

Deliverable B: Needs, Problem Statements, Benchmarking:

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Introduction

Parkinson's Disease is a neurological disorder that affects the brain's ability to send signals to a patient's limbs, thus making it difficult for a patient to begin a motion. Because of this lack of signals, a Parkinson's patient will want to do something like walk forward, but the brain will not send signals to their legs to move, thus the patient is stuck standing still as if they are "frozen" in place, unable to move their legs. This can cause the patient to have difficulty moving around, and will sometimes lead to the patient becoming stuck in place, unable to move from a given location without assistance. Even when able to move, the motion is difficult. One patient, Rollie, described walking as if he were "moving through syrup" or "molasses".

In addition to becoming stuck or frozen in place, Parkinson's has other effects on a patient's life. One such effect is the development of hand tremors. These hand tremors can affect a patient's ability to sleep due to a lack of comfort. Actions also become slower. As explained by Rollie, normally short tasks, such as getting out of bed, can become slow. When describing the effect on his routine, Rollie says with regards to simple tasks "you just slow down" or "[he] runs out of steam" and has a hard time completing tasks. In addition, the slowing effect of Parkinson's can lead to trips or falls, which in turn lead to other injuries such as broken bones.

Parkinson's initially presents itself with minor symptoms, such as hand tremors, but will get progressively worse until the patient must be admitted into a long term care facility. Unlike some progressive neurological disorders, the progression of symptoms for Parkinson's varies wildly from person to person, in addition to having a variety of ways it affects people.

Overall the largest issue faced by Parkinson's patients is the recurring issue of freezing, causing them to become stuck or have trouble walking. To assist with these issues, a device must be made constructed which stimulates the senses and will reliably trick the brain into walking, allowing a patient to overcome the "freezing" caused by Parkinson's.

Client Statements / Observations

Because of the rarity of Parkinson's, there are very few products currently on the market to assist with the problems of freezing or slowing. Because of this, most Parkinson's patients are reliant on other people to assist them in overcoming their bouts of freezing. This presents a problem, as there are times when there is no one else around to assist them. Due to this issue, any solution must work without the assistance of another person.

As stated during the interview, most solutions currently in use work by tricking the brain by one of two ways, either by giving the person a goal for their feet to go to, or by tricking the patient's brain into thinking they are already walking. During the interview, Rollie mentioned the story of another patient who became stuck after standing from their seat at a restaurant. To trick her brain into working, her husband threw down a couple of napkins to act as stepping stones. Because she had a goal, her brain was able to let her walk. Rollie believed that a device such as a pair of glasses which displayed virtual stepping stones would be a good solution, but due to cost constraints, it was determined to not be a viable solution.

One solution currently in use is to listen to rhythmic music, such as marching band music. Rollie stated that the rhythmic nature of the music was able to coax the brain into moving,

as the brain had a beat to follow like the rhythm of footsteps. Incorporating something which uses a rhythmic beat could prove to be a viable solution.

As explained by Rollie, the issues of freezing can be triggered by stress or anxiety, and thus any solution used must not cause the user any stress. As stated by Rollie, the device must not be too embarrassing to wear, which would cause the user to become anxious. Rollie also explained how Parkinson's patients suffer from hand tremors which vary in severity, and thus any device made must be easy to interact with.

Aside from the major issues of freezing and hand tremors, Rollie also explained that Parkinson's causes a host of other issues. As stated by Rollie, tasks begin to take longer and more difficult. He described the act of moving as if he were "[moving] in molasses". He also stated that it is easy for a patient to "run out of steam". To help with this, any solution must be quick and easy to put on, to prevent the likelihood of running out of steam. He also stated that patients tend to only be able to "do one thing at a time" so any device used must not involve any serious multitasking, be it when putting on, during use, or taking it off.

Customer Needs

#	NEED	Importance
1	The device is not too visual or embarrassing to wear.	5
2	The device is affordable.	4
3	The device is easy to interact with.	3
4	The device allows the user who is affected by Gait Freezing to start walking.	4
5	The device is portable/ lightweight.	4
6	The device's parts can easily be replaced if broken.	1
7	The device will not break if dropped or the user falls.	2
8	The device is easy to put on without the help of another person.	2

Problem Statement

Gait is a recurring and situationally triggered nervous system issue which precipitates from severe Parkinson's. Typically gait affects elderly people causing them to periodically freeze in place when walking and without proper stimulus can last for extended periods of time. Our goal is to create an easy to use, non-intrusive device to stimulate first steps and encourage walking.

Metrics

Metri c #	Needs #	Metric	Imp	Units
1	1,5	Volume of the device.	5	cm^3
2	3,4	Time it takes for the user to start walking once device is activated.	4	s
3	5,7	Weight of the device.	3	g
4	3,8	Time it takes for the user to put on the device	2	min
5	6,7	Strength of the parts	1	J
6	2	Material cost	4	CDN\$
7	4	Effectivity over Time	4	Scale 1-5

Benchmarking

	Volume	Time to Work	Weight	Setup Time	Strength	Cost	Effectivity over time
Metric	1	2	3	4	5	6	7
Need #	1,5	3,4	5,7	3,8	6,7	2	4
Units	cm^3	s	g	min	J	CDN\$	Scale 1-5
Spine Implement (Passive Treatment)	N/A	0	N/A	0	N/A	N/A	5
LaserCane	14748.4	<10	454	<1	N/A	\$199.0– \$239.00	2
Deep Brain Stimulation (Passive Treatment)	N/A	N/A	N/A	N/A	N/A	N/A	4
U-Step 2	10587- 187017	<15	13608	<1	N/A	\$575.0– \$879.00	3

Note: Many current solutions are in development and are focused on passive treatment rather than a physical product that is triggered when the issue occurs, this is why many items in the benchmarking are marked as N/A.

Target Specifications

	Metric	Units	Marginal value	Ideal value
1	Volume of the device	cm^3	<100	<36.87
2	Time it takes for the user to start walking once device is activated	s	<10	<7
3	Weight of the device	g	<300	<200
4	Time it takes the user to put on the device	min	<15	<10
5	Strength of parts	J	<4.4145	<2.943
6	Material cost	CDN\$	<100	<60
7	Efficiency over time	Scale 1-5	5	4

Final Speculation for product

	Metric	units	Value
1	Volume of the device	cm^3	<50
2	Time it takes for the user to start walking once device is activated	s	<8
3	Weight of the device	g	<250
4	Time it takes the user to put on the device	min	<12
5	Strength of parts	J	<3.5
6	Material cost	CDN\$	<80
7	Efficiency over time	Scale 1-5	5

Impact of Client Meeting

During our meeting with Rollie we were able to hear a first hand experience of an individual living with Parkinson's. Simple tasks would take a long time to accomplish and requires intense concentration. The person affected is limited to working on a single task at a time, for example, they are unable to walk and talk due to the focus required to take each step. Rollie also explain the situations his friends with gait are dealing with. He talked about their most severe example of freezing as well as the daily challenges they face. Some of the solutions these people implement to overcome their freezing include: shuffle back and forth, tapping their ankle with a coin and focusing on stepping over an object or drawn line in front of them.

After this meeting we were able to analyze the issues people with gait have and the methods they employ to overcome their obstacles. It was also determined that initiating a first step in our client would be critical to our design process as freezing was the most prominent and severe issue. Once the person was able to overcome their initial obstacles and take their first step, walking would be less of a challenge and become more natural. Linking initial stimulate with prolonged stimulation in order to solve the issue of gait was important in understanding the challenges these men and women face everyday. Having a device that would initiate first steps would be essential in giving the client peace of mind, thus walking would be easier to encourage.

In order to accomplish our task we have focused on a device that would be worn on both ankles that once activated would vibrate in rhythmic patterns associated with walking in order to encourage their first step. Once the client takes their first step our device can be turned off or kept on in order to prolong walking stimulus. We believe audible cues could be coupled with the rhythmic pulses to maximize the stimulus and encouragement given to our client.

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