Fourth Year Project Pre-Proposal

SYSC 4907

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The Problem

Carleton University's Davy Lab is a research group that works to better understand how environmental changes affect local threatened species of bats, amphibians, and reptiles. One such project involves investigating the effects of seismic vibrations from nearby wind turbine operation on the development of turtle eggs. Further, nearby highways can also generate ground vibrations that may have similar effects that must be studied.

The Solution

To give the Davy Lab the opportunity to complete this research, our primary goal is to create an incubator for turtle eggs that can simulate the ground vibrations generated by wind turbines.

Timeline

The following timeline will assume 3 or more students participating. If the group only consists of 2 students, some features of the incubator will be cut to prioritize vibration control.

The Davy lab will be treated as a client for the project group, with regular progress reports to be sent as email, with meetings set up at project milestones. A Microsoft Teams Site has been set up as a communication channel between the engineering project group and the Davy lab. Students at the Davy lab are encouraged to participate in discussions and planning.

The ideal end-product consists of a working vibration simulator with a sensor to ensure the correct vibrations, a fleshed-out user interface and data visualization tool, and sensors inside the incubator to monitor temperature and humidity. Final products and designs will be handed over to the lab so that they may use technology and produce more as needed for research. If working products are not feasible by the end of the term, all work will be handed over to the Davy lab to do with as they see fit.

Proposed Schedule

Task	Begin	Draft	Completed
Kickoff meeting between engineering team and lab	-	-	Aug. 26
Research	Summer	Sept. 7	Sept. 30
Proposal	Sept. 7	Sept. 30	Oct. 21
Hardware & Software Designs	Sept. 7	Oct. 8	Oct. 21
Finalize Part Orders	-	-	Sept. 30
Test Plan	Oct. 31	-	Dec. 10
Development – Software & Hardware	Sept. 30	Jan. 1	Feb. 15
Progress Report	Nov. 1	Nov. 18	Dec. 9
Oral Presentations	Jan. 9	Form – Dec. 9	Jan. 23-27
Integration Testing	Feb. 15	-	Feb. 28
Acceptance Testing	Feb. 28	-	March 10
Poster Fair	March 1	-	March 17
Final Report and Video	Jan. 15	1st – Feb. 17 2nd – March 24	April 12

Hardware/Software

Simulator

The incubator sub-system would consist of a **shake table** capable of <1Hz to 50Hz vibration (typical ground vibration measured from wind turbines (Borowski, 2019)). This can be achieved either using an **actuator** to vibrate a table on a rail suspension system or using a low frequency **tactile transducer** and **amplifier**. Currently, the **tactile transducer** solution is being considered to minimize mechanical components. An **incubator** would then be placed on top of the table for the eggs. The incubator could be a retail purchase, or something provided by Dr. Davy's lab. It would include the ability to **monitor and control temperature and humidity**. We would require an **accelerometer** to measure and ensure accurate vibrations, additionally allowing us to dampen or increase the vibrations based on the number of eggs and/or the type of the incubator.

The simulator would be controlled with a **BeagleBone Black board**, which contains a computer and multiple microcontrollers.

Interface

The simulator will have an attached **touch screen interface**, including the operation of the shake table, sensor data, data entry, and data visualization. If possible, an additional **application** (web and/or mobile) would allow remote control of the incubator. Work would be done in cooperation with the Davy lab, to create an interface most relevant to their research.

Budget Breakdown

The following budget is a rough estimate of primary components. Components and prices are subject to change depending on number of students, Davy lab requirements, and further research.

Item	Source	Price
Tactile transducer (5-200Hz) & Amplifier	TheButtkicker.com	$450
Incubator	Provided by lab	FREE
Accelerometer breakout	Canadarobotix.com	$15
BeagleBone Black	Digikey.ca	$106
Temperature & Humidity sensor	Amazon.ca	$16
Touch screen for interface	Amazon.ca	$80
		Total $667

Funding

- Davy Lab – $1000
- Carleton Fourth Year Project Fund - $500

The team will be applying for grants and is hoping to fully fund through grants if possible.

A little bit about us…

Meia Copeland

Meia has completed 7 co-op placements and internships over her academic career. She began her university journey in Chemical Physics at the University of Guelph but decided after 3 years to switch to Computer Engineering at Carleton University after falling in love with programming and software development. Since starting at Carleton, she has completed a minor in physics and has taken electives in machine learning (SYSC 4415), automatic control systems (SYSC 4505), and power engineering (ELEC 3105). Her expertise lies mostly in software development, with just under 3 years of cumulative industry experience—mostly in application and web development.

For SYSC 3010, Meia worked with her group to create a smart beehive that included features such as humidity, temperature, and ice detection, an ice removal solution, ventilation system, website interface, and both local and cloud databases. Her group won the class contest for best project video. The project earned an overall grade of A.

This year, Meia is taking a leadership role in the fourth-year project, as she has experience working with clients on development projects. She loves reptiles and is excited to learn more about them while contributing to the Davy lab's conservation efforts.

Shawaiz Khan

Shawaiz initially started his university education with Mechanical Engineering at the University of Ottawa, where he developed a keen interest in systems and programming while studying a computer-systems related elective course. After 1.5 years, he decided to switch to Computer Systems Engineering at Carleton University to pursue what intrigued him. For SYCS 3010, Shawaiz and his group worked together to create a smart pet-food dispenser. It allowed users to remotely dispense food for their pets using a phone app. Additionally, the users could monitor their pets using a cam, and monitor the surrounding humidity and pressure values to ensure their pets were in a comfortable living environment. Working on this project opened him up to the endless possibilities of hardware systems and gave him a decent and much-needed experience with hardware.

For the capstone, he was excited to come across Meia's project idea and hopes he can assist Dr. Davy's lab by working on this out of the ordinary and environmentally conscious project.

References

Borowski, S. (2019). Ground vibrations caused by wind power plant work as environmental pollutuon - case study. *18th International Conference Diagnostics of machines and Vehicles.* MATEC Web of Conferences.