Thesis Project Portfolio

Design and Construction of a Rube Goldberg Clock

(Technical Report)

Virtual Reality as an Adolescent Learning Tool

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Current social attitudes demand the introduction of digital and electronic technologies into nearly all spaces. Education is an important field currently experiencing this transition; advanced technology is quickly becoming an intractable part of the classroom experience. Meanwhile, virtual reality (VR) technologies make up one of the current technological trends. With this in mind, the STS research paper, "Virtual Reality as an Adolescent Learning Tool," explores virtual reality and its potential for impactful usage in adolescent education.

The virtual reality analysis is framed by the Social Construction of Technological Systems (SCOT) methodology. Researchers Trevor Pinch and Wiebe Bijker proposed this SCOT framework to assess how social forces interact with technological developments. The framework primarily suggests that the attitudes of social actors dictate technological progression. This framework is used in tandem with the technological momentum theory proposed by Thomas Hughes. Technological momentum theory suggests that technology maintains an inherent inertia throughout its existence. This inertia gives the technology a sustained presence and allows social forces to continuously adjust and mold its features. The two STS theories presented work together to position the virtual reality discussion as an urgent and important matter in the current digital age.

The primary research method is literature review. Scholarly literature demonstrates that VR educational applications can offer numerous benefits as well as a few costly drawbacks. Benefits include increased student engagement, lesson gamification, active educator involvement and the ability to modify learning techniques on an individual basis. Conversely, the technology is financially and physically inaccessible for a variety of actors. Additionally, the research predicts a challenging road ahead to successfully integrate VR into educational programs.

Ultimately, the research paper asserts that virtual reality is not yet ready for full-scale educational implementation. Current technological flaws make VR an unpredictable and untenable tool for learning. However, VR trials and innovations should continue. A few key innovations could allow school systems to eventually seize unique VR benefits in a sustainable and effective way.

As society shifts towards simulation, modeling and other abstract technologies, the technical project team determined it is important to preserve *tangible* creations that inspire learners. Thus, the group attempted to create a physical apparatus that could showcase the prowess of the current mechanical engineering program, entertain visitors, and draw in prospective students. The technical report, "Design and Construction of Rube Goldberg Clock," describes the process of creating an exciting physics-based wall clock for display in the Mechanical Engineering building.

The wall clock consists of ten pinballs moving through wire tracks, wooden channels and other 3D-printed components in a routine pattern. Every minute, a pinball is released onto the clockface. The ball completes an exciting route and deposits into a nine-slot array of "flippers." After ten minutes, nine pinballs fill this reservoir. A tenth ball triggers the release of the nine other balls from the flippers into a CNC-cut wooden path, creating a satisfying pinball waterfall effect. A large acrylic gear rotates in the backdrop of the clock and carries pinballs back up to the starting reservoir to ensure continuous clock operation. The technical team initially aimed to incorporate a ferrofluid clock element within the project in early design stages. The team eventually sacrificed this feature due to time and space constraints. Ultimately, the wall clock did not reach its ideal final image. The team accomplished several of the major design features, but a few elements were not consistently functional or complete.

The technical report breaks down the phases of the design and build processes. The team first modeled all project components in SOLIDWORKS to verify the components would fit together well and operate according to plan. The technical report next dives into in-depth analysis of major clock elements such as the rotating gear, the flipper array, and the welded wire track. The team also provides an explanation of how the components were physically assembled into the current clock. This explanation aims to provide future technical teams with the information needed to pick up and continue this project. The technical team ultimately created a clock prototype featuring several working components along with a few physical deficiencies. More importantly, the team gained valuable design, manufacturing and physical assembly skills that will prove useful in future engineering endeavors.

In summary, the STS research paper considers the potential impact of educational virtual reality implementation. Research ultimately determined that virtual reality is not yet ready to be introduced fully into adolescent school systems. Meanwhile, the technical report documents an attempt at creating a Rube Goldberg-inspired pinball wall clock. The technical team gained vital engineering experience and produced a unique, though somewhat incomplete, final product.