

Deliverable C: Conceptual Design, Project Plan, and Feasibility Study

Group C-5

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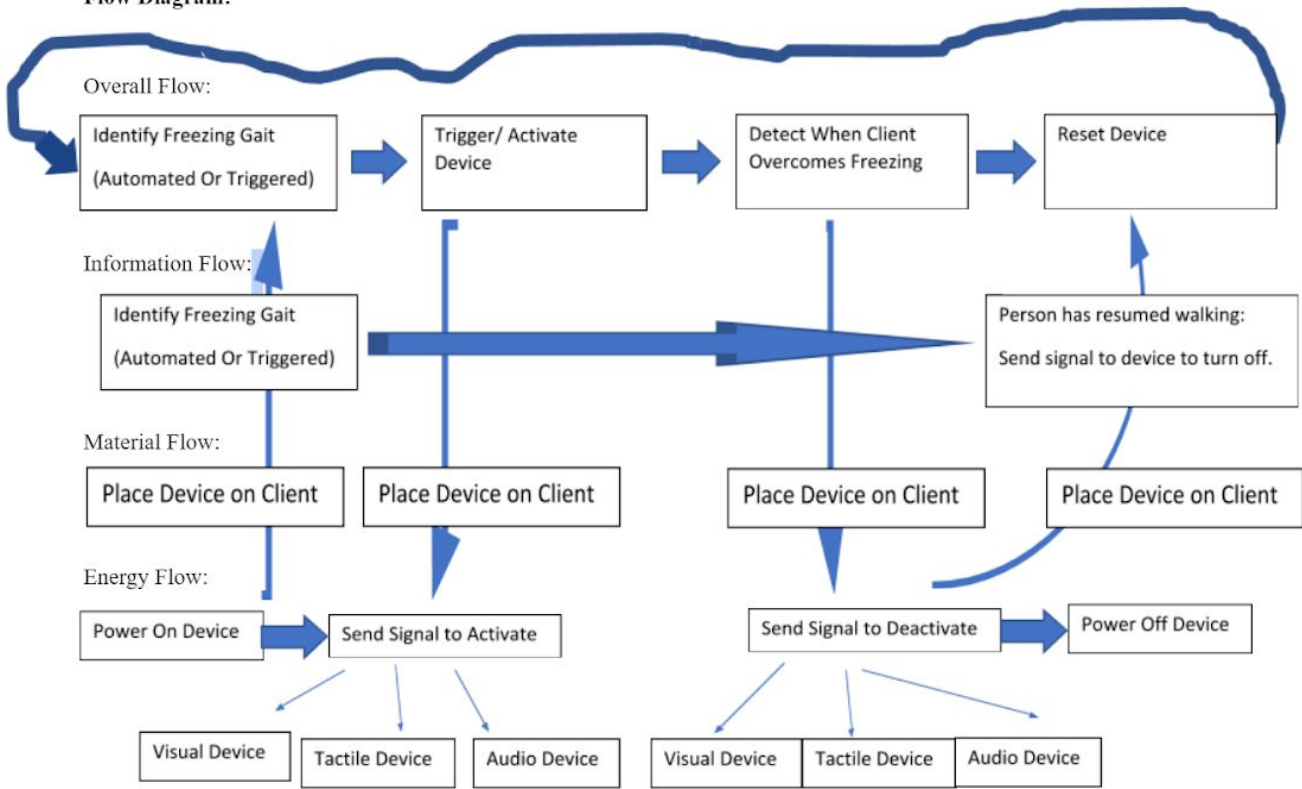
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Jordan Hilko

Aditya Nair

26h January, 2020

Flow Diagram:



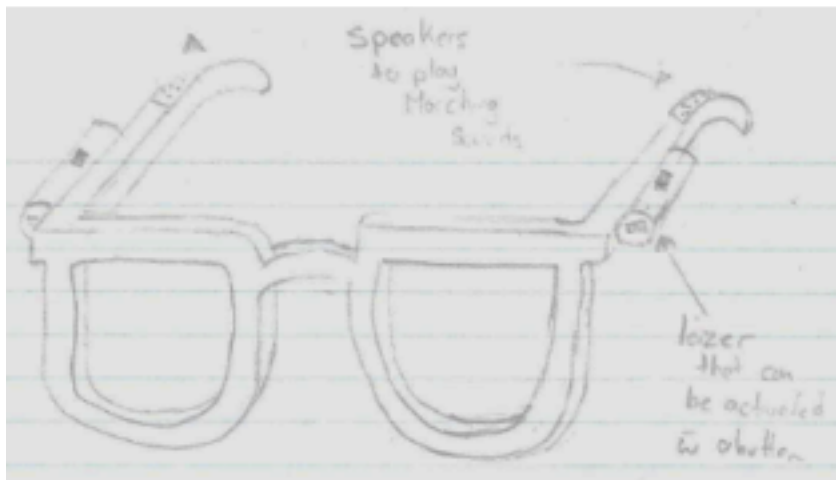
	Idea Title	Pros	Cons	Feasibility (TELOS)				
				Technical	Economic	Legal	Operational	Scheduling
1	Audio Visual Glasses (Liam W)	-Not easily noticeable -2 stimuli -Customizable	-Necessary to have adjustable /stabilized laser (Hand tremors could make use difficult)	Yes	Maybe	Yes	Yes	Yes
2	Ankle Mounted Laser (Liam W)	-Laser adjust/stabilize not needed	-Could be bulky	Yes	Yes	Maybe	Yes	Yes
3	Hearing Aid (Liam W)	-Easy to use -No extra cables/earbuds -Fast to equip	-Could be difficult to set up -Could become obsolete with hearing aid updates -Could hinder normal hearing	Maybe	Maybe	Yes	Yes	Maybe
4	Vibration Stimulus/ Cues (Liam Bruce)	-Adjustable -Fits in shoe = Hidden	-Unsure if it would work -Parts need to be small = more difficult to find parts	Yes	Yes	Maybe	Maybe	Yes
5	Laser Cane (Liam Bruce)	-Simple to make / construct -Modular design	-Must be carried around	Yes	Maybe	Maybe	Yes	Yes

		-Low cost -Simple to use -Can build more than 1 for more than 1 client		Yes	Maybe	Yes	Yes	Yes
6	Audio Stimulus/ Cues (Liam Bruce)	-Could be integrated into a phone app	-Must wear earbuds when in use	Yes	Maybe	Yes	Yes	Yes
7	Tile cannon (Gregory)		-Must be reloaded -Very obvious -Have to stop to pick up tiles	Yes	No	No	No	Yes
8	Laser Belt (Gregory)	-Subtle -Accessible	-Needs a belt -Laser is visible to others -Shirt needs to be tucked in	Yes	Yes	Yes	Maybe	Yes
9	Ankle bumper (Gregory)	-Follows the motion of the leg -	-Impacts could cause bruising	Maybe	Yes	No	Yes	Yes
10	Ankle metronome (Jordan)	-Can be used while sitting	-heavy - always need control device	Maybe	Yes	Yes	Maybe	Yes
11	Sole of foot rumbler (Jordan)	-Not visible -Always worn	-Has to be built in to shoe or a shoe insert	Yes	Yes	Yes	Maybe	Yes

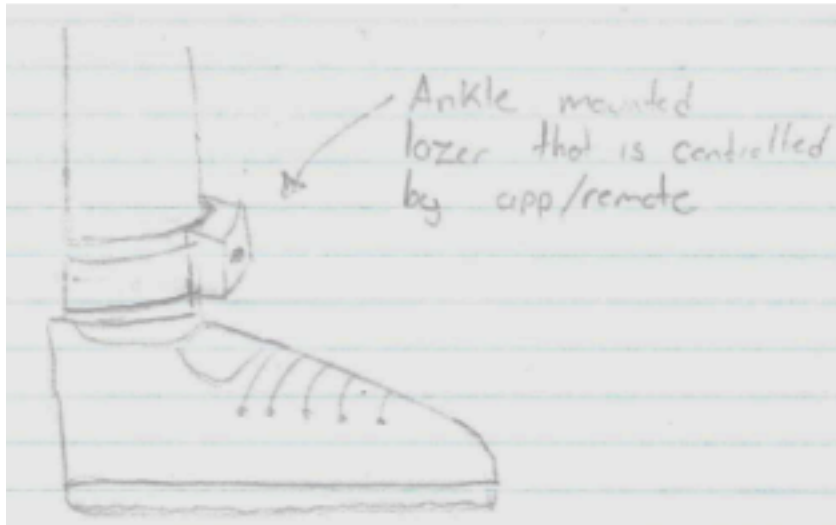
12	Ankle rumbler (Jordan)	-Not visible -Wearable	-Rigid and inflexible -Possibly uncomfortable	Yes	Yes	Yes	Maybe	Yes
13	Ankle band (Aditya)	-Inexpensive -Wearable -Flexible	-Needs earphones -Only works when they take a step -Requires sensors	Maybe	Maybe	Yes	Maybe	Yes
14	Vibrating socks (Aditya)	-Not Visible -More complete feeling of impact	-Hard to wash socks -More difficult to construct	Yes	Yes	Yes	Yes	Yes
15	Vibrating shoe w/ speaker (Aditya)	-Easy to attach -Less expensive	-External = Visible	Yes	Maybe	Yes	Maybe	Yes
16	Electric Shock Stimulus (Aditya and Liam)	-Good leg stimulation	-High risk -Lots of regulations	Yes	Maybe	No	Maybe	Yes

Concept Sketches:

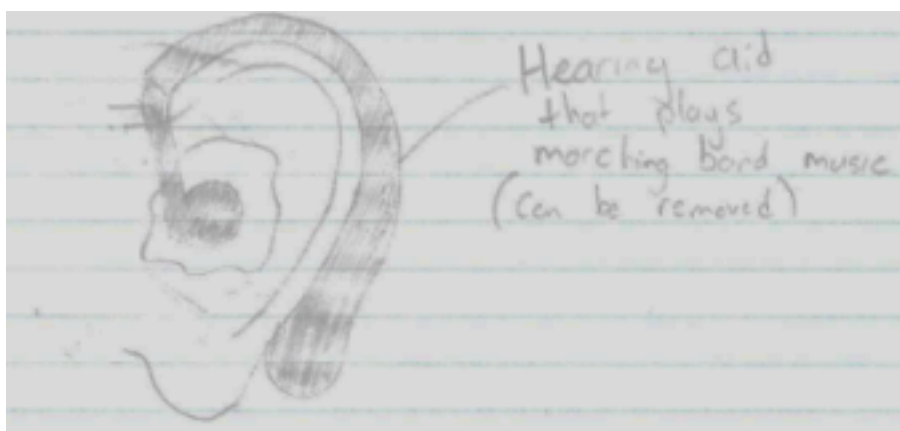
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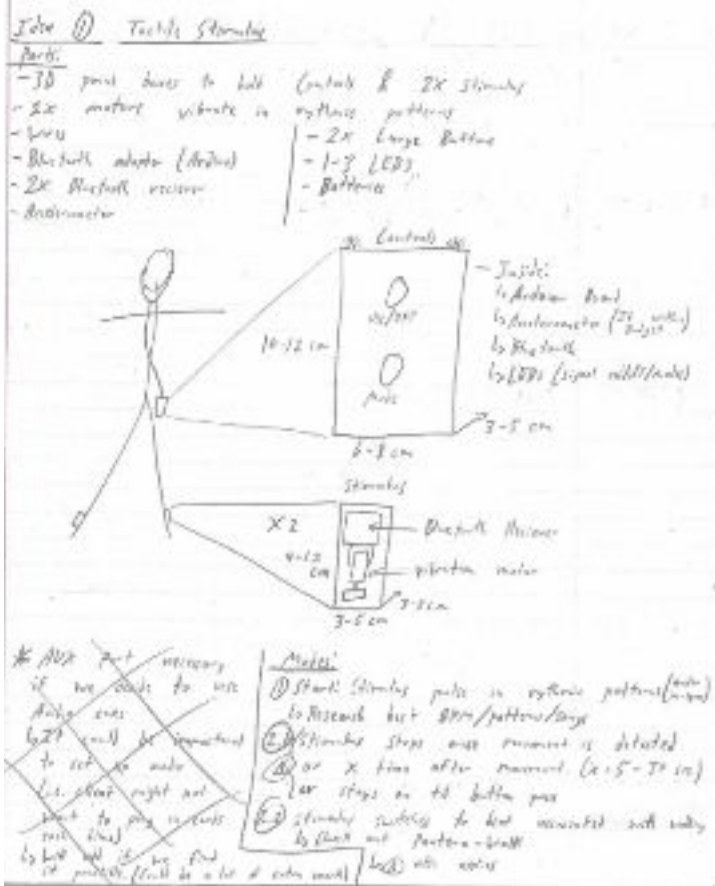
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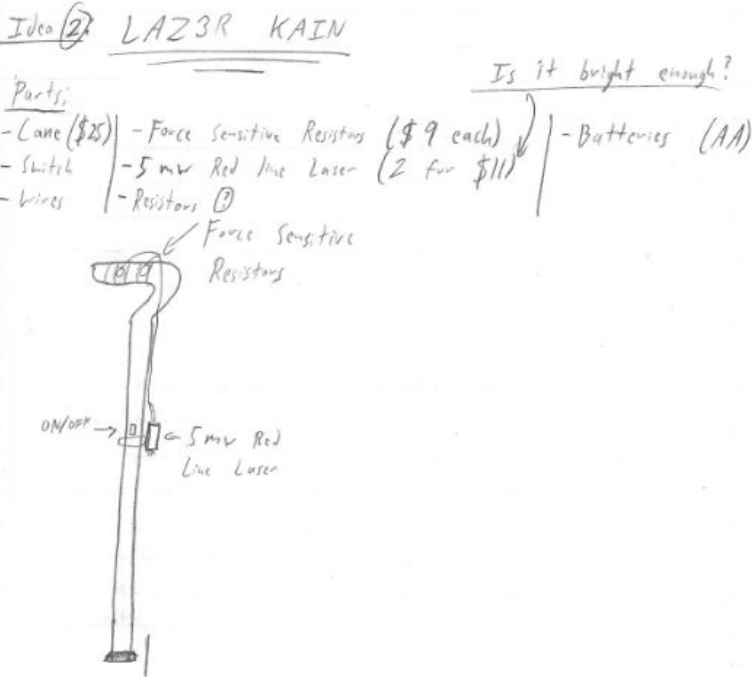
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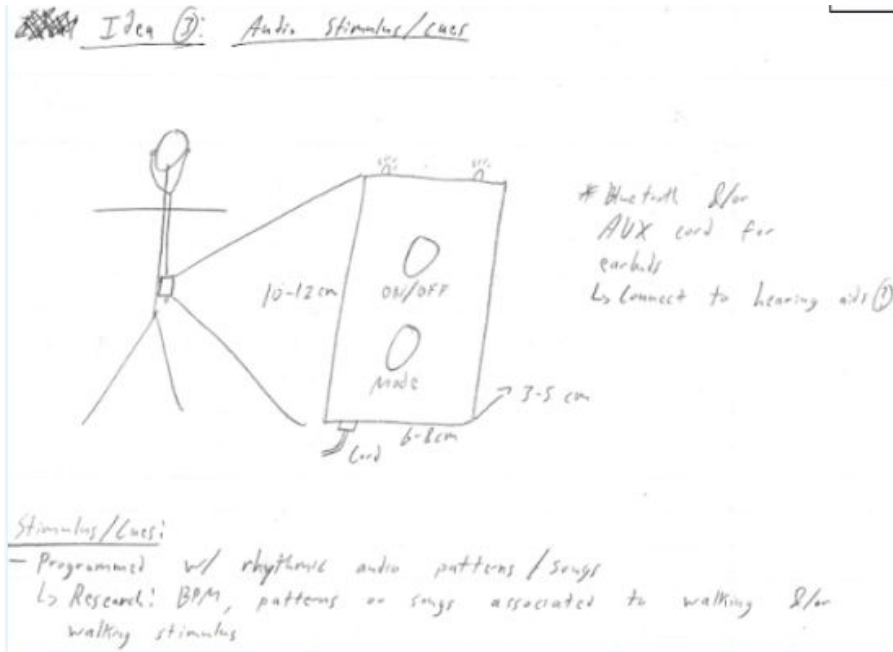


5.



Hand is placed on bill of cone, Force Sensitive Resistor activates 5mw Red Line Laser. Done.

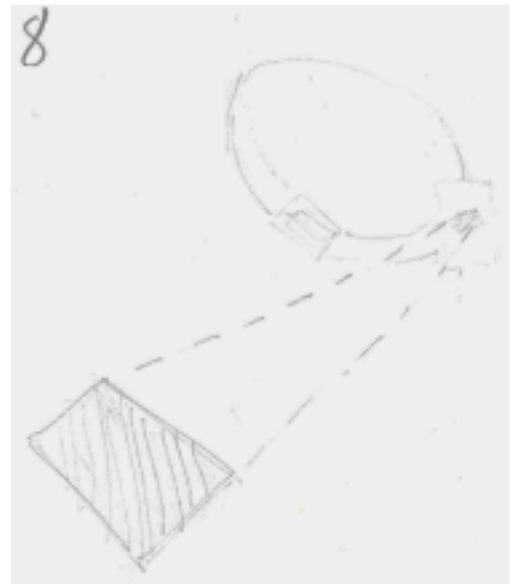
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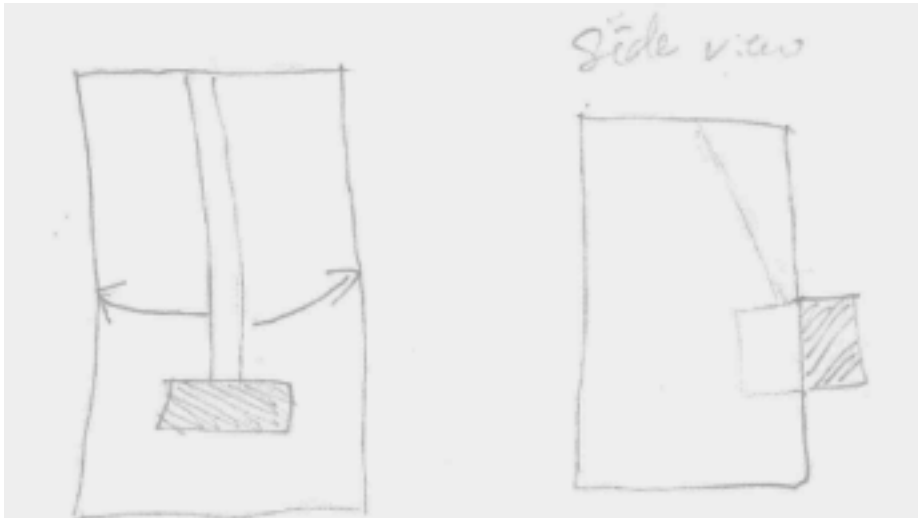
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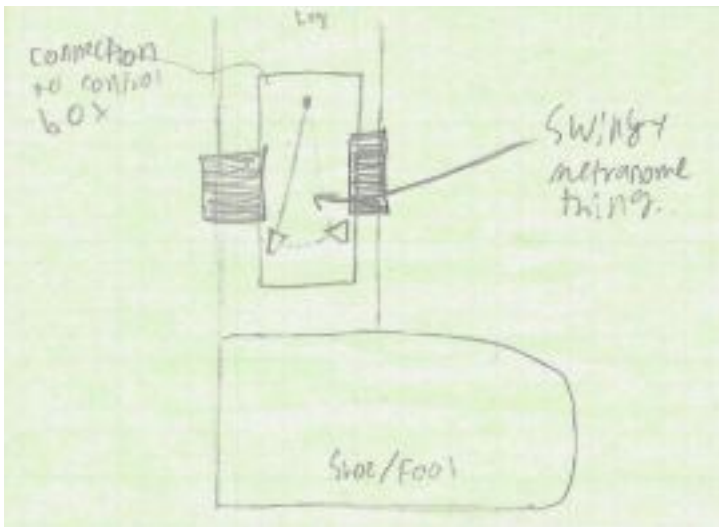
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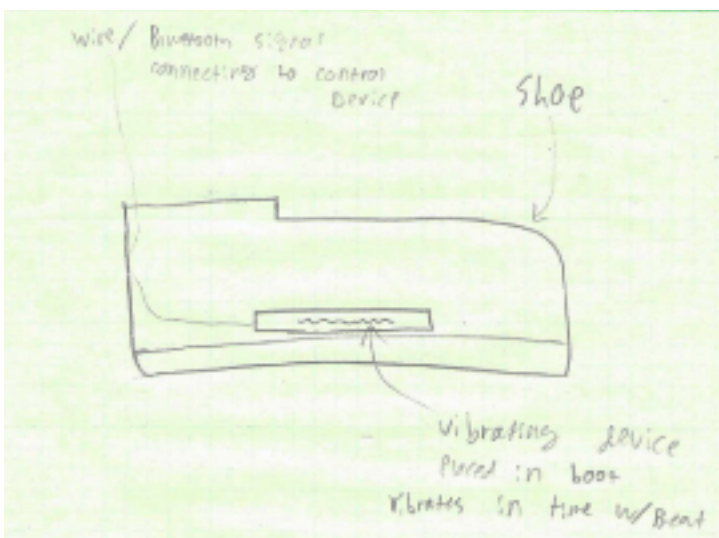
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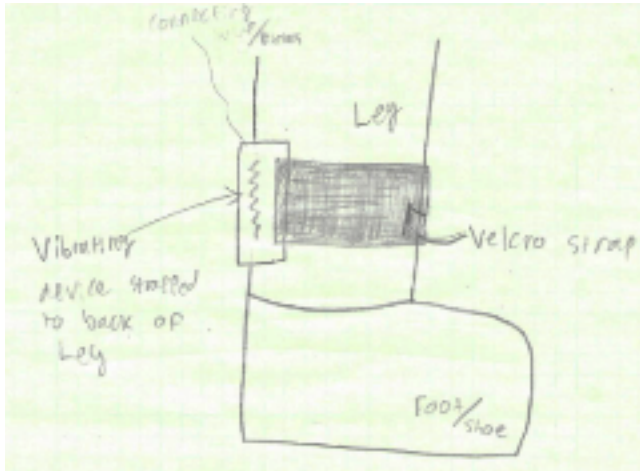
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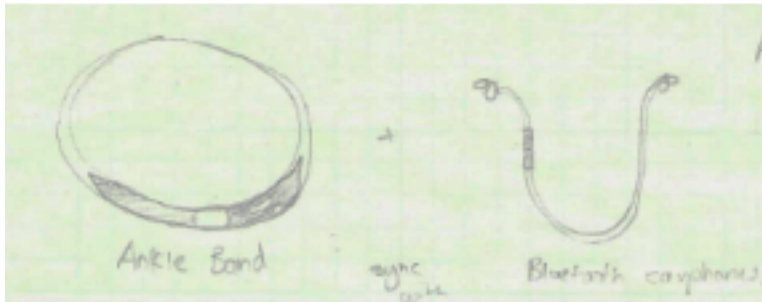
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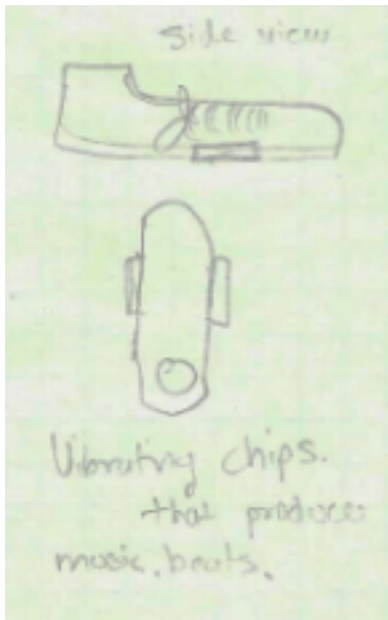
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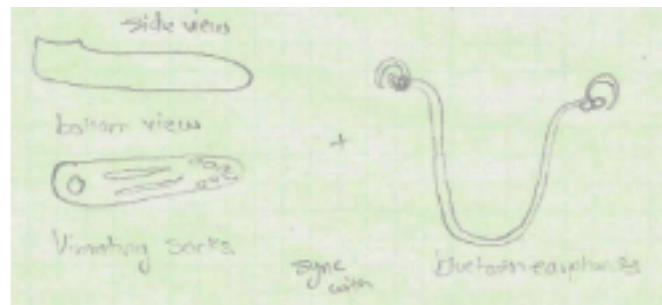
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Selection Criteria	Weight Factor	Vibrating Shoe Insoles		Laser Cane		Audio Stimulus 1. Hearing aids 2. Headphones		Audio Visual Glasses	
Volume of device	0.25	5	1.25	4	1	5	1.25	4	1
Time it takes for user to start walking once device is activated	0.15	4	0.6	4	0.6	2	0.3	3	0.45
Weight of the device	0.1	4	0.4	5	0.5	4	0.4	4	0.4
Time it takes the user to put on the device	0.075	4	0.3	5	0.375	2	0.15	5	0.375
Strength of parts	0.025	3	0.075	4	0.1	3	0.075	3	0.075
Material cost	0.15	4	0.6	3	0.45	2	0.3	2	0.3
Effectiveness	0.25	3	0.75	4	1	2	0.5	3	0.75
Total score		3.975		4.025		2.975		3.35	

Vibrating Shoe Insoles

A vibrating device that provides a physical stimulus that is much safer than any other stimulus such as shock therapy or kicking the patients on their leg as mentioned in the project description. When the patient experiences freezing of gait, they need some sort of motivation to start moving. Most of the times, people will aid and motivate the patient but when alone, its difficult to get out of it. With the help of a vibrating device that will be attached in their shoes' insoles, it will stimulate them to start moving again. This device perfectly meets the requirement of the client since it's not embarrassing and is very subtle and unnoticeable. The only problem with this solution is the sustainability meaning to sustain the vibrating device we need a powerful source to power it unless we attach the powersource in their heels. The way this device works is that it vibrates for 5 secs every time the client takes a step and also vibrates for 20sec every 15 mins. This will allow the client to continue walking and if they freeze then it'll stimulate them to move.

Feasibility Study

Technical: this vibrating device would require some vibrating chips and pair of insoles that would attached to each other at certain points of the insoles where the feet can feel most of the vibration. The insoles would require a specific type of cloth that would be used to keep the device in so that the client doesn't get electrocuted from the device. Device would also need a circuit board and wires to connect the vibrating chips

Economical: the chips are available on amazon and they cost \$11.99 per 15 chips which is quite cost efficient and an average insole would cost about \$15 and if we were to design an insole then

it would cost us \$30 since we need a material that can sustain our device. Since our budget for the project is \$100, the rest of the money can contribute to the circuit board and wires which can approximately cost \$40. So that totals to \$81.99 plus tax.

Legal: This product has already been created therefore we do not intend to sell it or undermine any existing products

Operational: It is quite simple to use, as you only have to put the insole in the shoe and turn it on

Scheduling: Arranging the product is not a problem since the only thing we require for the design is the client's foot size and configuring the device in the insoles. The estimated time of the product being presented to the client would be 2-4 weeks given we have all our resources to build the device.

Laser Cane (Visual Stimulus)

The laser cane is a device already available on the market [1], however it is sold at a price that exploits those affected with freezing Parkinson's disease. These products are typically sold for \$250, however, we can construct it for under \$70.

People suffering from Parkinson's can experience momentary freezing when they walk due to issues with nerve connections between their legs to the brain. When people affected are walking a freeze can flare up at any time. These freezes can last anywhere between 2 - 15 mins and in extreme situations hours.

There are multiple methods used by people with freezing Parkinson's. One person was able to overcome their freezing when they walked on the boardwalk and focused on stepping over each crack between the planks of wood. They claimed that they could run across patio stones due to the well defined target each stone presents.

Our product will work by shining a laser line on the ground in front of the person about an inch in front of their cane. This allows the person to focus on stepping over the line and thus taking a step. The laser will be attached to the shaft of the cane and be triggered when the person holds the cane handle. Force sensitive resistors will be used to monitor pressure on the handle of the cane and there will be a switch located on the cane to turn the device on/off. The on/off switch allows the user to enable the laser when needed and disable the laser when it is not needed.

Feasibility Study:

Technical: This device is proven to be feasible as companies have created this device [1] and university students have also replicated the design [2]. There are multiple laser intensities we are looking into. The laser must be bright enough to be visible on the ground. However, the laser intensity must be within a limit as to not blind the user if it reflects off a shiny ground surface.

Economical: The laser cane includes the following parts; cane (\$24), laser line diode (\$10-15), force sensitive resistors (2x \$9), cables, battery pack, 3D printed clamp and switch. Assuming 3D printing, cables, battery pack and switch can be accessed from UOttawa facilities or purchased for low cost, the price of these will be neglected. Assuming a 20% increase in costs

due to shipping; the cost including cane is approximately \$70, while a design based around a client's existing cane is \$40.

Legal: We do not intend to sell our product and due to this we can do not infringe on any copyright designs.

Operational: The design is simple and modular allowing our product to attach to an existing cane.

Scheduling: Intensity of laser will continue to be researched and a conclusion will be made before shipping. Shipping for parts will take 1-4 weeks depending on the part. The 3D printed clamp may have multiple iterations and cable management through the cane will be attempted to produce a clean and sufficient design. Total estimated production time is 6 weeks.

Audio Stimulus

The audio stimulus uses either a headphones or a hearing aid and both execute the same function which is to produce a rhythmic beat. This will cue the client to walk in sync with the beat ultimately motivating them to walk. The headphones or the hearing aid will be pre-programmed to produce the same beat or a preferred beat by the client so that its specially used just for this purpose. The only difficulty the client will have to face is that they'd have to wear it with them everywhere they go so that they don't experience freezing of gait. It is a proven way of aiding patients with freezing and thus is quite helpful.

Feasibility Study:

Technical: It requires any headphones or hearing aids in which we can program our function

Economical: The average expected cost for this device would be about \$80 since neither

headphones or hearing aids are cheap therefore creating this device will utilize a heavy amount of our resource

Legal: This product has been produced before and we don't own this idea so therefore we don't intend to sell it

Operational: It is only operational if the user/client uses the hearing aid otherwise when you're not wearing the headphones then you may experience freezing of gait otherwise it is easy to wear and portable.

Scheduling: The configuration of the headphones or the hearing aid might be a challenge we face during this designing and building process but all in all it is a reasonable solution to aid patients with parkinsons. The estimated time of completion would be 4-6 weeks give we have all our necessary resources.

Audio Visual Glasses (Visual stimulus)

The concept of visual glasses is simply a pair of glasses with an attachment that projects either a laser or panel on the ground. There are already models of visual glasses or smart glasses as we know them however they are extremely expensive and not designed to help someone with parkinsons. Our goal is to take a regular pair of glasses and add a simple projector such as a laser pointer which can then be turned on remotely for easier access. Also audio stimulus can also be used to create rhythm and motivation for the client. When it comes to target specifications the glasses meet most of the requirements as the device should be light and not very visible. The biggest problem would be if the user has to activate the device as we could either have the user

activate the laser directly which could be hard due to its small size and the hand tremors that come with parkinsons. The advantages are that There are Two stimuli and that the device is customizable meaning that if our client was to change glasses the device could easily be transferred.

Feasibility study

Technical: The main restriction is how the device will stabilize when the user is trying to walk as they need to step on the projection and not have the projection move away from them which would be the case if it was just a simple laser pointer.

Economically : There are many pairs of smart glasses available however, none of them are made to project an image so adjustments would have to be made no matter what. the cost of these glasses would cost between \$200 CND - 700CND which is just too expensive. our solution would include a simple pair of glasses and a laser pointer with some modifications which would cost us no more than \$50 as the client already has glasses

price for glasses: <https://www.lifewire.com/best-smart-glasses-4172796>

Legal: Due to use not using any previously made smart glasses we can make an attachment as long as that attachment has not already been made by another company. As of now there are no attachments made that project an image.

Operational: Our biggest problem is getting the laser to keep the projection in one place and then reset this can be programed simply using motion sensors or similar methods.

Scheduling: the main part is to be bought and then to be adjusted to be able to fit so the first prototype can be accomplished within 3 weeks depending on when we are able to get the laser pointer.

Bibliography:

[1] Laser Cane:

<https://www.caregiverproducts.com/lasercane.html>

[2] University Students Laser Cane Project:

<https://www.jamesdysonaward.org/en-SG/2018/project/parkinson-smart-cane/>

[3] Force Sensitive Resistor 0.5": <https://www.canadarobotix.com/products/353>

[4] 2x 5mw Red Line Lasers:

https://www.amazon.ca/WayinTop-Adjustable-Positioning-Sighting-Telescope/dp/B07ZNKTCLO/ref=sr_1_31?keywords=line+laser&qid=1579736895&sr=8-31

[5] 50mw Laser (\$15 US)

<https://www.laserlands.net/diode-laser-module/532nm-green-laser-module/532line/1235-532.html>

[6] Cane:

https://www.amazon.ca/Hugo-Mobility-Adjustable-Handle-Reflective/dp/B005IV0AI8/ref=zg_bs_6370904011_4?_encoding=UTF8&psc=1&refRID=R2XA9QK6AK82WDFASJCJ

[7] Tiny Vibrating Motor

https://www.amazon.com/BestTong-10000RPM-Wired-Vibration-Motors/dp/B073YFR5WR/ref=sr_1_13?keywords=vibrating+motor&qid=1580012914&sr=8-13

[8] Insoles

https://www.amazon.ca/Copper-Fit-Balance-Infused-Orthotic/dp/B071CF8FKD?ref_=MGiftedC&pf_rd_r=CYVC2RW7K0K64FW3636M&pf_rd_p=633da8a1-8e1a-5933-8e50-7e99c3f9a465&pf_rd_s=merchandise-search-6&pf_rd_t=101&pf_rd_i=6370049011&pf_rd_m=A3DWYIK6Y9EEQB