DESIGN AND CONSTRUCTION OF A HALF HUMANOID HALF ROTUNDA ROBOT: ROTUNDAUR

SUSTAINABLE MAKERS: TEACHING MAKER VALUES

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SOCIOTECHNICAL SYNTHESIS

Plastic waste from 3D printers has added to the world-wide issue of non-degradable waste. The technical project sought to create a mobile, user-interactive, 3D printed robot to ideally serve as a tour-guide for the Mechanical Engineering Building at the University of Virginia. The robot was aesthetically designed to be a 'Rotundaur', a half-Rotunda and half-humanoid robot, to pay homage to the neo-classical design prevalent at the University. The Science, Technology, and Society (STS) research focused on the sustainability of 3D printing and its connection to the Maker Movement. By using Pacey's triangle with a System in Context model, an Actor-Network handoff model was designed to depict an ideal method to incorporate maker technology, like 3D printers, in an educational system to increase knowledge of sustainable and ethical design practices. The STS research was tightly coupled through an ex post facto analysis of the unsustainable practices conducted in the prototype and design phases of the technical project.

The technical project design took inspiration from the Meccanoid G15KS Personal Robot and the Sony Aibo in terms of user interfaces for programmed functions, and joint motion. A second key focus in the design was maintaining a University theme, which was incorporated in the both the color scheme and Rotunda Chassis design. To meet the mobility aspect, a set of mecanum wheels and controller were added together. The two driving constraints for the design were the motor size for the arms, and total print size. For this reason, the initial design prototypes focused on prototyping a single arm to validate programming for motor control and confirm relative size of the overall robot. After completing the prototype of the arm, it was determined the scale of the project was too large; which was not considered in the final budget, as the prototyping material was considered expired.

The final design of the arm was scaled to approximately one-half the original length. It provided a shell to conceal the motors and wires, as well as additional space to add claws. The torso and rotunda chassis were design as separate parts to allow for ease of access for hardware adjustment. After completing the design and prints for the robot's components, the project advanced into the build phase during the last few days of the semester. The finalized product had major issues regarding programming and hardware. The design team determined that given extended time, the robot would have been completely functional with regards to the initial desires. It was recommended that future work be focused on adding the ability to save and playback prescribed motions, and add aesthetic features regarding screen functionality and LED strips.

The purpose of the STS research was to determine a manner of incorporating Maker Movement values and technology into the educational system in an effort to teach sustainable values and promote ethical design with regard to curbing plastic waste. Actor Network Theory provided a basis for developing a handoff model to implement maker technologies into education. A variety of sources, ranging from national news agencies and magazines to text books and scholarly articles, were used to provide background information linking plastic waste and unsustainable 3D printing practices. After which, Pacey's Triangle and a System in Context model were used to map the connection between education, sustainability, and 3D printing. These served as the stepping stone for how the Actor Network handoff model was designed.

The educational system was quintessential to incorporating sustainability and ethical design lessons in the model. It was noted that hands-on learning from maker technologies can improve student focus. Furthermore, as technology improves, access to these technologies provided a manner to increase exploration and inventiveness. Two universities provided support

to students and clubs who wanted to combat 3D printed plastic waste. The support came through both emotional, and in one specific case, financial grants to incentivize students and teachers. By using these cases, it was recommended that the handoff model provided a proper manner to teach values to the younger generation, and a better model could be designed based on more in-depth research.

Whether it was not regarded during design or the driving force for research, 3D printed plastic waste was the knot tying these reports together. Without conscious thought, it was easy to make prototypes and contribute to a growing problem. If the model in the STS report was implemented, the technical project could have been more sustainable, and fewer plastic parts could have been avoided.

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