Team 1: Proof of Concept Demonstration

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Introduction - Background

- Don’t you want your yard looking like this or even better?
- Always have pests wandering and ruining your lawn?
- Tired of purchasing ineffective pest deterrents?

Introduction - Purpose/Motivation

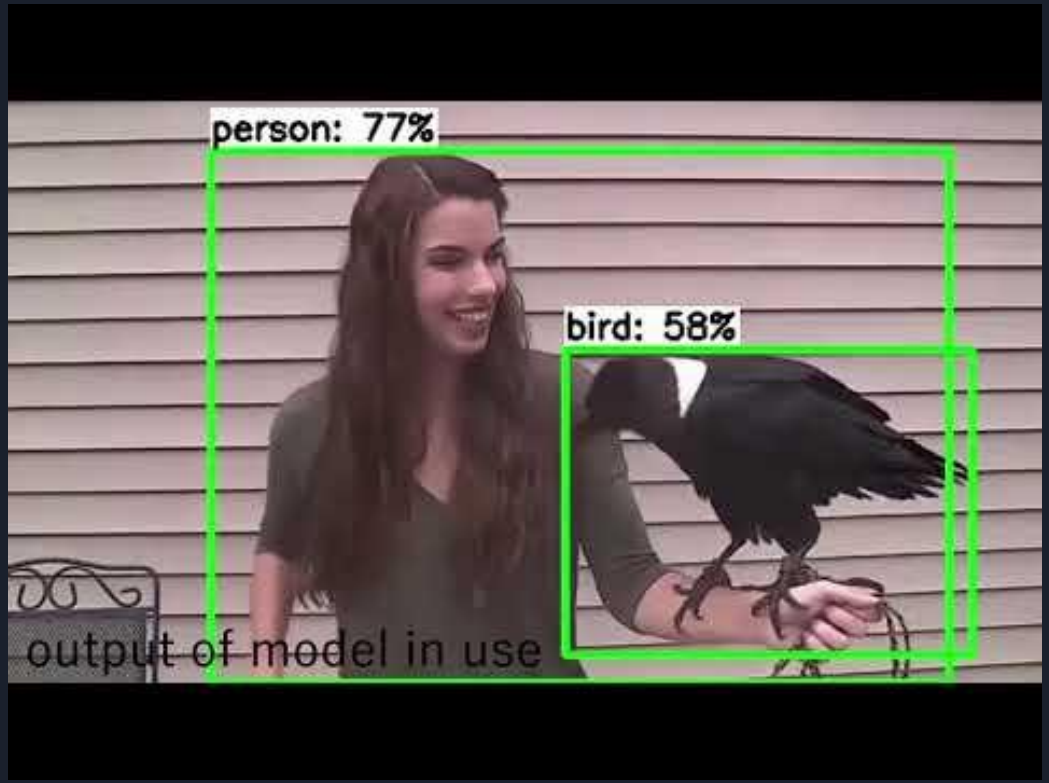
- Flud -- Smart Pest Deterrent
- A cost-effective AI approach in deterring pests
- System includes: AI trained camera, rotating sensor, water-based spray mechanics

- Helps in lawn maintenance
- Saves your time and money
- Provides ease of use with its simple and intuitive design

Introduction - Team Members

• Clifford Fung,	CEO ,	Full Stack Software Engineer
• Josh Baltar,	CTO, CCO,	AI Software Engineer
• Desmond Trang,	CIO,	AI/Mobile Software Engineer
• Justin Tsang,	CFO,	Hardware Engineer
• Miguel Taningco	CSO ,	Project Manager
• Eric Wang	CDO,	Systems/Hardware Engineer

Video



Business Case - Ideal Customer

- Ideal customer
  - Homeowner
  - Cares about the look of their grass
  - Looks towards technology to fix problems
    - Ie. security cameras for home security, IoT technology, automatic systems
- Considerations for the ideal customer
  - Correct detection
  - Accuracy of water jet
  - Night capabilities
  - Power consumption
  - Web application ease of use

  - Correct installation
  - Low maintenance
  - Weather proof
  - Long term solution

Business Case - Market

- Lawn and garden equipment manufacturing industry is analyzed

- In the US, $446.7 million per year
  - 28.6% of this industry is supplementary products for lawn maintenance
  - Results to $127.76 million per year

- Homeownership rate and per capita disposable income are both expected to rise 1.3% over the next 5 years

Business Case - Competition

Competition:

- The Scarecrow, Orbit Yard Enforcer (motion detector sprinkler deterrent)
  - Moderately effective with the an initial burst of water and nuisance of getting wet
  - Activates to any motion including humans or pets
  - Shoots blindly at a range rather than a specific direction
  - Predictable, so pests easily learn to ignore the initial burst of water
- The Guardian (ultrasonic deterrent)
  - Visually more lowkey
  - Can be heard by younger people like young adults or children
  - No evidence to support that noise works as the primary deterrent
- Grannick's Bitter Apple (taste deterrent)
  - Invisible, easy to apply
  - Only solves problem in a small area of a yard
  - Diluted after precipitation, need to constantly reapply

Flud Competitive Advantages:

- Pest detection
- Pest customization
- Targeted aiming
- More powerful water jet
- Video recordings

Business Case - Price, Financing

Approximate price of Proof of Concept:
- $500
  - Raspberry pi
  - Google coral
  - Portable battery charger
  - Ball bearings for the physical product
  - Camera module
  - Other components and 3d printing

Approximate price of Prototype:
- $500
  - Component repairs and replacements
  - 3d printing

Expected price of production:
- Reduce cost through injection molding
  - wont break even until the 10000
  - Can create a 3d printing factory instead
- Produce a more compact model
- Use weaker components
- Reduce electrical components
- Choose cheaper manufacturers
- Mass produce

- Retail price expected to be $200-$300 with a 25%-35% profit margin
- Although the price is higher than competitors, the features still outcompete

Technical Case - High-level description

Main Functions:

- Physical device functions:
  - Detection of pests
  - Aim and direct nozzle to shoot water at pests
  - Record videos of pest detection
  - Designed for use in lawns and gardens
  - Battery powered

- User experience:
  - Register device to our servers
  - Selection of pests to target or avoid
  - Display of statistics on water usage and device status
  - Access to videos recorded from the device

Technical Case - Materials and cost

Materials:

- Plastics:
  - Flud structure: $30
  - Flud exterior: $20
  - Water piping: $10

- Metals: Material costs depends on supplier
  - Microcontroller
  - Nozzle
  - Motors
  - Wiring

Cradle to Cradle Design:

- PETG plastics
  - Recyclable and durable
  - Scale up from 3D printing to injection molding to reduce cost

- Find suppliers with the most environment friendly components
  - Battery
  - Microcontroller
  - Motors

Technical Case - Scope and Design

Changes in Scope and Design:

- Single camera system
  - Reduced cost and system complexity

- Motion sensors
  - Four sensors rather than a single 360 degree motion sensing array
  - Component availability
  - Fits within dimensional constraints

Risk Analysis - Danger from Water

Risk: **Water can potentially injure a pest if water is sprayed at a vulnerable spot.**

Mitigation Plan:

- Include various means to repel pests
  - Water, noise, lights
- Water will only be forceful if pest is close to Flud
  - Have motion detectors that can detect pests that are further away
  - Have system startup and begin to deter pest quickly
- Include disclaimer saying that the company is not responsible For any damage done by the device

Risk Analysis - Danger from Battery

Risk: **Battery can potentially leak or explode if it is compromised.**

Mitigation Plan:

- Include various failsafes to stop the battery's usage and turn off power
  - Temperature sensors
- All electronic circuitry is enclosed and not exposed to external stimulus
  - I.e. rain, wind
- We will include an instruction manual that teaches the users for safe disposal of Flud

Risk Analysis - Water Usage

Risk: **Different levels of water usage may be in effect.**

Mitigation Plan:

- Designed Flud to use no more than 2 cups (475mL) of water per usage
  - Allows for ~24 usages in a week even up to Stage 3
- Allow the users to set alerts to notify themselves if they are approaching their water limit
- Allow the users to toggle off/on pests to deter

Watering trees, shrubs, and flowers excluding edible plants		**Stages 1 & 2**: On any day from 4 am to 9 am if using a sprinkler, and on any day at any time if using a hand-held hose with automatic shut-off device, a soaker hose, water container, or drip irrigation **Stage 3**: On any day at any time if using a hand-held hose with automatic shut-off device, water container, or drip irrigation. Prohibited if using a sprinkler or soaker hose

Risk Analysis - Security

Risk: **Web application / Database may be breached and data is taken.**

Mitigation Plan:

- Require proper credentials for all HTTPS requests
- Require SSL/TLS between the web application and the database
- Encrypt all passwords stored on the database
- Users can only access their Flud device through a unique hash key that is provided to them

Risk Analysis - Lack of User Awareness

Risk: **The consumer may not know how to assemble/use the Flud safely and as intended.**

Mitigation Plan:

- Include instruction booklet with the Flud that gives instruction for every use case and assembly
- Include the necessary warning labels for dangerous parts
  - I.e. electrical components, moving parts, water pressure, small parts
- Have tutorial videos on youtube addressing the different usages and benefits

Risk Analysis - Lack of Marketing

Risk: **With lack of Marketing, there is a chance Flud will not be successful.**

Mitigation Plan:

- Promote Flud through friends and family
- Try to place Flud into major retailers for lawn care / maintenance
  - I.e. Home Depot
- Spend money in advertisements
  - I.e. newspaper, online, radio ads
- Sponsor influencers
  - “49% of Consumers Depend on Influencer Recommendations”

Risk Analysis - Lack of Funding

Risk: **We will need to initially spend more money to prototype and develop Flud.**

Mitigation Plan:

- Develop and test theoretical designs through cost-efficient means before developing with production materials
  - I.e. test the physical feasibility through 3D printing before using injection molding
- List Varia Technologies as a public incorporated business to allow ourselves to sell stocks to generate more cash flow

Adherence to Standards

Standards that Flud adheres to (extended list in requirements documentation)

Standard	Description
CAN/CSA-C22.2 NO. 61508-1:17	Functional safety of electrical/electronic/programmable electronic safety related systems — Part 1: General requirements [1]
CSA C22.2 NO. 0.23- 15	General requirements for battery-powered appliances [2]
CAN/CSA-C22.2 No. 60529:05 (R2010)	Degrees of protection provided by enclosures (IP Code) [3]

Self-Reflection

Things we learned as a whole:

- Proper market research to ensure a competitive and unique invention
- How to integrate all of our project components together

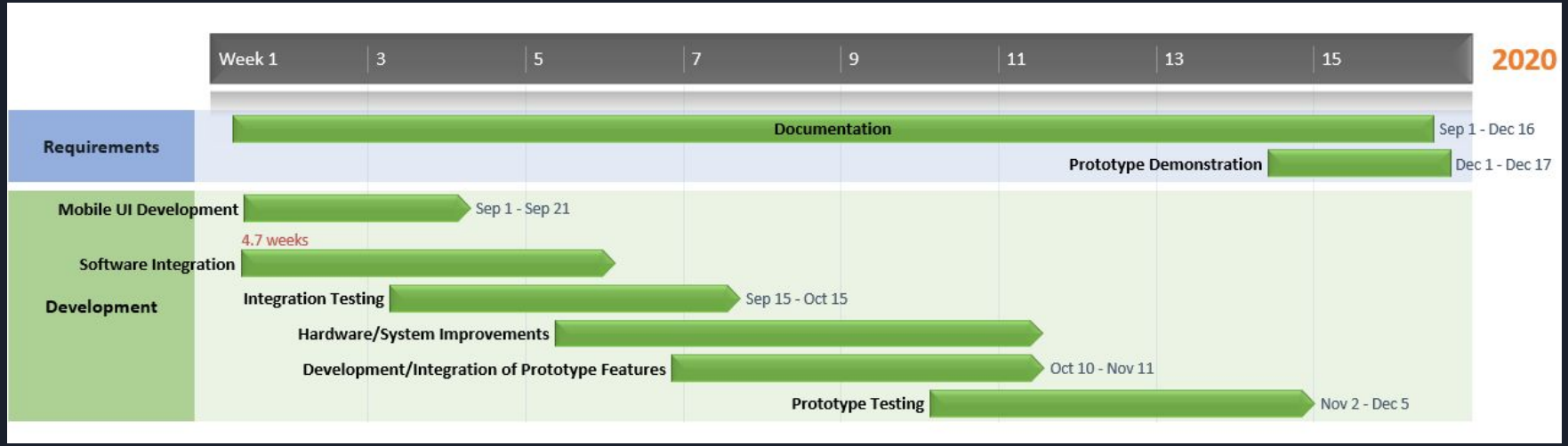
Things we learned as individuals:

- Deploying web app to Heroku
- Creating a Gantt chart
- Networking with Raspberry Pi

Changes to development Process:

- Meet more than once a week
- Proper code review

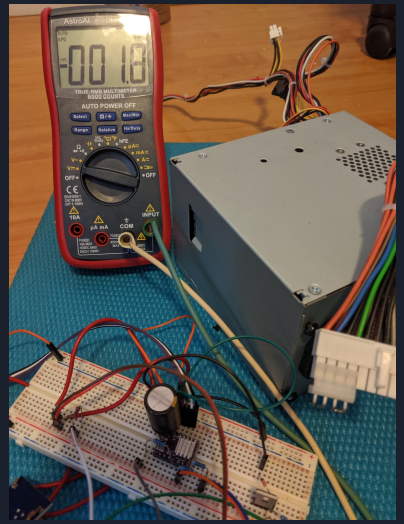
Schedule & Brief plan for 440



Gantt Chart of our plans in ENSC 440 and the Prototype stage

Testing and Testable

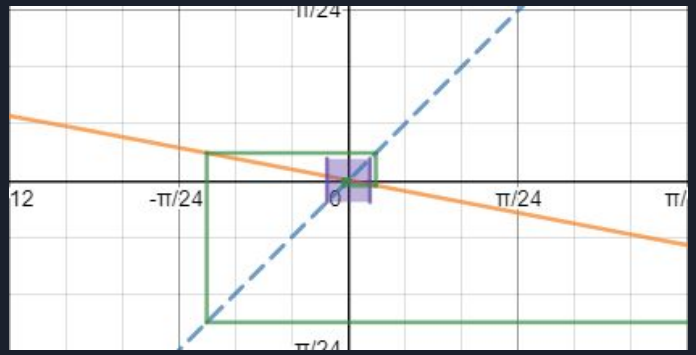
- Proof of Concept Testing (Hardware)
  - Batteries
  - Camera
  - Stepper and Servo Motor Movement
  - Solenoid Valve



Testing and Testable cont’d

- Proof of Concept Testing (Object detection)
  - Evaluates images at 5 fps
  - Recognizes raccoons, squirrels, crows
  - Recognizes people
  - Recognizes dogs
  - Recognizes cats
  - A box will be shown around a recognized object
  - A corresponding label will be shown above the box

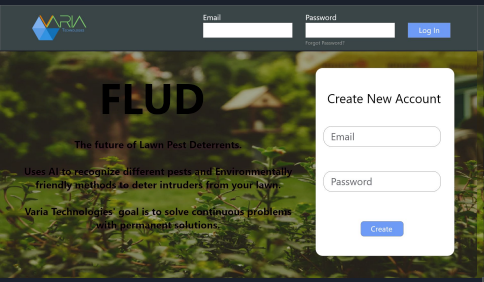
Concept Proven

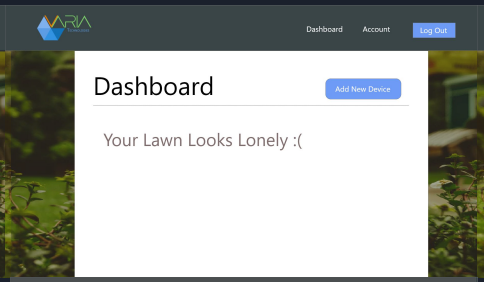


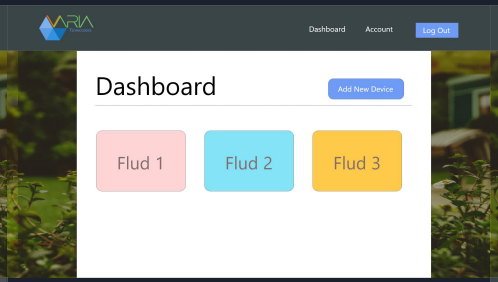
Validation of Device Features:

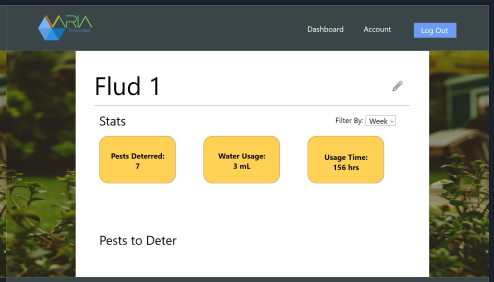
- AI
  - Recognizes various pests
  - Looking to expand the animal set and accuracy
  - Adding Coral to increase FPS
- Aiming
  - Calculation accuracy of horizontal movement through models
    - https://www.desmos.com/calculator/avyn25xbgi
  - Looking to test out movement API for prototype
- Web Application
  - Able to have barebone web application hosted on Heroku
  - Looking to send data directly from the Pi to the Web App
- Movement
  - Servo, stepper, nozzle used to aim and direct water flow

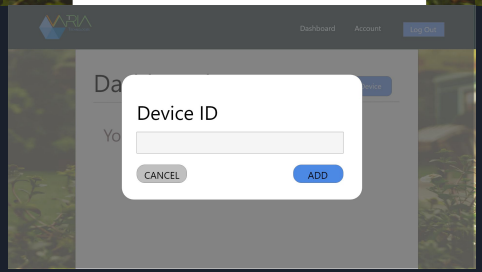
Appearance Modelled - Software

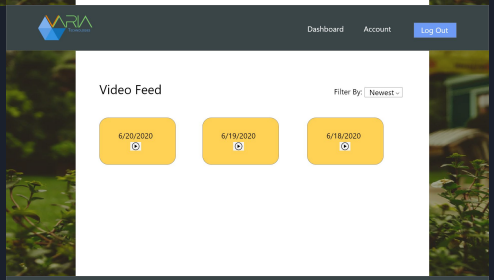


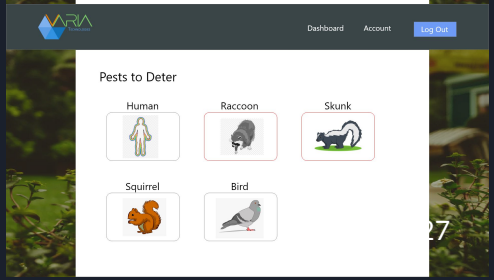












Appearance Modelled - Hardware

Back View

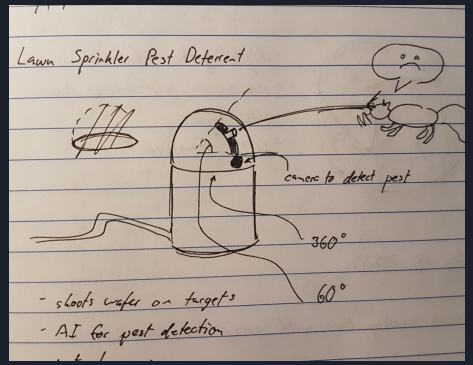
Front View

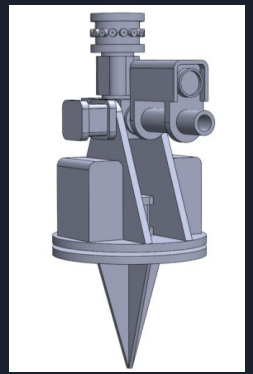
Technical Design, Exploration, Research

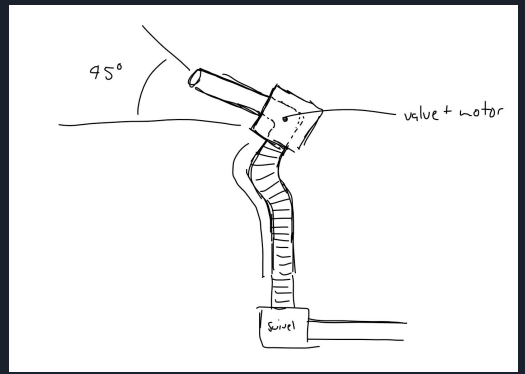
- Physical Look
- Depth Perception and Viewing
- Data Transfer and Web Application Design
- Power Management
- Complementary Features

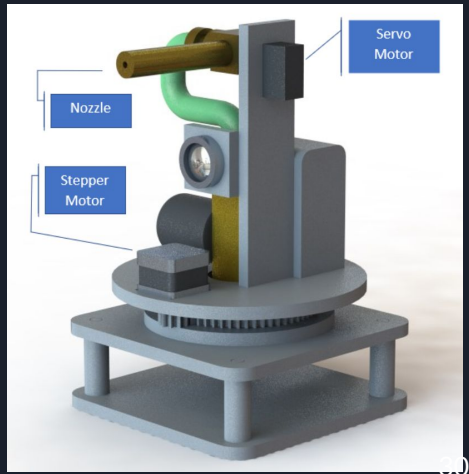
Technical Design, Exploration, Research

- Physical look
  - Initial proposition: Observatory type of shape, internal design considered
  - 2nd iteration: Electronics moving with the nozzle, hose twisting considered
  - 3rd iteration: Hose twisting designs, hose bending considered
  - PoC iteration: Hose twisting solved using a pipe entering from the side



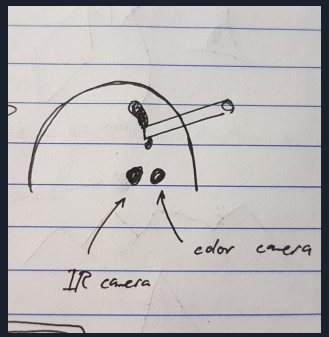


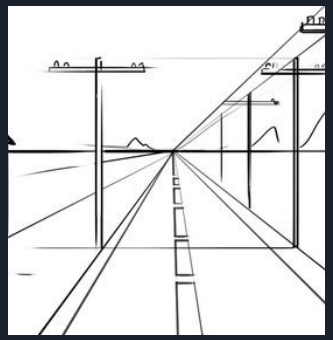


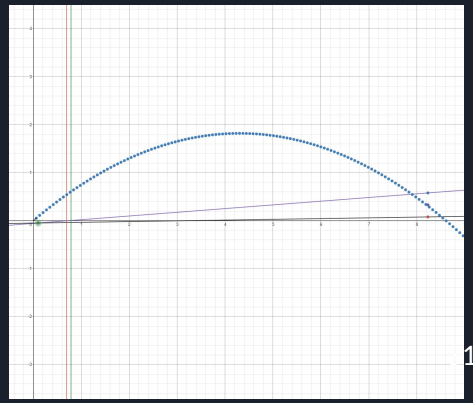


Technical Design, Exploration, Research

- Depth Perception and viewing
  - Initial proposition: Two cameras, one infrared, the other color for depth perception, power usage considered
  - 2nd iteration: single camera without an ir cut filter which can see at night, depth perception considered
  - 3rd iteration: Depth perception by ideal horizon, ideal conditions too improbable
  - PoC iteration: Use of apparent center of sensor considered and the expected height of the pest

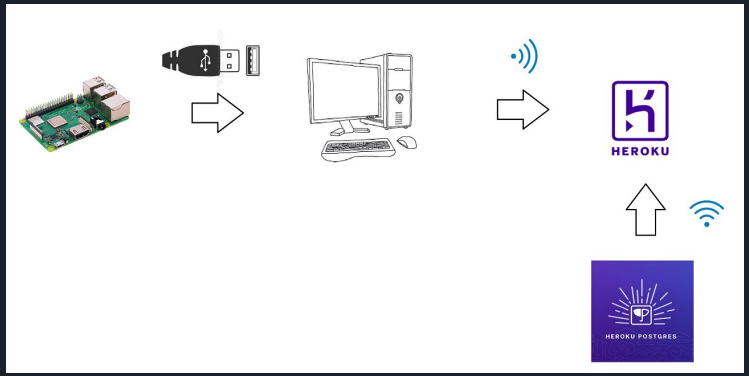






Technical Design, Exploration, Research

- Data transfer and Web Application design
  - Initial proposition: raspberry pi that will send data to the web application hosted on a server
  - 2nd iteration: Created barebone web app on Heroku with local script that pushes data from local computer to Postgres database hosted on Heroku
  - 3rd iteration: Created local web application that has basic HTTP routing that connects to database, local script that pushes data to Postgres on Heroku
  - PoC iteration: Web application hosted on Heroku, SFTP to transfer data from pi to local, local script to push data from local to Postgres on Heroku



Technical Design, Exploration, Research

Power management:

- Initial proposition: AC from wall plugs to satisfy all power requirements
  - Introduce unwanted twist in our wiring.
  - Requires cable management on the consumer's end
  - Potential electrical hazard

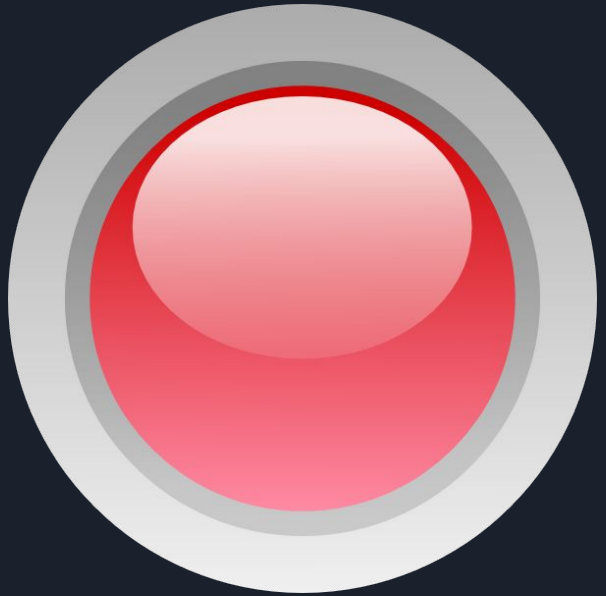
- PoC iteration: battery power
  - Greater range of movement
  - Safety - Allows electronics to be fully enclosed
  - Ease of installation
  - Requires effective battery management

Technical Design, Exploration, Research

Complimentary features:

- LED flash
  - Designed to trigger fear response from the pests
  - Condition pests to avoid area
  - Potentially reduce water and power usage

- Noise
  - Device motors and transmission generate noise
  - May induce fear in pests
  - Condition pests to avoid area



Conclusion (and Acknowledgements)

- Flud -- The future of lawn pest deterrents
- Will deter any unwanted pests while unharming any of its surroundings
- With our dedication and motivation, we will strive to ensure we deliver a successful product
- We learned to find a variety of different technical resources, reach out to other engineers for resources, and the steps to setup and deploy a fully functional web app with a back-end and a front-end
- We would like to give a special thanks to our friend Kean for allowing us to use their 3D printer

Questions?

References

[1] Scc.ca. 2017. CAN/CSA-C22.2 No. 61508-1:17 | Standards Council Of Canada - Conseil Canadien Des Normes. [online] Available at: <https://www.scc.ca/en/standardsdb/standards/28870> [Accessed 8 June 2020].

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[5] https://digitalmarketinginstitute.com/en-ca/blog/20-influencer-marketing-statistics-that-will-surprise-you