ARTS ENGINE

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21st Century Hammond Organ

Two Sentence Elevator Pitch:
ArtsEngine is a U-M program based on North Campus that promotes durable collaborations between arts, design, engineering, and technology. Students on the ArtsEngine project will create a media-integrative 21st century expressive instrument by re-imagining and re-designing a vintage analog musical instrument – a Hammond M3 organ.

Abstract:
Can a musical instrument be re-imagined and re-designed to integrate state-of-the-art technologies, while remaining true to the original intent behind its creation? When invented in 1934, Lauren Hammond integrated state-of-the-art technologies with a traditional keyboard interface to create an electronic organ that rivaled the sound palette of the pipe organ. In 2020, how can advances in electronics, digital signal processing, sound shaping and design take advantage of the keyboard/sound design interface of the Hammond organ? Furthermore, can such an instrument be further modified to support multimedia artistic expression?

A Hammond M3 organ has been donated to the audio studios in the Duderstadt Center at the University of Michigan. Two years ago, a team of students began to restore the M3 to working order. Expanding upon their work, the students on the MDP team will extend the Hammond-organ interface to support artistic expression in multiple modalities. This must all be accomplished while maintaining and expanding the playability of the instrument without hindering the opportunities for creative expression that it presents. Many facets of engineering, design, and creativity are at play including the opportunity to model alternative keyboard solutions found in the Stearns collection. It is expected that the final product will be a unique resource for artists and performers at the University of Michigan.

Impact:
The re-imagined Hammond organ will be integrated into the performance resources in the Duderstadt Center of the University of Michigan. It will serve both as a concert instrument as well as a collaborative research tool for further study of multimedia real-time expression by musicians, composers, artists, dancers, architects, and engineers.

Scope:

<u>Minimum Viable Product Deliverable (Minimum level of success)</u>

- Fully functional restored organ console
- Digitized control

- Digital realization of original Hammond sound synthesis

Expected Final Deliverable (Expected level of success)

In addition to the minimum viable product deliverable,

- Fully networked for audio and data
- Expanded options for sound synthesis that incorporates principles from contemporary instruments in the Stearns collection, including the Michigan-based Wavemakers analog synthesizer
- Viable mode of expression through an artistic medium besides sound to be determined by the student team

Stretch Goal Opportunities: (High level of success)

- Proper loudspeaker display and implementation of the original Leslie effects and more contemporary spatialization technologies
- Tunable algorithms for mapping between sound and light
- User interface support for storing and retrieval of performance parameters including support for tethered and untethered operation.
- Looping, overlaying, mixing, routing of multimedia streams

Student Skills:

MDP Sponsored Projects are both a professional and academic learning experience for students. By participating in this program, students are actively preparing for graduate school and a professional career. As part of the experience, MDP expects professional behavior. To best prepare you for future professional opportunities, your experiences on this MDP team will be very broad. In addition to key technical skills that you will bring to the team, you will engage deeply in the self-directed learning of new and important concepts, demonstrate flexibility, collaboration, and cooperation, and develop strong professional communication skills. This also means that you will need to be able to work outside of your traditional area of study in the true multidisciplinary nature of our projects. You won't always be able to anticipate how your skills and expertise will be used, so the MDP Sponsored Project will challenge you to grow and develop as a professional.

Project Area	Specific Skills	Likely Majors
Organ console restoration (1 student)	Wood-working, 3D printing	ARTDES (ALL) MECHENG (BSE)
Sound synthesis/design/control (2 students)	MIDI control/synthesis, DSP	Performing Arts Technology (PAT) EE (BSE) CE (BSE) CS (ALL)
Keyboard/Pedal hardware/firmware (2 students)	Digital electronics/networking	CE (BSE) PAT
User interface/artistic expression (2 students)	Keyboard/organ performance, music composition, installation artist	SMTD-Music A&D (ALL) ARCH (ALL) SMTD-Musicology SI (MS)

Additional Desired Skills/Knowledge/Experience

Any of the following Skills, Knowledge, Experience, Interest or Outlook, would be valuable to the 2020 team. We don't expect students to be familiar with all or even most of the technical items, but strong candidates will have familiarity or experience with *some* of them and a positive attitude to learn what is necessary as the project gets underway. Please highlight your experience with any of the items on this list in your personal statement on the application.

- Ability to read music
- Ability to play the organ or other instrument
- Interest in restoration/antiques
- Interest in Internet of Things (IoT)
- Experience in building/modifying electronic music instruments
- Building/integrating/assembling robotic systems

Location:
Most of the work will be done in the Duderstadt Center on campus where the organ is located.

Sponsor Mentor:

David Greenspan
Managing Producer, Audio Studios
Media & Studio Arts, Duderstadt Center
David (Dave) Greenspan is the managing producer for the audio studios in the Duderstadt Center at the University of Michigan where he is responsible for the design, maintenance and operation of the audio facilities. Prior to Dave's appointment to U of M, he was the Technical Director (Presentations) and format Production Director (Recording) at the Interlochen Center for the Arts. Dave received his BS ('86) degree in Telecommunication and Film from Eastern Michigan University where he worked in the Communication and Theatre Arts department as a TA and WEMU as Recording Engineer and remote broadcast engineer.

Executive Mentor:

Gregory H. Wakefield
Associate Professor of Electrical Engineering and Computer Science
College of Engineering
Gregory H. Wakefield is the newly appointed faculty director of the University of Michigan's ArtsEngine. His past and present research interests include auditory signal processing, spatial audio, musical acoustics, cognitive architectures, vocal pedagogy, auditory perception, cochlear prosthetics, and sound quality engineering. In addition to his academic research, Prof. Wakefield has served as a technical consultant in product sound quality to the Ford Motor Company, Boeing, Cochlear Americas, and Blue Ridge Research and Consulting. He holds doctorates in Electrical Engineering and Psychology from the University of Minnesota.

Faculty Mentor:

Kyle Snyder,
Assistant Audio Studios Manager
Media & Studio Arts, Duderstadt Center

Kyle P. Snyder is an engineer, educator, and consultant skilled in audio recording and mixing, sound design for film and video, facility design and integration, and live event production. Past clients include Ohio University, the Banff Centre, and countless musicians, arts, and film organizations. Most recently, Snyder contributed a chapter to the recently-released Routledge Companion to Music, Technology, and Education and served as Audio Post Production Supervisor on Paul Laurence Dunbar: Beyond the Mask. When he's not teaching or recording, Snyder can be found serving as Governor of the Audio Engineering Society.

He is also a proud member of The National Academy of Recording Arts & Sciences, The Society of Professional Audio Recording Services, The Association for the Study of the Art of Record Production, and the Music & Entertainment Industry Educators Association.

Legal Requirements:
Citizenship Requirements.

- This project is open to all students on campus.

Intellectual Property Agreements / Non-Disclosure Agreement Requirements

- Students will be required to sign a University of Michigan IP/NDA document.

Summer Project Activities

- No summer activity will take place on the project.

Company Information:
ArtsEngine's mission is to inspire, foster, and strengthen intellectual collisions and durable collaborative practices driven by the arts, design, engineering, and technology to fully maximize the potential of students and faculty on North Campus.

https://artsengine.engin.umich.edu/who-we-are/