Thesis Project Portfolio

Motion of the Spheres: Constructing a Compact Mechatronic Orrery
(Technical Report)

Marching to a Different Drummer: A Proposal For Rhythm Game-Based Therapy Using EMDR as a Model
(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

Intuition and Experience as Guides for Growth

"The privilege of a lifetime is being who you are." -Joseph Campbell

Taking the first step on a project, devoting yourself to that journey, is like stepping into the dark, not knowing what lies ahead. But step after step, you find your light at the end, a new understanding of yourself and your work. That was very much the case with my research. The STS research paper began as an observation of how comfortable and clear-headed rhythm games make me feel; the technical project was an exercise in mechanical design, a long-time passion of mine. To research the usefulness of rhythm games as a form of therapy was to find facts behind my feelings; to build a planetary model that was more versatile as an educational tool than a traditional gear-based orrery was to test the limits of my own creativity and imagination. In both endeavors, the goal was to grow, and create a foundation that might help others grow in their own way.

My capstone professor approached us with the idea of a mechatronic orrery- a planetary model controlled by a computer rather than a gear train. We wanted to make something that will inspire future engineers towards invention and artistry by showcasing what mechatronics can do. It seemed simple, but as we started the planning process, we realized how complicated the orrery would actually have to be to realistically model the motion of the earth and the moon around the sun. Our main struggle was interference; how could we move the bodies around one another without twisting wires or bumping parts into one another? Our solution was to create a three-part concentric shaft system where one shaft moved the whole earth-moon assembly, one shaft below

that controlled the moon's orbit around the earth, and the bottom shaft kept the earth's axis pointing to the north star. From there, we 3D-printed a prototype and tested it to figure out what else we might need. We added ball bearings for smooth movement, metal hardware and inductive sensors so the machine could detect when it was in a starting ("home") position, and we reinforced our design in the places where it would experience the most stress. The most rewarding part of the experience was when we realized we had gone from being a handful of individuals to a team, tackling multiple tasks simultaneously through coordination and reinforcing the overall development with our combined talents. Our professor praised our ingenuity and tenacity. We had grown together.

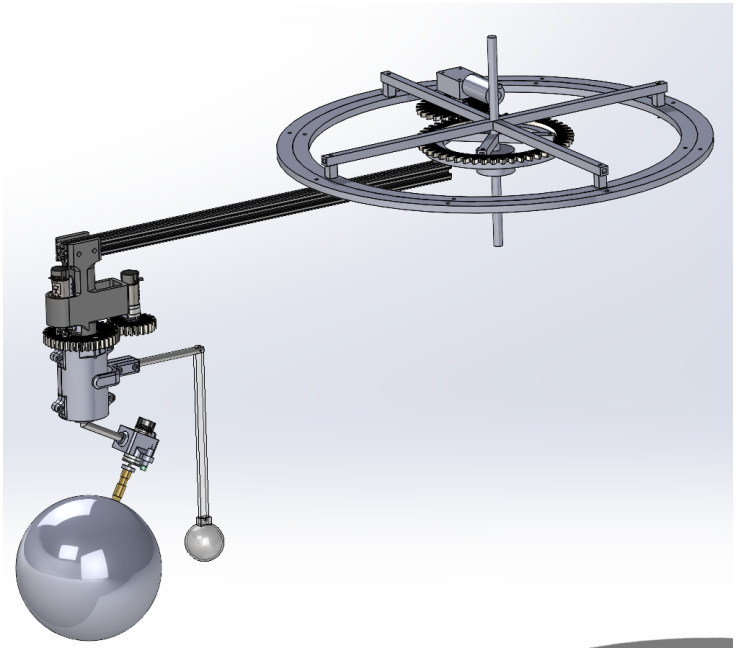

Figure 1: A late-phase CAD model of our orrery prototype. The large ring handles the Earth's orbit around the Sun, while the contraption at the end of the long arm handles the position of the Earth's axis and the Moon's motion around the Sun.

My STS research is a continuation of my prospectus. In a prior semester, I investigated whether or not rhythm video games might have the potential to train auditory-spatial attention;

that is to say, whether or not they could gradually improve the player's ability to collect and synthesize information about what they hear around them. My idea was that this form of entertainment, already prevalent due to its popularity, could be repurposed to provide training and growth while making such exercises easy and approachable through an entertainment medium. The concept itself stemmed from how I often feel mentally refreshed after playing rhythm video games. My results seemed promising, so I refined my approach, shifting my focus into how existing rhythm games compare to PTSD treatments that rely on heavy sensory input. I took a deeper dive into how existing therapies are thought to work, I looked into experiments on how exercise and "exergaming" (exercise through video games) affect our ability to learn and adapt, and I did my best to figure out what rhythm game therapy might look like based on my findings. In the end, I created the groundwork for further research; rhythm game therapy shows promise as a concept, but there's still a lot of work to be done in terms of design and clinical testing. My hope is that creating a therapy method that's connected to a popular form of entertainment will make PTSD treatment more accessible and less affected by the stigma surrounding treatment.

Both of these projects pushed me to expand my understanding beyond my comfort zone, starting with something familiar and fun. They are steps on my journey to become a researcher and an educator, and I do not think I would be considering that future if I hadn't done both of them. Furthermore, by working with topics that many find interesting, I have hope that my work can reach and inspire others, by appealing to their curiosity, to set out and make their own discoveries. Engineering can feel like a rigid discipline, but it isn't. By incorporating our passions into problem-solving, we can start a journey to make something new.