

APPORTECH™

Final Presentation



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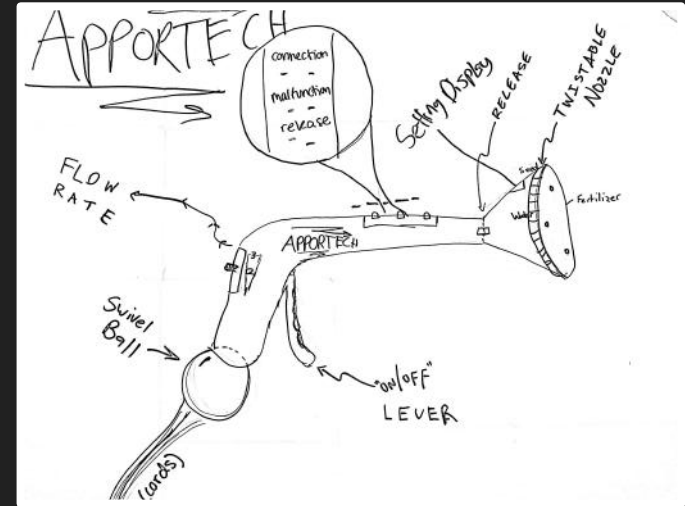
The Project - Apportech™

VFT Design brings to you Apportech™, a state-of-the-art 3-in-1 horticultural tool equipped with the ability to dispense water, seeds, and fertilizer from the same unit. Apportech™ strives to put the user first and offers an innovative solution to simplify the plant nourishment process.



The Process (First Leg)

- Preliminary Web Research
- Informal Observation Visits - Home Depot & Mahoney's
- Created Initial Survey
- Administered Initial Survey at Mahoney's
- Revised Survey Based on Initial Feedback
- Administered Updated Survey (Online)
- Collected and Reviewed the Data
- Defined User Needs and Requirements
- Created Design Concepts
- Performed Heuristic Reviews of Concepts
- Conducted Structured Interviews about Concepts



Presentation Overview (Second Leg)

- Task Analysis
- Hazard ID
- Initial Product Prototype Development
- Risk Assessment
- Simulated Use Testing
- Data Analysis and Reporting
- Finalized Prototype



Our Progress



Task Analysis

- The team performed a hierarchical task analysis (HTA) in preparation for a Hazard ID.
- Overall Goal: Watering and fertilizing a ten foot garden. (Without walking through garden).
- The task analyzed included 6 Steps:
 - Fill Containers
 - Check Error States
 - Replace 24 Hour Nozzle
 - Fertilize Garden
 - Water Garden
 - Clean Apportech
- The team then brainstormed the associated sub-steps.

Steps	Sub-Steps
1	<u>Fill containers</u> Grab Apportech Ensure that tubes are connected to bottom of the containers Open desired container lid Fill container with appropriate material (water, seed, fertilizer) Close container lid Ensure containers are properly locked into the cart
2	<u>Check error states</u> Turn it on (on cart) Remove handpiece from holster Check Error Lights on Handpiece If nozzle needs to be replaced, go to step ____ If nozzle is not clicked into place, fix nozzle. If device is clogged, take handle apart and clean clogs
3	<u>Replace 24 HR Nozzle (if necessary)</u> Twist off nozzle Retrieve a new nozzle Click and twist new nozzle on Ensure that the error light is off Place handpiece back into holster

Hazard ID

- The HTA provided direct input into a Hazard ID.
- The team assessed the various hazards, situations, severity levels, and P2s associated with each task of the HTA.

Hazard ID	Hazard	Hazardous Situation	Harm to user	Severity Level	Severity Level Description	P2 - probability of hazard leading to harm
1	Use Error	User drops handpiece on foot	Bruise or Abrasion	Very Low	The handpiece does not weigh that much to cause significant damage	Remote
2	Use Error	User rolls over foot with carrier	Bruise or Abrasion	Low	It will be painful, however, it will almost certainly not require medical attention	Remote
4	Use Error	User hits themselves in the face with the extender	Bruise, abrasion, or broken bone	Moderate	Moderate if a bone is broken	Occasional

Risk Assessment

- The team performed a user-related risk analysis by identifying potential failure modes, causes, and effects associated with tasks previously defined in the HTA

Risk ref.	User Task	Potential Failure Modes	Potential Failure Cause(s)	Effect(s) to Patient/ User/ Environment (Hazard)	Severity	P2	P1	Likelihood (P1 x P2)	Risk (Likelihood x Severity)	Mitigation Strategy
1	1 Fill Containers	User overfills containers	User cannot see how much material is in container	Potential chemical burn if filling fertilizer. Overflowing and spillage if filling water or seeds.	High	Unlikely	Occasional	Unlikely	AFAP1	Clearly show max fill mark on container
4		User spills material	User trips, knocks it over, loses grip	Potential chemical burn if filling fertilizer. Overflowing and spillage if filling water or seeds.	High	Unlikely	Occasional	Unlikely	AFAP1	Make containers with lower center of gravity to tip over
5		User does not properly close container, causing spillage at some point	No feedback for locking lid	Potential chemical burn if filling fertilizer. Overflowing and spillage if filling water or seeds.	High	Unlikely	Occasional	Unlikely	AFAP1	Make sure lid clicks to let user know it is closed
6	2 Check Error States	User comes into contact with hazardous material	Error state indicators may not be bright	Potential chemical burn if material is fertilizer	High	Unlikely	Occasional	Unlikely	AFAP1	Show green LED for okay and red for error state to make it easier to distinguish
7			Malfunctioning LEDs	Potential chemical burn if material is fertilizer	High	Unlikely	Remote	Incredible	AFAP2	N/A
8			User forgets to check error states and 24 Hr nozzle was not locked	Potential chemical burn if material is						Trigger cannot be pressed if not

- Using P2s and P1s from Hazard ID we determined Likelihood (P1 x P2).
- Using severity from Hazard ID and now Likelihood we found Risk (Likelihood x Severity).
- Risk mitigation strategies for each failure mode were recommended.
- Fortunately, all risks were AFAP1s and AFAP2s and none fell in the not acceptable category.

Conclusions Drawn from Risk Assessment

- With none of our risks being rated as “Not Acceptable,” the team focused on mitigating risks with our AFAP1 “as far as possible.”
- The team implemented the following risk mitigations in the prototype prior to usability testing:
 - Marked max fill line on containers to prevent overfilling
 - Included two LEDs for each error state indicator, one red and one green, to better indicate when there is an error
 - Included red LED light that indicates when the safety is on to better alert user of safety state
- Other mitigations to be included in the final design include:
 - Lower center of gravity for containers to avoid tipping
 - Make container lids lock to prevent spillage and alert user that lid is correctly closed
 - Trigger disabled if there is an error to prevent user from misusing device
 - Include multiple warnings in manual to describe safety precautions while using device
 - Prevent extender from being too forceful to prevent accidental injury

Initial Product Prototype

- The team gathered to create a prototype with high enough fidelity to run usability studies.
- The team created the initial prototype out of the following materials:
 - Cardboard
 - Duct Tape
 - Garden Hose Head
 - Modded Caulk Gun
 - Computer Mouse



Initial Prototype Demo



Usability Testing

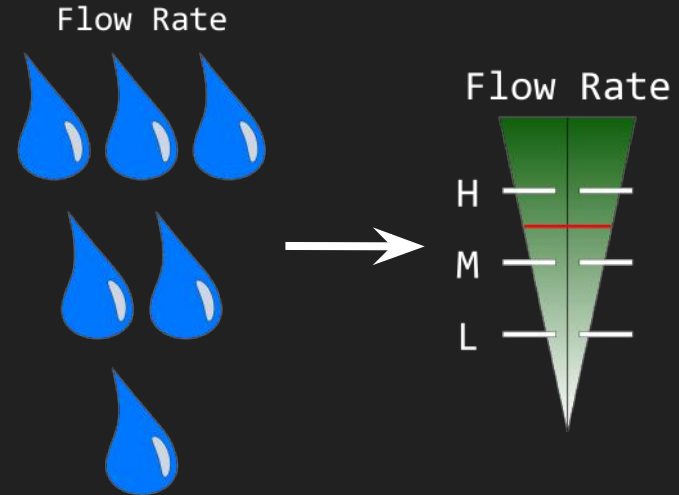
- The team conducted usability tests with the initial prototype.
 - N = 5
 - A pilot test was run to work out any issues prior to gathering data.
- The test consisted of some preliminary demographic
- Due to the limitations of the prototype, we asked participants to imagine performing some tasks including:
 - Filling the Containers
 - Reading Error States
 - Watering Plants Out of Reach
 - Switching Material Mode
 - Adjusting the Speed Flow Rate
- The tests concluded with final interview questions to assess the quality of the experience.

Data Analysis & Reporting - Key Findings

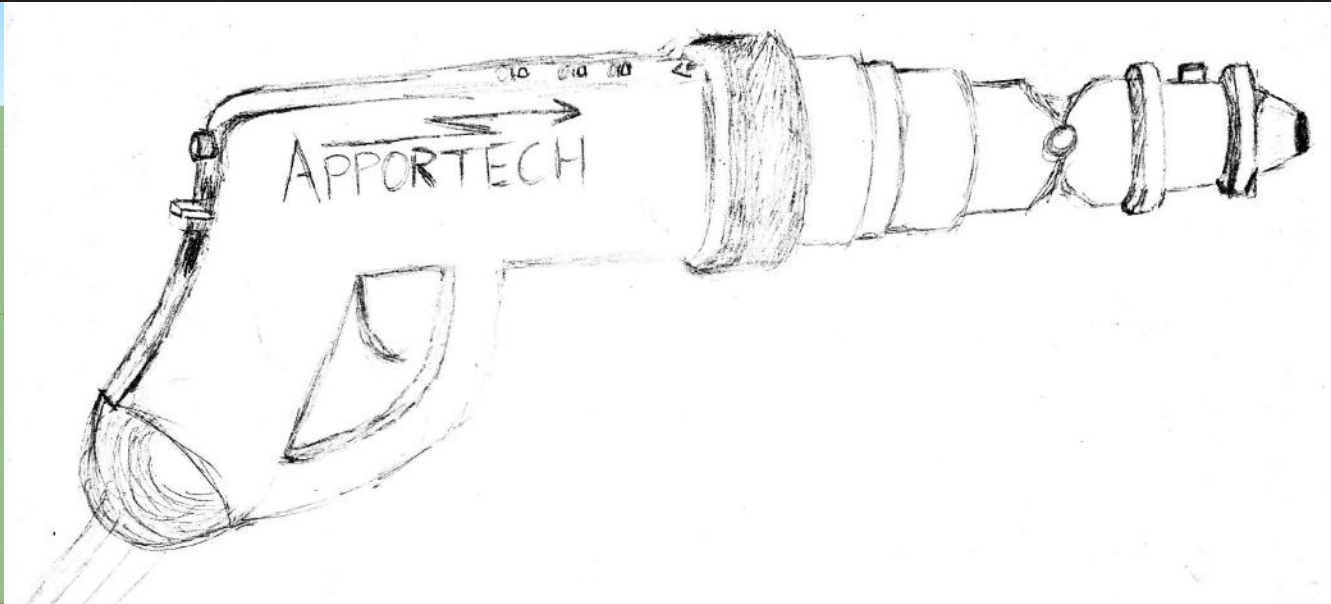
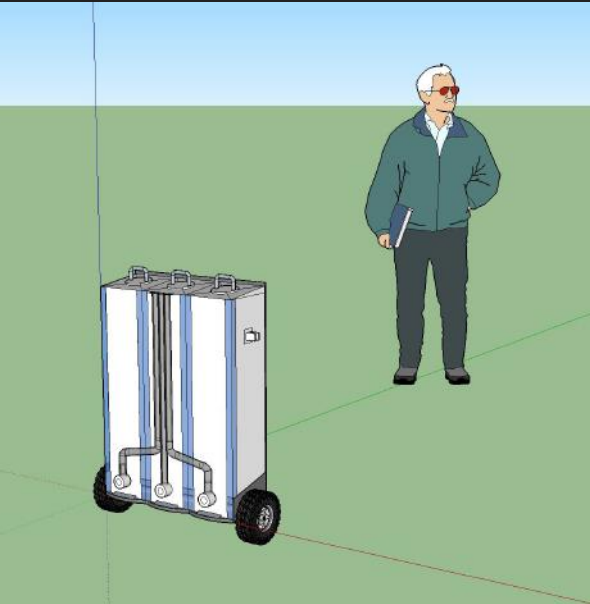
- In general, participants were confused about the wording/color coding of our error states
 - Suggested improvements included: device should not function if malfunctioning; ready to use light if working properly
- $\frac{4}{5}$ participants correctly identified our extend option, though they all did not notice the automatic button
 - A suggested improvement included changing the extend option to manual (this will eliminate some of our hazards)
- 5 participants correctly identified the speed adjustment dial
 - One suggested improvement included altering the symbols so that it was more apparent it could be used for all materials and not just water

Prototype Finalization

- Based on the data analysis and reporting, the team went back to the prototype to make necessary changes. After discussion, the team:
 - Fixed Error Light Ambiguity
 - Clarified error state language.
 - Changed from a two LED system to one.
 - Added a “Ready to Use” LED
 - Created a Less Ambiguous Display for Flow Rate
 - Added Indicating Triangles for Currently Selected Material
 - Clarified the Safety Toggle



Bringing Our Concepts to Life



The Final Prototype



The Handpiece



The Container Unit



Looking Forward

- The team is in the process of preparing the final report, to be delivered by May 2, 2016



Thank you!

Any Questions?