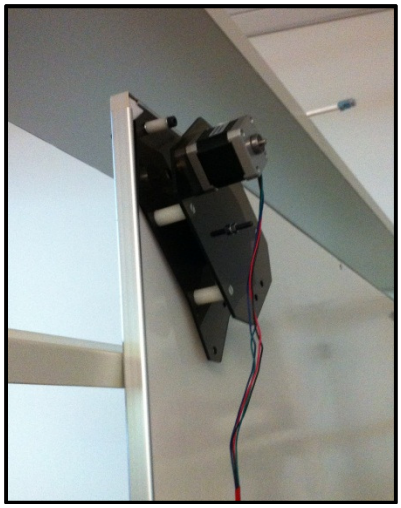

Figure 1: First prototype of motor mounts laser cut from smoked acrylic

Under the guidance of Professor Ben Recht in the Optimization Lab at the Wisconsin Institute for Discovery, Jack Boland has been working on this project for the last semester. Using an Arduino microcontroller and Grblshield, he has been working on modifying the firmware of the device to properly transform the GCode into stepper motor controls that will accurately reproduce a specified image. Additionally, he designed the first prototype of the motor mounts using CAD software and fabricated them out of a laser-cut, smoked acrylic (see Figure 1). The prototype is close to finished and the fabrication of the hardware is scheduled for completion in the next couple weeks. In order to achieve this goal, fellow engineering student Ian Anderson has join the project and will contribute his experience with computers.

Additionally, Art Department graduate student Paul Lorenz has joined the team to help develop the next step of the research and assist the group with an artistic perspective.

FUTURE STEPS

The first, nearly completed, phase of the project is to create the hanging plotter. After this has been done and we have demonstrated that we can effectively reproduce images using this hanging stylus, we will reexamine the design and make modifications to improve the device's accuracy, speed, line quality, and versatility. Among other things, this may involve redesigning the motor mounts and the stylus harness, increasing the number of motors from 2 to 4, optimizing the tool path generation and GCode interpretation, and integrating a z-axis motion for the stylus to allow for producing multiple independent lines.

After Phase I is complete and the capacity of the device is better understood, efforts will begin in order to try and cater the design towards a potential use and to explore different possible projects and creative uses. So far, there have been a wide range of ideas, such as the following:

Possibility #1: An art installation that is perpetually drawing and erasing an ever changing design on a public wall. The device would be a kinetic art piece that produces a graphical representation of data collected from the WID such as statistics of the computing pool (CONDOR) or published research from the building. Or maybe in support of the WID's green initiatives, the graphic could display energy usage throughout the day.

Possibility #2: Using an array of sensors or data taken from the internet, the wall could act as a permanent display board where the device would erase and update various fields such as weather or news headlines in a kind of physical desktop of information. It could be used to post announcements or as a calendar for events at the WID.

Possibility #3: Mounted in a public space in the WID, people could tweet a message to the Wisconsin Institute for Discovery's account and the device would randomly write their message on the wall. We would design an algorithm to determine what size and how long the tweets would be displayed and would filter the messages based on relevance to current events in the building.

These possibilities are far from an exhaustive list of ideas and simply a small sampling of the potential final results. The project team will continue to develop implementation ideas as the project progresses and with feedback from the WID advising.

ROLES OF EACH MEMBER

Jack's strengths lie in mechanical design and prototype fabrication, and consequently, Ian was added to the team to help develop the programming side of the project. Each member will be contributing to all the aspects of the project, but Jack will focus more on the physical fabrication and Ian will work more on the software side. Considering Paul's experience with technology, coding, and design, he will be a valuable asset to the team throughout the process. His insight will be particularly instrumental during the content creation phase of the project.

CONCLUSION

Considering the progress that has already been made and the addition of members to the project, it will only be a short time before exciting results are visible from the team's progress. The pace will soon pick up and the project is only a few steps away from completion of the preliminary hardware prototype and opening up a wide array of new opportunities and possibilities. With the support and advising of the Wisconsin Institute for Discovery, there is great potential to produce an intriguing and engaging display for the building.