

Undergraduate Research Symposium May 19, 2017 Mary Gates Hall

Online Proceedings

POSTER SESSION 1

Commons East, Easel 70

11:00 AM to 1:00 PM

Cyrcle: A Smartphone in the Shape of a Circle

Chelsea Ramos, Senior, Electrical Engineering
Ishana Sharma, Senior, Electrical Engineering
Yuqing (Jill) Yin, Senior, Electrical Engineering
Mentor: Robert Bruce Darling, Electrical Engineering

The objective of this project is to develop an affordable (optimally less than \$200 to manufacture), 4G/LTE touchscreen mobile phone in the shape of a circle. This will be accomplished by learning how to gather and assemble phone parts, design and solder printed circuit boards (PCBs), and program and test a custom phone. We will thereby apply concepts of communications, embedded systems, software programming, and PCB design. So far, we have built three different phones with various types of screens, processors, speakers, microphones, antennae, and more to compare the prices and performance of each phone and part. The ultimate intended outcome of the project is to build a circular phone that has all the features of a rectangular phone and more in terms of hardware, software, appearance, and usability. The desired performance specifications for the phone are that it can make and receive calls, create and receive SMS messages, and provide notifications via a speaker, buzzer, or any combination thereof. The idea for this project was originally conceived by dTOOR's founders (prior to incorporation of the company) after they had grown frustrated with the bulkiness rectangular phones. They observed that rectangular phones had become the norm, but such phones were impossible to fit comfortably into women's pockets and they all tended to look the same. As a result, dTOOR's Cyrcle phone came into development. The uniquely-shaped Cyrcle phone is devoid of those troublesome corners that rectangular phones have, thus making it easier to carry around, much like an accessory. The prototypes for the phone are definitely brighter and more fun to carry around than other phones and they have successfully attracted a non-rectangular market. These prototypes use traditional, rectangular PCBs and so now, the next challenge is to build the Cyrcle with custom, circular PCBs.

POSTER SESSION 1

Commons East, Easel 69

11:00 AM to 1:00 PM

Visualizing Geoenvironmental Data on Mixed and Virtual Reality Devices

Chang-Yu Wu, Senior, Electrical Engineering
Michael Jeffrey (Michael) Omori, Senior, Electrical Engineering
Travis Espiritu (Travis) Bailey, Senior, Electrical Engineering
Liyuan Wang, Senior, Electrical Engineering
Mentor: Robert Bruce Darling, Electrical Engineering
Mentor: Payman Arabshahi, Electrical Engineering
Mentor: John Sahr, Electrical Engineering
Mentor: Daniel Cook

The purpose of this research is to generate immersive, natural-looking environments from geoenvironmental data that can be viewed on hardware-constrained virtual and mixed-reality platforms. Current mixed and virtual-reality technologies, such as the Microsoft HoloLens, are constrained by limited hardware resources. These constraints set limits on the realism and quality of immersion of virtual reality environments. Thus, no software previously existed to intelligently render immersive 3D terrain on hardware-constrained virtual and mixed reality devices. Through research in terrain generation and 3D rendering, the Viewpoint Generator application was created that can accurately and realistically render 3D environments. To render the terrain, 3D environments generated in Unity, a game rendering software, are pre-processed on a host machine. The 3D terrain is sliced into a grid containing individual slices. For each slice of terrain, a set of concentric panoramas and a skybox are generated. These static components require relatively little power to render. Performance was benchmarked through simulations in Unity and on-device with a Microsoft HoloLens, with a minimum frames-per-second (fps) requirement of 60 fps to prevent nausea induced by slow rendering. These components form the Viewpoint Generator application that can be deployed to hardware-constrained devices, which allows users to explore areas of a 3D environment not previously possible on hardware constrained devices. Applications for the Viewpoint Generator include uses in civil engineering and environmental restoration and visualization. Large-scale environmental projects too large to convey through static 3D

renderings or by human imagination can now be explored in an accurate and realistic virtual environment. As the Viewpoint Generator is designed to operate on compact devices, it is easily deployed to remote environments. The Viewpoint Generator sets the foundation for development in procedural environment generation based on geoengineering data, allowing new visual insight into civil engineering and environmental restoration projects.

SESSION 1T

EMBODIED VOICES: NEW DIALOGUES IN MUSIC AND DANCE

Session Moderator: Juliet McMains, Dance
Meany Studio Theatre
12:30 PM to 2:00 PM

* Note: Titles in order of presentation.

Dance Partnering: The Act of Engaging in a Physical Dialogue

Warren Woo, Senior, Dance

Mary Gates Scholar, UW Honors Program

Mentor: Bruce McCormick, Dance

I have observed that a significant portion of dancers who study ballet or modern dance have minimal partnering experience, and the resources that connect the concepts of contact improvisation, social partner dance, ballet, and modern dance for students are limited. With this realization, I decided to further research in the field of dance partnering pedagogy and ask what could tie these techniques together. This research took place during the fall 2015 through spring of 2016 school year. For my methodologies, I led and documented bi-weekly sessions at the UW dance studios, reviewed related literature, conducted interviews with dance professionals, and met regularly with my mentor. For the studio sessions, I prepared movement exercises and guided participants with prompts that focused on the cultivation of trust, the body's capacity to listen, and the development of physical skills necessary to be a versatile dance partner. Throughout this research, the theme of physical dialogue came up repeatedly. From my findings, I have come to conclude that above all else, the capacity to listen and to enter a physical dialogue is essential when dancing with a partner. This oral presentation will also include movement demonstration articulating my findings.

POSTER SESSION 3

Commons East, Easel 56

2:30 PM to 4:00 PM

Synthesis of Flexible Anodic Aluminum Oxide Membranes

Lilia Rodriguez-Ley, Senior, Mat Sci & Engr: Nanosci & Moleculr Engr

Mentor: Bruce Hinds, Mater. Sci. & Engr.

Mentor: Brian Goodall, Materials Science and Engineering

Anodized aluminum oxide (AAO) with macroscopically-aligned, hexagonally-packed nanopores is an attractive substrate both for making nanomaterial templates and forming membranes. AAO has a tunable pore diameter, a well-defined pore structure, and is easily scalable. However, it is brittle which makes it difficult to work with and limits its applications. Here we present a method for synthesizing AAO nanoporous membranes that are flexible. We perform a two-step anodizing process using 99.999% pure aluminum foil in Oxalic acid. We make flexible AAO by patterning aluminum seams in a triangular grid to relieve stress. Additionally, fittings and a patterned gasket protect the aluminum strips from the anodizing solution. With flexible AAO, further research can be carried out on pharmaceutical separation applications and biochemical filtration. For this project I wrote up a protocol for my laboratory to make AAO on site for use in future research projects.

POSTER SESSION 3

Balcony, Easel 103

2:30 PM to 4:00 PM

Protein Binding Ligand with Zwitterionic Peptide Co-Layer for Continuous Affinity Protein Separation

Yao Yan, Junior, Exchange - Arts & Sciences

Mentor: Bruce Hinds, Mater. Sci. & Engr.

Mentor: Alex Peek, Materials Science and Engineerign

A dynamic membrane system with nanometer-thick electrodes is able to selectively bind genetically modified proteins with specific protein ligands and pump them across the membrane with sequential voltage pulses. The previous tests on this system show that after several separations of mixed proteins, the separation rate decreases due to bio-fouling; non-specific proteins lie on the surface of membrane and diminish the ligand's affinity to target modified proteins. A colayer of non-fouling zwitterionic peptides and affinity ligands is functionalized to the membrane surface. We set up rubber chambers to mimic the working environment of the separation system. Mixed protein separations are performed in the chambers and permeates are quantified with UV-Vis spectroscopy. After introducing the zwitterionic non-fouling agent, the membrane maintains constant separation rates while retaining high binding capacity.