# Introduction -> This part is not necessarily needed.

## Purpose

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.

## Intended Audience and Use

*Herpetology*?? Researchers working with species that tend to nest around windmills and/or highways.

The “device” can be used to study the long term effects of windmill vibrations, or ground vibrations from highways on the development of turtle eggs. One set of eggs could be used as a control, while the other set could be subject to the vibrations generated by the “device”. The differences between them could be studied over time.

## Scope

## Definitions and Acronyms

Define risks -> What could go wrong? How do we mitigate these risks? Who is in charge of these risk items?

One of the risks would be accidently providing the wrong frequency to the eggs/ or to provide different frequencies to different incubators. To avoid that, multiple accelerometers (possibly one for each incubator) will be used to constantly measure the vibrations to ensure the desired frequency is achieved consistently, while minor differences are tracked.

Additionally, a motor failure would result in a system shutdown. To prevent that, multiple motors could be used. This would spread the load across all the used motors, as well as greatly reduce instances of a single point of failure.

There would be a possibility of external vibrations applied to the incubation system. For example, construction/heavy machinery nearby. For the most part, the lab has to make sure to conduct their experiment where such examples wouldn't be a factor, although, the system will be placed on thick rubber mats which would minimize the effect of external vibrations by absorbing them.

# Overall Description

## User Needs

Who will use product and how?

In this case, researchers will place turtle eggs in plastic containers and place it on a table top. Motors will be used to vibrate the table top, creating similar situation as a nest around a windmill or a highway. An accelerometer will constantly measure the vibrations to ensure ideal frequency is maintained. A temperature and humidity sensor would be used to monitor the area to ensure ideal incubation conditions are met. The temperature, humidity, accelerometer data will be stored in an online database for the lab to monitor remotely.

## Assumptions and Dependencies

- Framework we are basing on

- External factors?

- Reusing software from a previous project?

Project management framework could be *Waterfall*. Requires minimal client input. Have a hardship date??. Don't need a working prototype in the first go. Requirements and scope are clearly defined.

One major assumption is that external vibrations are not significant near the device.

Another assumption is lab can take care of the humidity and temperature **control**.

We assume the researchers are not tech savvy. To take care of that, we will aim to keep the controls simple, and implement an Adaptive User Interface.

# System Features and Requirements

## Functional Requirements

* Requirements essential to product use
* Table top vibrating at a specific frequency and amplitude
* Continued operation possibly multiple days at a time (60-90 days incubation time)
* Data collection -> accelerometers for vibrations, other sensors for environmental variables
* Export data

## External Interface Requirements

* Hardware required

## System Features

* Requirements necessary for system to function, MVP
* Temperature and Humidity monitoring
* Touchscreen interface for control (what kinds of control?) turning motor on/off, turning sensors on/off, turning accelerometer on/off, changing vibration frequency of motor ?
* Local SQL database to track sensor measurements and timing
* Network connection (Wi-Fi and ethernet)
* Export SQL database to a spreadsheet that can be emailed or exported to USB stick

## Nonfunctional Requirements

* Important to use of product, but not fully necessary for us.
* Safety, performance, security, quality, etc.
* Portability/Size - System would be compact ideally (need to find a balance between size and performance/number of eggs/incubators lab can use at a time) considering the limited space in the lab/office. Is it easy to move around by researchers.
* Scalability - As a future project, can the lab add a second shaker to the same system. Controlling both with the one set of controls.
* Reliability - Create a device which the lab can depend on for running throughout the incubation period. (With breaks, since windmills do not turn all the time depending on factors such as windspeed/ maintenance/repairs?)
* Usability – The researchers will be comfortable operating the device. Simplified UI etc.
* Maintainability - Ease of replacing parts over time if certain parts break down.

**Stretch Goals:**

* Multiple frequencies
* Temperature or Humidity control
* Battery powered
* Improved UI.
* Website connection
* GraphQL for database
* Cloud database to remotely keep track of the temperature and humidity data gathered, as well as the values recorded by the accelerometer.(any more data we can keep track of? Maybe instances of power loss?)
* Back up motor in case of failure

**Breaking up immediate goals/checklist:**

Electrical:

* Finishing up proposal draft.
* Testing with a Low Frequency Portable Shaker Table
  + Breaking down to component level to recreate our own variant.
* Testing with a simple motor and plywood plank
  + ...
* Integrating PWM – Pulse Width Modulation
  + ...

Systems:

* Finishing up proposal draft.
* Setting up database
  + Beaglebone
  + Local SQL database  
    -> Decide which one (MySQL?)
  + Email functionality
* Setting up sensors
  + Temperature
  + Humidity
  + Accelerometers -> Will likely need multiple!
  + Determine with lab frequency of measurements
  + Motion sensor (to notify of hatching?)
* User Interface
  + Touch-screen
  + Control motor frequency and amplitude, duration of experiment. Preferably on-the-fly
  + Begin experiment
  + End experiment
  + Email spreadsheet to desired users (enter emails, save for future use, be able to remove as needed)
  + Page that shows current measurements (accelerometers, environment, time) and time of experiment
  + Debug page that allows resetting in case of a serious fault or emergency
  + Pre-program length of experiment
  + Settings page
    - Network connection
    - More to come when we talk to the lab about our initial designs
  + Website -> This is stretch goal (MVP will just be the touchscreen with ability to email spreadsheet)
* Manual buttons, ports
  + Off button/switch that can turn on/off whole machine
  + Ethernet port (in case not wanting to use Wi-Fi)
* Control system
  + When frequency/amplitude is changed, need to gradually change signal (not suddenly)

Figure out what exact parts we need to order, how they interact with each other, using what type of communication.

Use the above info to create a set of sequence diagrams based on the Use Cases.