THE MODIFIED WEED PULLER

A REPORT SUBMITTED BY

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TO

DR. ROBERT FLEISIG

FOR

SEP 760: DESIGN THINKING

SPRING SUMMER 2019

AT

W BOOTH SCHOOL OF ENGINEERING PRACTICE AND TECHNOLOGY
MCMASTER UNIVERSITY

Acknowledgement

We would like to express our sincere regards and heartfelt appreciation to our professor, **Dr. Robert Fleisig**, Associate Professor, W Booth School of Engineering Practice and Technology, McMaster University, for his tremendous help, encouragement, invaluable guidance and meticulous attention during this course work. He always pointed us in the right direction during the course of difficulties by investing his valuable time, advice and cooperation. It has been a great pleasure and honour to work with him.

Furthermore, we humbly express our gratitude to **Mrs. Paramjit Longia** for offering us her valuable time and providing us with the chance to work with her. We always received warm welcome from her whenever we visited her during the course work. We also thank our second stakeholder **Mr. Jugraj Bondu**, for testing our prototype and offering feedbacks on our design.

Contents

*Refers to the design process section

Introduction

Mrs. Paramjit Longia is a 55 years old lady who lives in Brantford with her family. She has two daughters and her husband is a truck driver. She works as a supervisor in a warehouse nearby her house. She was recommended to us by one of our friends as we were looking for a person facing challenges to execute routine chores due to physical limitations. She is a petite lady with 4'9" height. Due to her short height, she is facing a number of problems which a normal person would never think of as a problem. She likes to cook for her family and she spends most of her time in her backyard garden. The daily chores in cooking and gardening have become a challenge because of her short height. Our main focus was to identify some of those main challenges and find solutions accordingly.

First Interview

[1]* Our first interaction with our client was at her house. At this point we visited her with an open mind as we knew very little about her. The only thing we knew about her before this meeting was her short height. She shared her hobbies that how much she likes gardening and cooking. The reason she gave us to like the gardening is to keep her busy since her husband is a truck driver and he returns home one or two days a week. Her younger daughter is an undergrad student at McMaster University and because of that she doesn't spend much time with her mother. The elder daughter is in India studying MBBS. Due to these circumstances, she was spending most of her time alone and to make herself occupied she started doing cooking and gardening. She told us a number of incidents when she almost tripped trying to place or pick stuff from the top shelves. She tried to indicate several problems where she thought an engineer would be helpful. After talking for some time, we visited her backyard garden. She had a lot of plants and vegetables in her garden. The first problem that we saw was with her backyard door. Since she was short and because of this, she couldn't reach the top of the door to facilitate the locking mechanism. She told us that it happened to her several times that she got locked out because she couldn't operate the lock from the outside. It was a potential point for us to work on.

Figure 1 Picture of Mrs. Longia signing a consent form

Discussion

After the first interview, we had some major points to talk about. [2]* The first positive point for us was to perceive that the solution would be related to gardening and cooking. Because

*Refers to the design process section

these two things seemed very important for our client. We filled up HMW template based on our understanding as shown in Appendix A. The potential problem of the backyard door was declined after some discussion since one of our team members already knew the solution. He had seen this solution implemented for the use of a wheelchaired person. So, we decided not to work on this problem since we would be working on something already invented before. This could've been constrained our design approaches. The next step was to find the meaning of her liking. We realized that only keeping herself busy wasn't a valid reason to do something with that much of dedication. So, we set our new goal to know the real reason of her interest towards gardening and cooking.

Second Interview

This session had a motive to know the real reason of her likings. After creating rapport from the last meeting, she was feeling more comfortable with us now. She shared that she blames bad nutrition for her short height. She believes that she didn't get adequate nutrition in her childhood and that resulted in her short height. She doesn't want the same thing happening to her daughters. So, she tries to cook for her daughters and keep their nutrition full. This attempt made her to explore things online and in the local market which led to gardening hobby. Using fresh vegetables to cook meal was her best try to keep her family healthy. Furthermore, she grew up in an area where she was surrounded by greenery. She showed us different vegetables she had in her backyard. When she was showing us around, she had an eye on a weed and she tried to pull that weed with the help of a weed puller. The ground was dry and hard. So, this made it hard for her to penetrate it. She wet the ground and then easily penetrated it. We didn't see much challenge ourselves to operate the weed puller on the dry ground. This was her physical structure which made it hard for her to use the weed puller.

Discussion

The second interview gave us insights about her love for gardening and cooking. It provided the back story for her hobbies. So, we tried to create an empathy map shown in Appendix A based on our interaction with her. The map is based on four factors. What does she say, do, think and feel? This time we decided to focus mainly on gardening because all the problems we saw in her kitchen could be solved by ordering a product from Amazon or buying it from a local market. [3]* Working on the gardening helped us to converge our ways but there was a problem. We didn't decide what she felt about the gardening and we assumed that it could be nostalgia. But we needed to make sure that our assumptions were right.

Third Interview

She shared something very emotional with us this time. She told us that she had a younger brother who died one year ago due to cancer. Her brother had a number of indoor plants and he loved doing gardening. When he was having his treatment, she took care of his indoor plants because he kept insisting that these plants were very important to him. He had his treatment for two years and during this treatment she was taking care of these plants. After fighting for two years, he passed away and she moved all those plants to her house. She feels her brother is alive when she sees those plants. We had a sense that these plants were very important to her. The written notes of these interviews are given in Appendix A.

*Refers to the design process section

Discussion

It was clear from the last interview that those plants were a part of her life. [4]* Our main focus was now shifted towards gardening only. We spent significant time on various ways which would help her to enjoy gardening even more. As shown in Appendix A, we came up with 24 ideas to make gardening more enjoyable for her. But at this time when we tried to contact her, we came to know that she was away. She was visiting her home back in India. Due to this situation we got stuck in the moment. Then we decided to continue with the information that we already gathered. Our professor, Dr. Fleisig acted as our stakeholder as well as our guide at that moment. Based on our 24 ideas, we needed to select one or two ideas from them. We categorized our ideas in to two categories.

1. Need of a device
2. No need of a device

The reason of categorizing the ideas in to these categories was to make it easy for us to decide on which category we would want to work. [5]* We chose to work on the first category since we needed to create a prototype of the solution. It would be easy to create a prototype of the solution where a physical device is required. The other category would need a project management plan. So, it was more beneficial to choose one where we would practise design thinking approach better. We marked borders of the eight ideas with a red colour where a device was required as shown in Appendix A. Among these ideas, [6]* the weed puller idea was selected. Because a weed puller is kind of a device which is used by almost everyone having a backyard and our client had a problem to use it properly and she wasn't aware that this was something that could be solved.

Critical Incident Technique

We had a plan that we would visit our client after coming up with a number of ideas and areas where we could help her. At that time, we came to know that she wasn't available and this incident deprived us from the control. We weren't sure what to do to next. All the plans that we prepared earlier had no meaning now. But we tried to find the positive opportunities those got opened due to this situation. Our faculty guide gave us some courage that it had happened before with other students as well. We realized that we could take it in a positive manner and start working on a new plan. This new plan would help us to learn things those might not be possible with the previous plan. We prepared a new plan that we would continue working on our project and our professor will be our new stakeholder. If we need someone to test our prototype then we will find someone. This attitude kept us going and we made a new plan. At the end, we got some help from other persons as well and we learned more about making rapport with the other stakeholders.

Figure 2 Being Optimistic

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Ideation

A weed puller is a device which is used to pull weed out of the ground manually. Figure 3 shows the standard design of a weed puller. It has a foot rest area where a person will place his foot and press in the downward direction. The blades will help to penetrate the ground and grab the weed and then pull it out. The problem that we observed with our client was mainly with the balancing. She doesn't have proper balance and that is why she can't put much force on the foot rest area. Also, the handle is straight and hard to guide.

Figure 3 Standard design of a weed puller

Idea 1

The first sketch that we made took in to an account the main problem of less area on the foot rest. The idea was to increase the surface area of the foot rest so it would be easy for our client to stand on it. The inherited foot rest area is very less can trip a person if he has balancing issues.

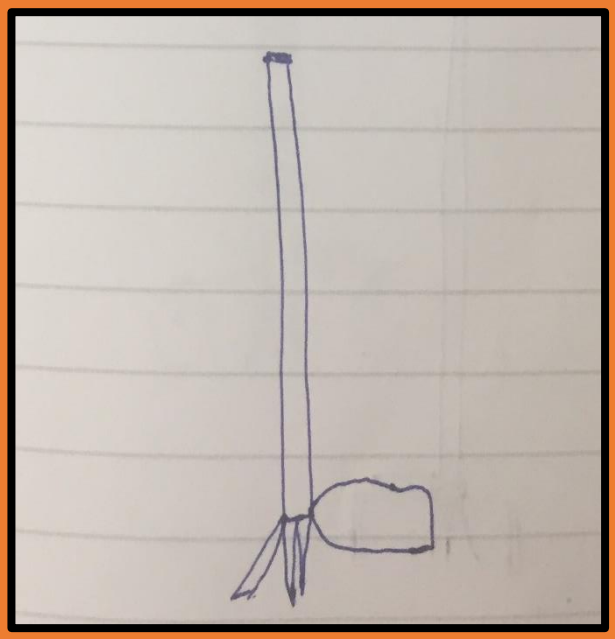

Figure 4 More foot rest area

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Idea 2

In these sketches, the foot area was extended. The two sides were used to make proper balance. These two sides can be used to stand on them and put pressure to penetrate the ground. The next improvement was done by adding hand actuator at the top of the handle to make the gripping easier.

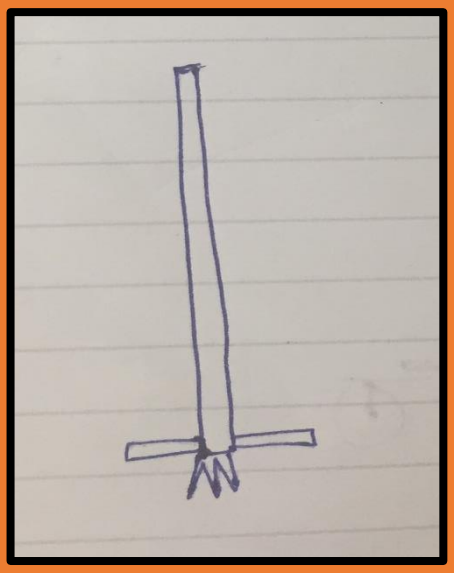

Figure 6 Double foot rests

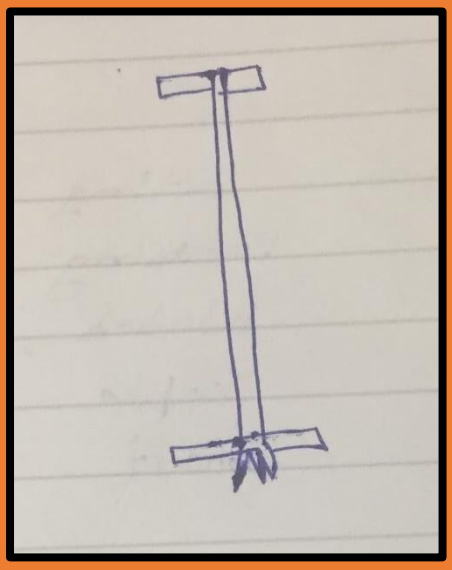

Figure 5 With extended support at the top

Idea 3

In this sketch, a rotating wheel is installed on the side of the weed puller. This wheel will be used to make a hole in the ground. This motion will make it easier to penetrate the ground and this wheel is flexible to move across the handle and in this manner the position can be modified according to the height of an operator.

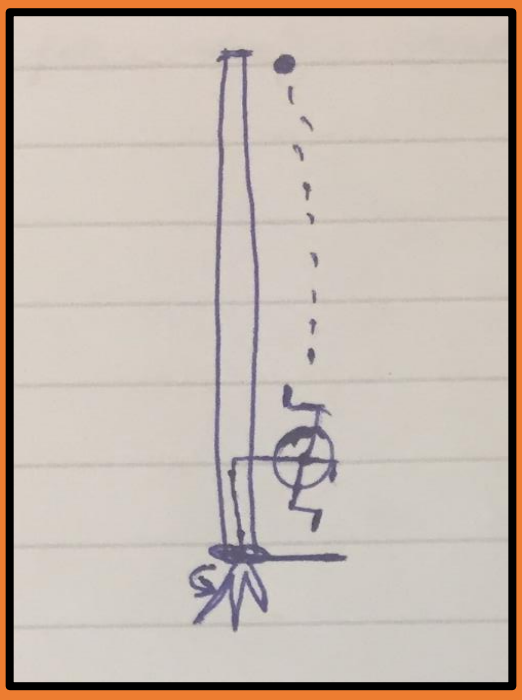

Figure 7 With wheel actuator

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Idea 4

When our client used water to damp the ground to make it softer, it gave us an idea to mount a water sprinkling system on it. The sketch shows the position of a water tank and an actuator. An operator can sprinkle some water on the ground first and then use the standard weed puller to penetrate the ground.

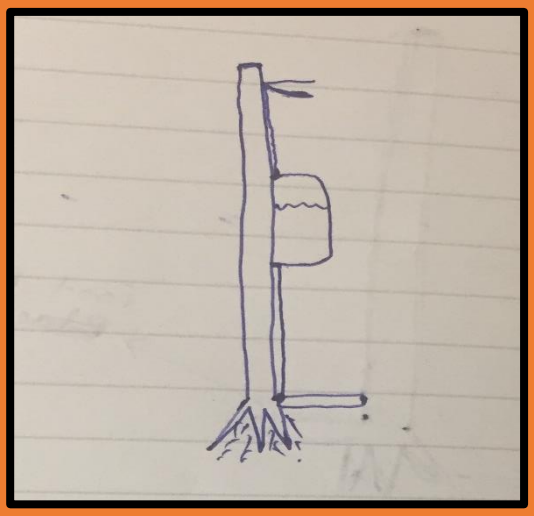

Figure 8 With a water sprinkler

Feedback

Since our client was out of the country and our professor was our acting stakeholder, we asked for his feedback. After reviewing our sketches for some time, the first thing he asked that why did we use blades only. The appeal of this question was strong and we realized that we were unintentionally setting a paradigm that only blades can penetrate the ground. So, after that, we again started from the very beginning and found out that we needed something sharp to penetrate the ground. The real property that we needed was sharpness and not the blades particularly.

The next step was to seek the different ways to remove weed from the ground. [7]* This decision diverged the whole process and now we were working not only on the weed puller but on the different ways to remove the weed. We brainstormed on the possible solutions with some basic concepts as shown in Appendix A. We categorized it in to four types based on the process behaviour.

1. Penetrate the ground and take the weed out – The idea is to penetrate the ground first and then take the weed out. The iterations for this category are shown in Appendix A.

2. Cut the weed from the top – In this category, the weed wouldn't be taken out of the ground but it would be cut from the top. The rough work is shown in Appendix A.

3. Destroy the weed by chemical products – A chemical will be used to destroy the weed. This process will take some time and may damage the soil and environment. The sketches are shown in the Appendix A.

4. Cut the source of sunlight.
   a. Covering by sheets
   b. Covering by snow
   c. By plastic bags
   d. Use cemented floorings

*Refers to the design process section

Second Feedback

After showing these sketches to our stakeholder, we got feedback that some of these ideas were too crazy to work with. For example, the use of a flamethrower can be used to destroy the weed. But it won't be a prudent decision to ask a 55 years old lady to use it. Some of those ideas were too impractical and hard to make. So, [8]* we decided to work again on the basic design of the weed puller. This time, we were trying to modify the existing design according to the need of our client.

The sketch in Figure 9 was created to make sure that there is enough support inherited in the design for the use of an old person with less balance. Instead of one support, two supports were used so that an operator can use his both hands to hold the weed puller. The design was taken from a walker concept which is used by old people to walk. The foot rest was also modified so that an operator can easily put pressure on it and doesn't trip easily. There are two protruding handles at the top of the supports. These are used to make sure that when the weed is pulled out from the ground then the hands of an operator don't slip away. The rough sketches of the basic designs are shown in Appendix A.

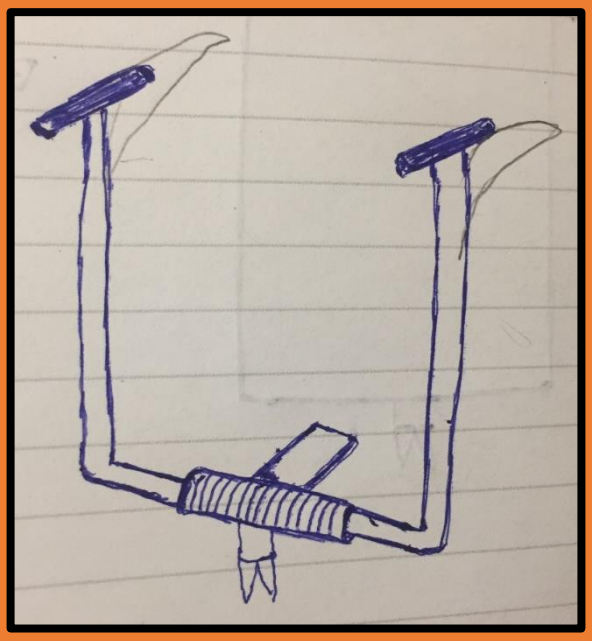

Figure 9 Modification of a weed puller

CAD Model

After creating the sketch, we digitalized it using NX Siemens a CAD software. This software helped us to visualize the design better. The blue parts in the figure are supports and can be moved. We created the simulation of the movement to see the functionality. Another picture of the CAD model is shown in Appendix A.

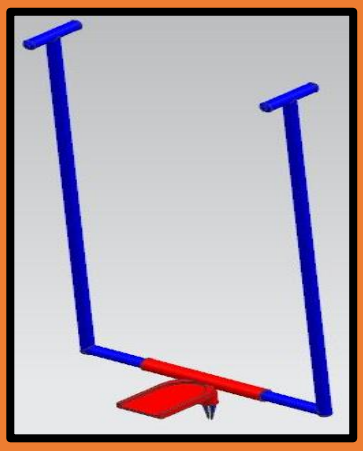

Figure 10 CAD of the weed puller

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Prototype

It was initially decided that PVC tubing would be used to make a prototype. But when we went to Home Depot, we found that the PVC tubing didn't have adequate strength to hold the whole structure in the position. So, we looked for something stronger. We found plumbing pipes. The pipes were heavy but they had enough strength to provide testing base. Based on the available options, we decided to build our prototype with plumbing pipes. Two three feet pipes were used to provide support handles. Two 8" pipes were used to connect the support handles with the middle portion. To make connection of these two pipes, an elbow joints were used. The four-way joint was used in the middle to provide openings for the other pipes. A 2" pipe acted as a blade to penetrate the ground. The picture of the prototype is shown in Appendix A.

Role Playing

We wanted to know that the protype we made was fulfilling the purpose that we wanted it to. So, we decided to do a role play for this. Even after making the initial sketch, we tried to visualise that how the device would work. After making a CAD model, things got a bit clearer. We did a role play with sticks because we didn't have a real prototype then. We tried to see that how the movement would change if the weed puller is pressed at the side. It gave us some perspective that a person can trip if the blade isn't in the ground before putting all the force at the one side. When we made the prototype, it got much easier to do the role play with it. Both the member of our team tried the prototype several times. We made some hypothetical scenarios such as if the weed is at the corner or if the weed is at uneven ground. Based on these scenarios we did the role plays. This exercise helped us to understand the situation of the person who will use this design. we realized that the prototype is too heavy as it is made of plumbing pipes. But regardless of its weight and putting all the force before the penetration, we didn't find any major problem with this design.

Prototype Testing

After creating the prototype, we needed to test the functionality of it. Since our client wasn't available, we decided to work with someone who has significant experience in gardening. We found a person named Jugraj Bondu who has been working in a garden clean up company for more than a year. He is an experienced person on whom we wanted to test this prototype. We explained him about our situation and he understood that we are making it for someone having misbalancing issues. He himself admitted that he also experienced that situation a number of times. But he explained that companies make the design in that manner to make the process quicker. Because it was a common assumption made by those companies that a healthy person with no liability is using their weed pullers. But he still tested it and told us that he liked the idea of installing two supports to hold the weed puller. After penetrating the ground for several times, he asked that why did we put an extra rod for

Figure 11 Mr. Bondu testing our prototype

*Refers to the design process section

foot rest. According to him, when he was putting force on that extra rod, it was making him tripped over. He explained that a normal weed puller has a hold support at the middle and that's why manufacturers don't have any other place to put a foot rest but at the side. [9]* It made sense and we realised that we needed to make some changes. We asked him to use our weed puller without the extra rod and the picture is given in Appendix A. After using it, he told that it was way easier than the latter. So, we removed the extra rod and added a platform at the middle to increase the surface area since our client is old and has some misbalancing issues. Figure 12 shows the modified prototype in which we added an extra platform to place a foot on it. An operator will use the two long rods to grab the weed puller. Then he will place his foot on the platform and put some weight on it. This gesture will help to penetrate the ground with the help of the applied force. Then, the operator will pull the weed puller in the upward direction to take the weed out of the ground.

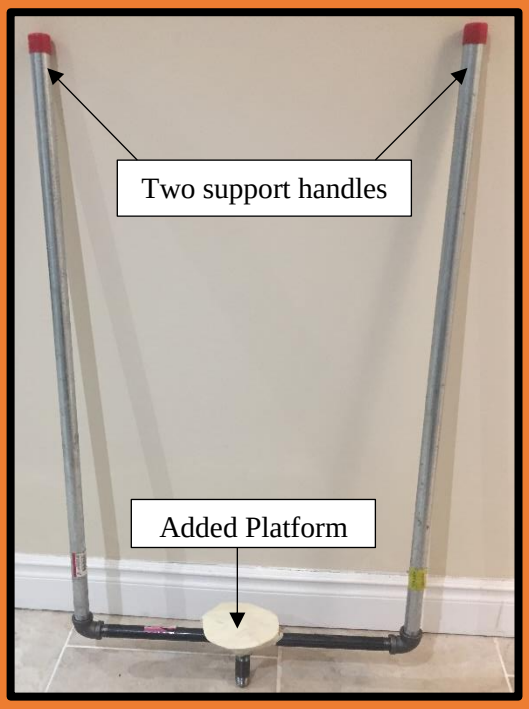

Figure 12 Modified design of the prototype

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Design Process

Figure 13 Design progress graph

1. We started our journey when we visited our client for the very first time. At that time, we didn't know anything about our client and what kind of problems she was facing. Due to this situation, our solution section had infinite number of possibilities.
2. When our client showed her interest in gardening and cooking, then at that point we got some convergence and perceived that our problem-solution would probably be related to these two topics. At that time, we found some certainty and the curve started moving down.
3. We got more convergence towards the final solution when we realized that the problems, she was facing in a kitchen could be solved by purchasing things from local stores. At that time, we tried to eliminate things where we couldn't help her. Majority of things where we could've helped her was related to gardening.
4. After hearing her strong connection with gardening because of her brother, we had shifted our whole focus on the gardening now. This made the curve to go down not much but a little bit because we already sensed earlier that we were going to work on the gardening.
5. At this point, we categorized the gardening solutions in to two types and we decided to work on the one with a need of a device. The reason of choosing this category was to make sure that we would make a prototype and do testing afterwards. This decision eliminated some uncertainty.
6. In our second interview, we saw her operating a weed puller which she had difficulties with. She wasn't aware that this was something which could be listed as a problem. So, we decided that if we would work on it then it would be something she won't be expecting but will like if shown to her after finding a right solution for it. This decision

*Refers to the design process section

moved the curve towards certainty since now we knew that we needed to modify the weed puller.

7. This is the point where we needed to look back for more options. We were working on the design of the weed puller but suddenly we realized that the aim wasn't to use the weed puller but to remove the weed. So, we redefined every possibility again which moved the curve more towards uncertainty. Now we were working on any possible way to remove the weed.
8. After exploring other options, we ended up with the weed puller. But this time we were more certain about the solution because we contemplated other options which could be useful for further improvements in the weed puller. Our decision to get back to the weed puller reduced the uncertainty.
9. The last movement we got towards certainty when we got feedback from our weed puller operator. He suggested us some ways to improve the design. This action moved the curve towards more certainty.

At the end of the project, we can’t claim that the solution we presented is the best solution since there are number of things such as a proper testing and compatibility with our client those are still required to check. The final solution may change in the structure as required by the need of our client.

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Personal Reflections

Navjot Singh

It has been an intriguing journey from the beginning. The course work is designed to work as a team. But I was working alone as I was the only student taking this course at that time. The support from the professor helped me a lot to continue my work during this period. From the first class, there had been a constant conflict between my engineering thinking and design thinking concepts. The successful product requires utility, usability and meaning. I had been always struggling to get the sense of the meaning of a product. But this course is about finding the meaning of the product to the clients. I learned from theoretical concepts of the design thinking in the initial stage but at that time those things didn't make much sense to me until I started talking to my clients. I talked to two clients as an exercise and I got some basic information about those clients. When I shared that information with the professor, I realized that there was nothing unique about the information. All the information I gathered was a basic one. The reason of this failure was not able to build a rapport with the clients. This was the time when I celebrated the failure because I had started learning something new. I went again for the interview with a different client. This time, I was able to build a rapport with a lady named Ahlena and she shared some unique things about her life and her son. This success boosted my confidence and I did another interview with a nursing student of McMaster university. I noticed that it doesn't depend on only you how you conduct an interview but the interviewee also plays an important role in it. An extrovert person is always easy to have a talk with but it takes a lot time to get an introvert person to feel comfortable. This situation arose when I met Mrs. Longia who is an introvert personality. She was very nice person and welcomed me with Indian hospitality manners. But we were facing awkward moments to decide whether this is a professional meet or a usual thing. Even asking to have a seat got fully confused for both of us. But this situation went away after sometime and we built a rapport which led her to share many personal incidents and memories. At this time, I realized the importance of building a rapport with the clients because now it was easy for me to know her needs better. On the other side, not everything was going in my favour. Since I was working alone, I faced some problems because of this. The note making had become difficult because when she was talking, I needed to make notes. But when I was looking down to make notes, she stopped talking in between several times. When she started talking again, she didn't start with the same emotions as she was before. At that time, I felt losing a connection with her. It is always important to keep an eye contact with a person to make him feel that he is being heard and understood completely.

In the middle of the course, another student Vajiheh Motamer (Aida) came to join the team. It introduced a new challenge on me as well as on her. Now I needed to explain everything to her about what I did during the past couple of weeks. It was a challenge in the beginning but then I realized that this was the perfect opportunity to practise the most important concept of design thinking which is building on the ideas of others. Now we were working as a team and brainstorming became effective eventually. There were several incidents where we had completely different approaches. But listening to each other helped us to understand other's perspectives. We had a very big conflict about categorizing the process of weed removal. But when we listened to each other on turns then we realized that both perspectives were right. We put together everything in a single idea and worked again on it. It diverged the solution but we ended up with a more freedom to choose solution from. Sometimes we overthink on one thing

*Refers to the design process section

to the extent that if someone presents something different, it is hard to make sense out of it. But if we let the other person to share his idea completely then it can help to get better things out of it.

An engineer has an I-know-better mindset. This mindset put me in a lot of confusion when I visited my client. I made my mindset beforehand that I wouldn't start convergence to conclusions as instructed by the theory of design thinking. But when I was seeing any problem, I was thinking about solving it right away. For example, when our client was sharing her problems with the backyard door, I started thinking about the solution the moment she told me about the door. I got in to a deeper thinking that I didn't realize that I was supposed to listen to her further conversation as well. I couldn't even remember what she told me after that. I was completely focused on finding the solution while she was talking. After that incident, I tried not to seek solution right away. Also, I learned about going back without getting discouraged. We made sketches of the weed puller and we were 100% sure that we had our AHAN moment. But when we discussed it with our professor, we lost all the enthusiasm as we were instructed to go back again and rethink on it. At that moment, I realized that I was trying to reach for the solution quickly and it made me to miss other possible solutions. The important thing is to think about different ways to approach one thing. From these approaches, majority of the approaches may seem impractical and they will be impractical. But contemplating on these ideas will open more opportunities to accept one or two things from the crazy ideas to implement to a feasible idea. Overall, the journey was confusing but interesting and it taught me the value of being a person who can feel the needs and emotions of other people by putting aside a rigid engineering mindset.

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Vajiheh Motamer

This course was a good and new experience which I have had so far as I was not suppose to take this course. As I my thesis is as per Design Thinking I was looking for a Design Thinking course as I was new in this course. After I found this course offered Dr. Fleisig, I was really happy to offer this course in the summer and I was going to audit that because I was pretty sure that It would not be possible to take it as per one month had passed from the beginning of the course. Thanks to Dr. Fleisig ‘s support I was able to take this course. I got familiar with only student of that class called Navjot Singh. He had had two interviews with his client until that time. In the beginning I was really worried about the interviews which I had not attend. Thanks to Navjot he shared all information during the meetings that we had. At the beginning I found the course too difficult and I was frustrated about the understanding the client ‘s problem. Always I was thinking about the solution what I did for all the software projects and the clients that we had. After reading part of Design Thinking book that kindly professor gave me, I found I have to change my mindset. There are two most important things which I found, and I am applying during my thesis project as well:

1- As per Design thinking is process for creative problem solving, so in order to doing the design thinking project first we should understand what the problem is exactly in perspective of the client not from our perspective as a designer. We should **understand** the user ‘s needs.

2- After understanding the client I should not focus on the solution as a designer, I should focus on the all ideas as much as possible even crazy ideas that call divergent thinking and then we can refine and narrow down to the best idea that called convergent thinking.

The above knowledge about the design thinking help me to work with Navjot although we had some challenges about the sketches that professor had asked about the weed remover apart from the existing client ‘s weed remover. However, we listened to each other and it was the most important to be able to work as a team and we were able to design a prototype effectively. The most important challenge was when I was going to fast and straightforward to the solution, but I improved during the discussion which we had. I am very happy to take this course. I would like to take this opportunity to thank Dr. Fleisig. I had an incredible experience. In addition to more advanced information and learning to apply my knowledge into my thesis project, I was given the opportunity, one I enjoyed immensely, to work with Navjot as a teammate. That was an invaluable experience.

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Appendix A

1

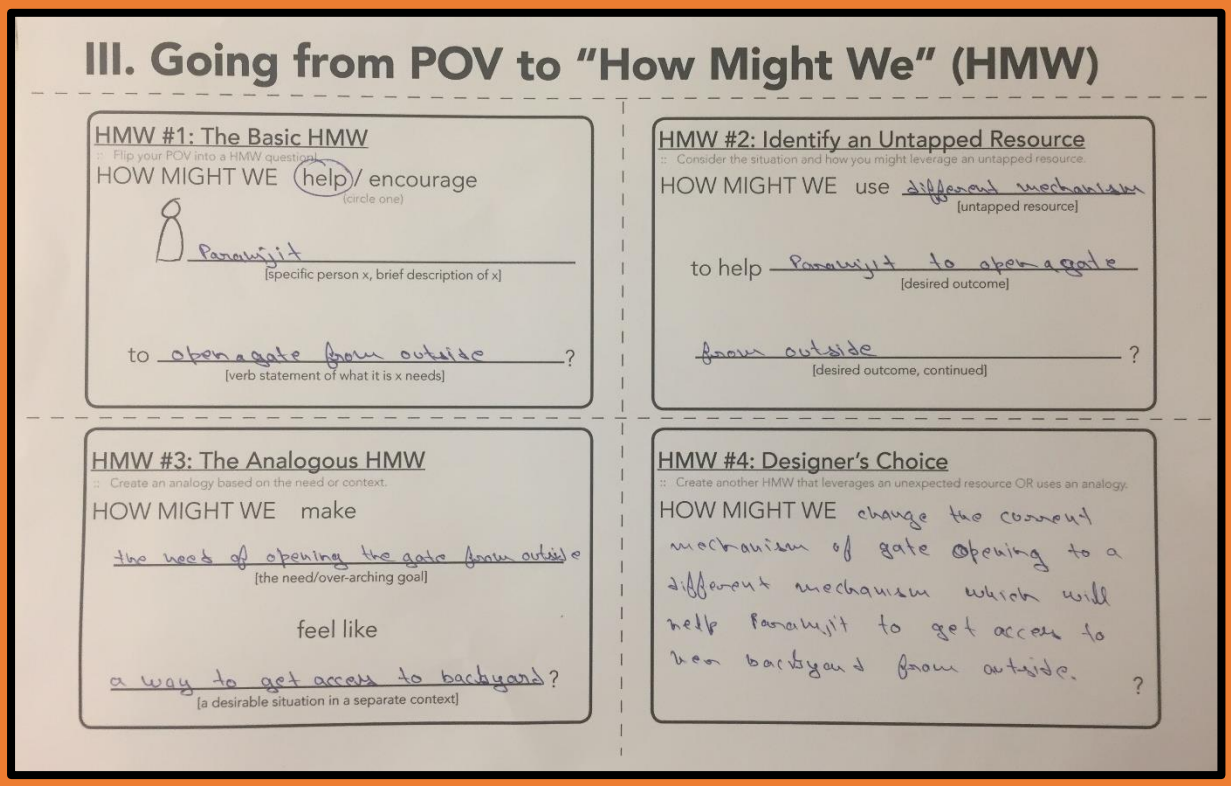


Figure 14 How might we template

*Refers to the design process section

1.1

LETTER OF INFORMATION/CONSENT

Client/User Interviews for SEP 760 – Design Thinking

Student Investigator:	Faculty Investigator:
Navjot Singh	Dr. Robert V. Fleisig, PEng, Associate Professor
McMaster University	Walter G Booth School of Engineering Practice and Technology
Hamilton, Ontario	McMaster University
(905) 525-9140	Hamilton, Ontario
Email: singhn59@*mcmaster.ca*	(905) 525-9140 ext. 27408
	Email: robert@mcmaster.ca

I am doing this research for a graduate course in design thinking (SEP 760) at McMaster University. As part of my course, I am required to engage a client/user who will have valuable input for my design project in the course. You are invited to participate in this project through interviews. My design project is about the design of an app to aid people with a health, wellness, or aging-related challenge. In each interview, I will ask you up to *ten* questions related to our design project that will help us understand the challenges you face and the design of a new app which may aid you. I will record your comments either by hand in a notebook or on an electronic device. I ask that you participate in approximately three interviews of an hour duration each once a week for the next three weeks.

Your privacy will be protected. I will not record anything that could identify you personally. The material I record will only be shared with my peers and instructors in the course. By participating in these interviews, there are indirect benefits to you but you will help train design engineers like me. These interviews will help us learn to listen to persons who might use our designs and how to conduct research with human participants. You are participating in this interview confidentially.

If any photograph or video is taken, the content will only be used in the course presentation/report submitted to the professor. This content will be securely stored and will be destroyed immediately after the completion of the course.

Your participation in these interviews is voluntary. If you decide to be part of the interviews, you can decide to stop (withdraw), at any time, even after signing the consent form or part-way through the interview. If you decide to withdraw, there will be no consequences to you. If you do not want to answer some of the questions you do not have to, but you can still be interviewed. If you wish to withdraw after an interview, please do not hesitate to contact me.

If you have questions or require more information about the study itself, please contact me. This course project has been reviewed by the McMaster University Research Ethics Board and received ethics clearance. If you have concerns or questions about your rights as a participant or about the way the study is conducted, please contact:

McMaster Research Ethics Secretariat
Telephone: (905) 525-9140 ext. 23142
c/o Office of Research Services
Email: ethicsoffice@mcmaster.ca

CONSENT

I have read the information presented in the information letter about an interview being conducted by ~~*student name 1*~~ Navjot Singh, *student name 2, student name 3,* and *student name 4*, of McMaster University. I have had the opportunity to ask questions about my involvement in this study and to receive additional details I requested. I understand that if I agree to participate in these interviews, I may withdraw from the study at any time. I have been given a copy of this form. I agree to participate in the study.

Signature: Paramjit Longia

Name of Participant (Printed) Paramjit Longia

Figure 15 Consent form

*Refers to the design process section

2

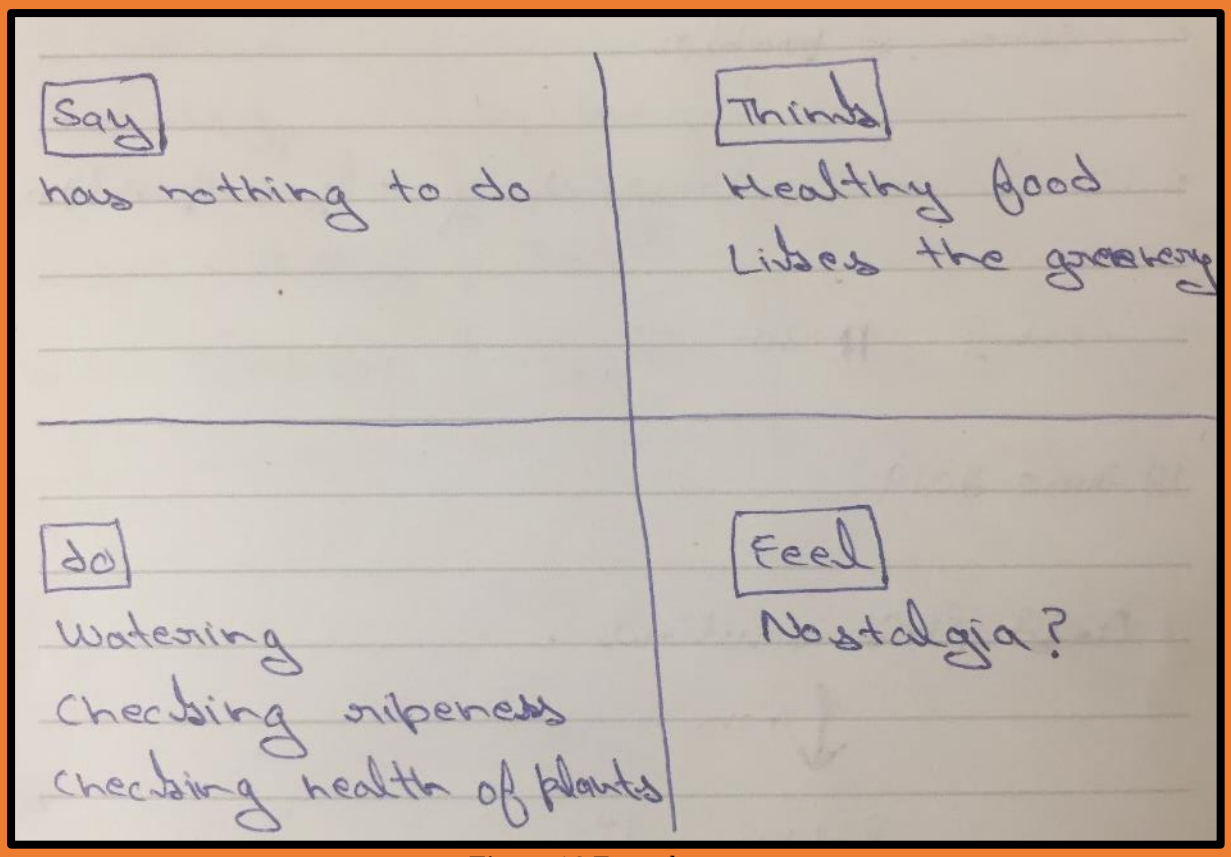
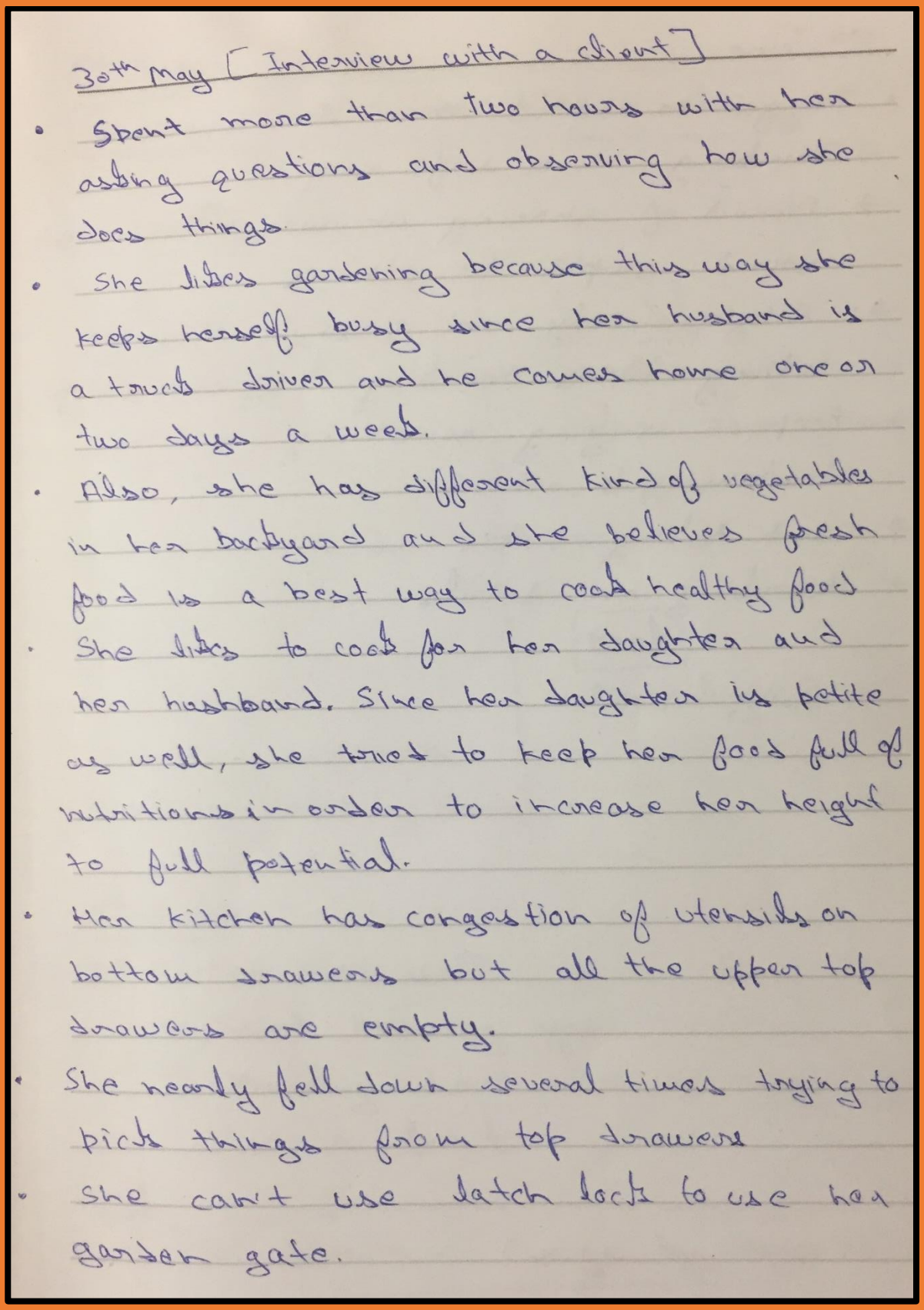


Figure 16 Empathy map

*Refers to the design process section

2.1



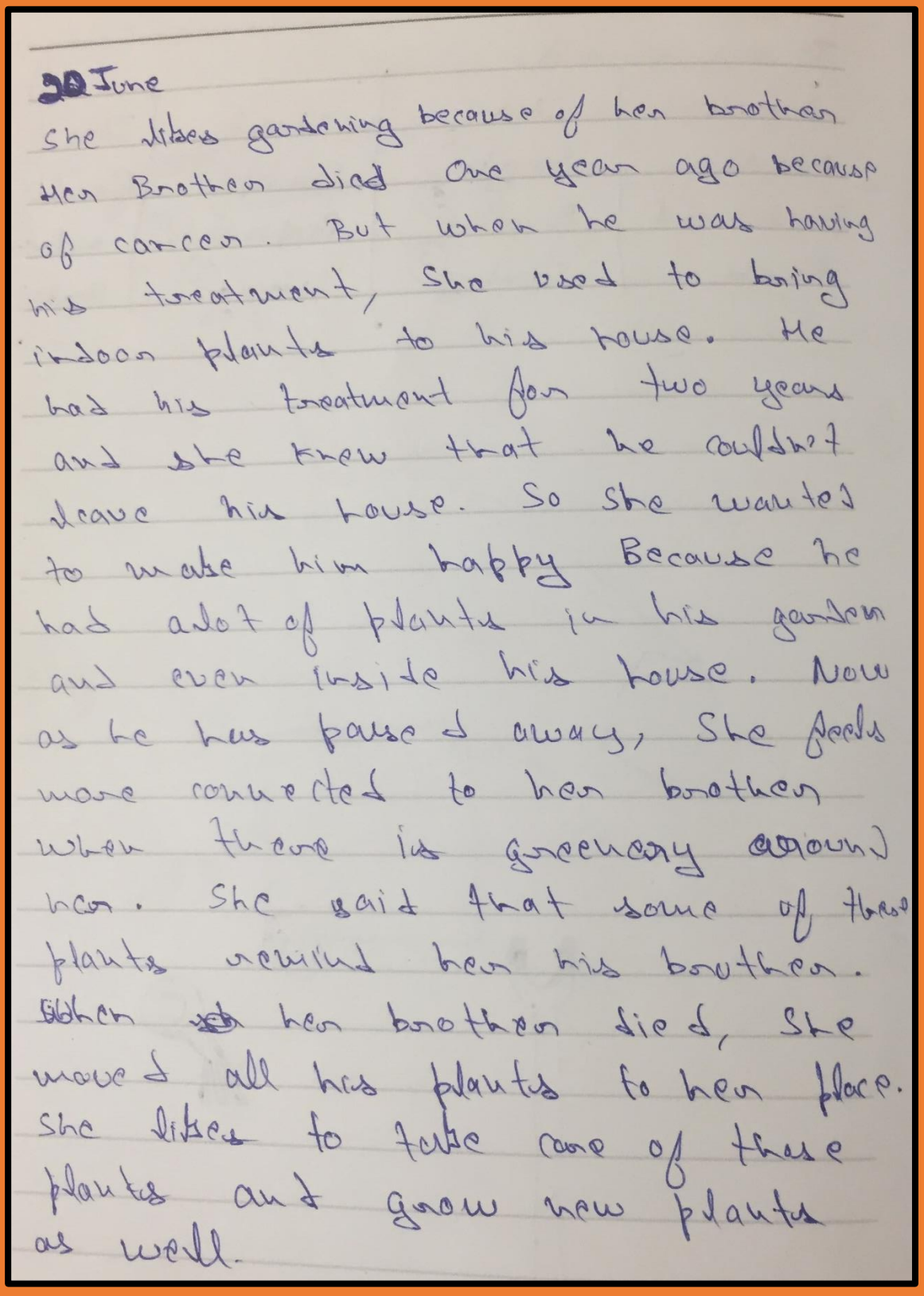
30th May [Interview with a client]

- Spent more than two hours with her asking questions and observing how she does things.
- She likes gardening because this way she keeps herself busy since her husband is a truck driver and he comes home one or two days a week.
- Also, she has different kind of vegetables in her backyard and she believes fresh food is a best way to cook healthy food
- She likes to cook for her daughter and her husband. Since her daughter is petite as well, she tried to keep her food full of nutritions in order to increase her height to full potential.
- Her kitchen has congestion of utensils on bottom drawers but all the upper top drawers are empty.
- She nearly fell down several times trying to pick things from top drawers
- She can't use latch lock to use her garden gate.

Figure 17 Interview notes 1

*Refers to the design process section

2.2



20 June

She likes gardening because of her brother. Her Brother died one year ago because of cancer. But when he was having his treatment, she used to bring indoor plants to his house. He had his treatment for two years and she knew that he couldn't leave his house. So she wanted to make him happy. Because he had a lot of plants in his garden and even inside his house. Now as he has passed away, She feels more connected to her brother when there is greenery around her. She said that some of these plants remind her his brother. When her brother died, She moved all his plants to her place. She likes to take care of these plants and grow new plants as well.

Figure 18 Interview Notes 2

*Refers to the design process section

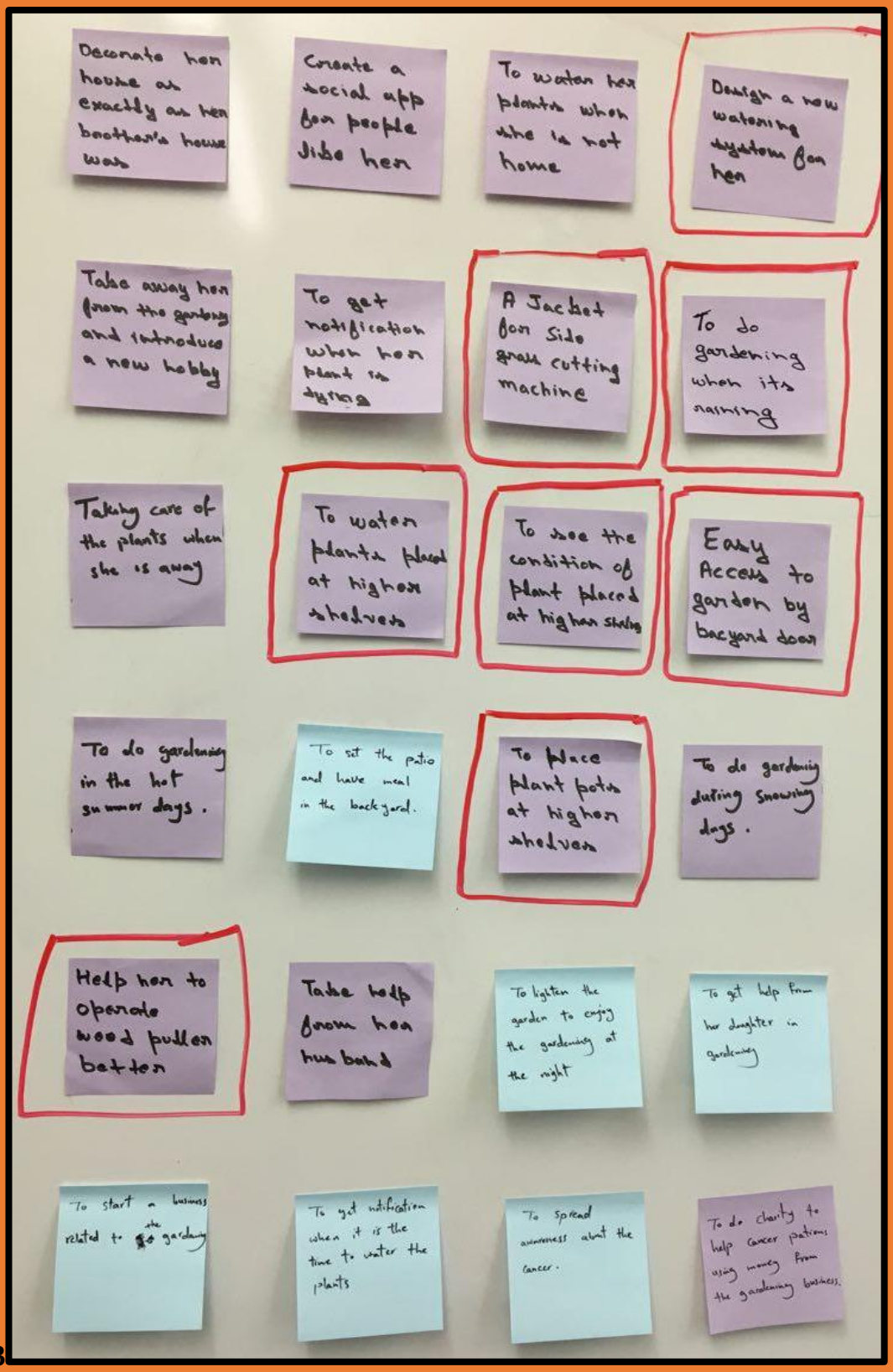


Figure 19 Ideas on sticky notes

*Refers to the design process section

4

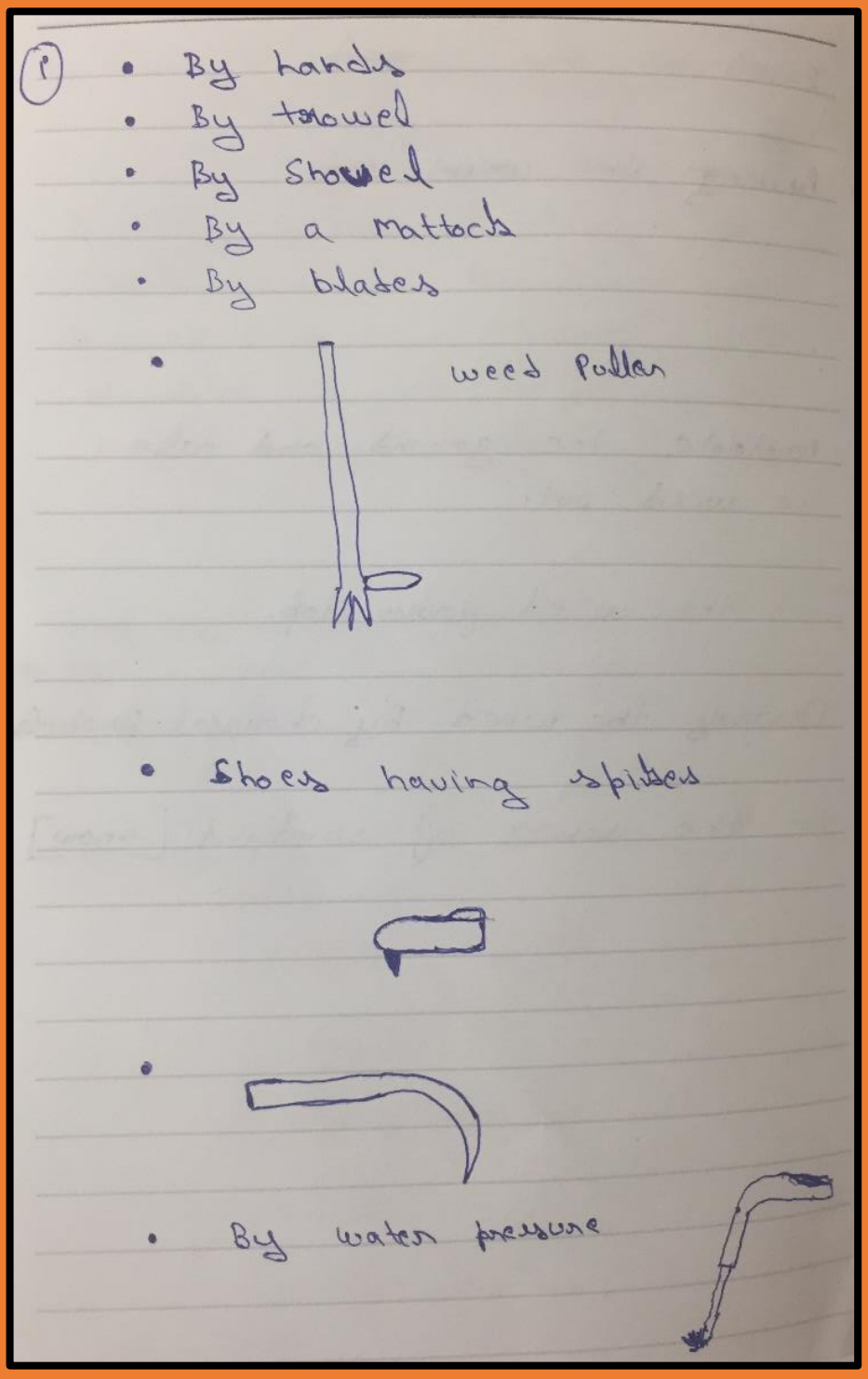


Figure 20 Penetrate the ground and take the weed out

*Refers to the design process section

5

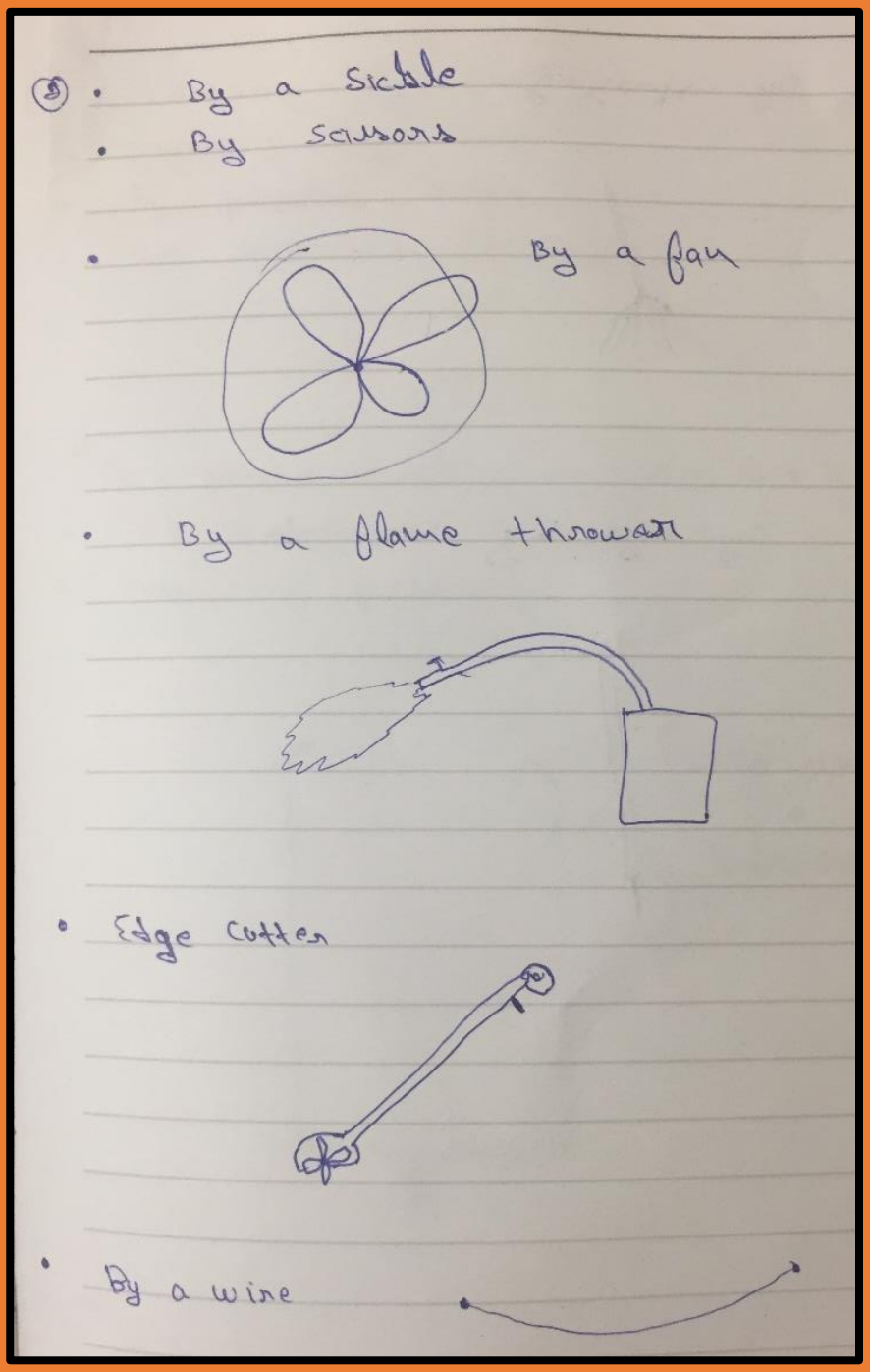


Figure 21 Cut the weed from the top

*Refers to the design process section

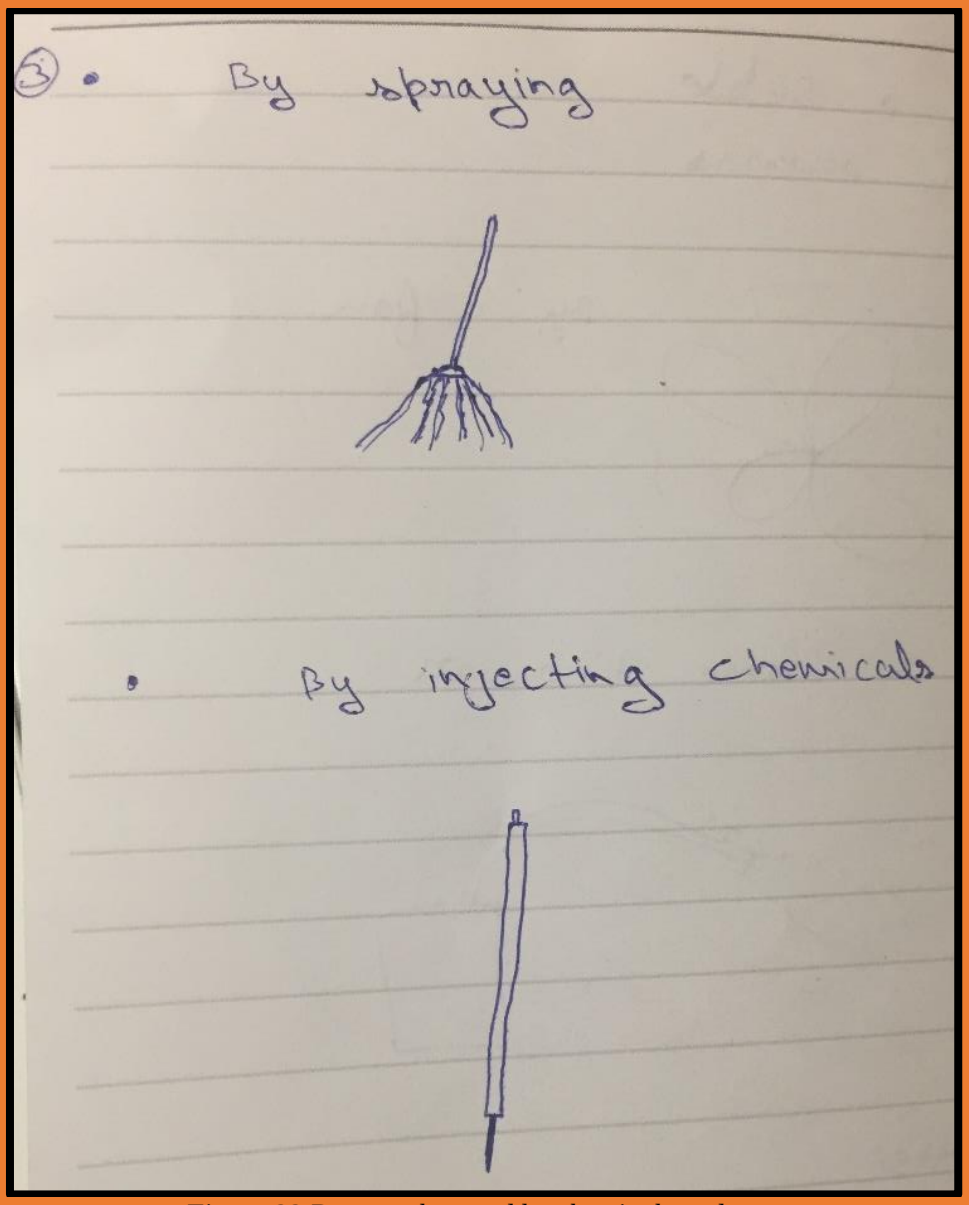


Figure 22 Destroy the weed by chemical products

*Refers to the design process section

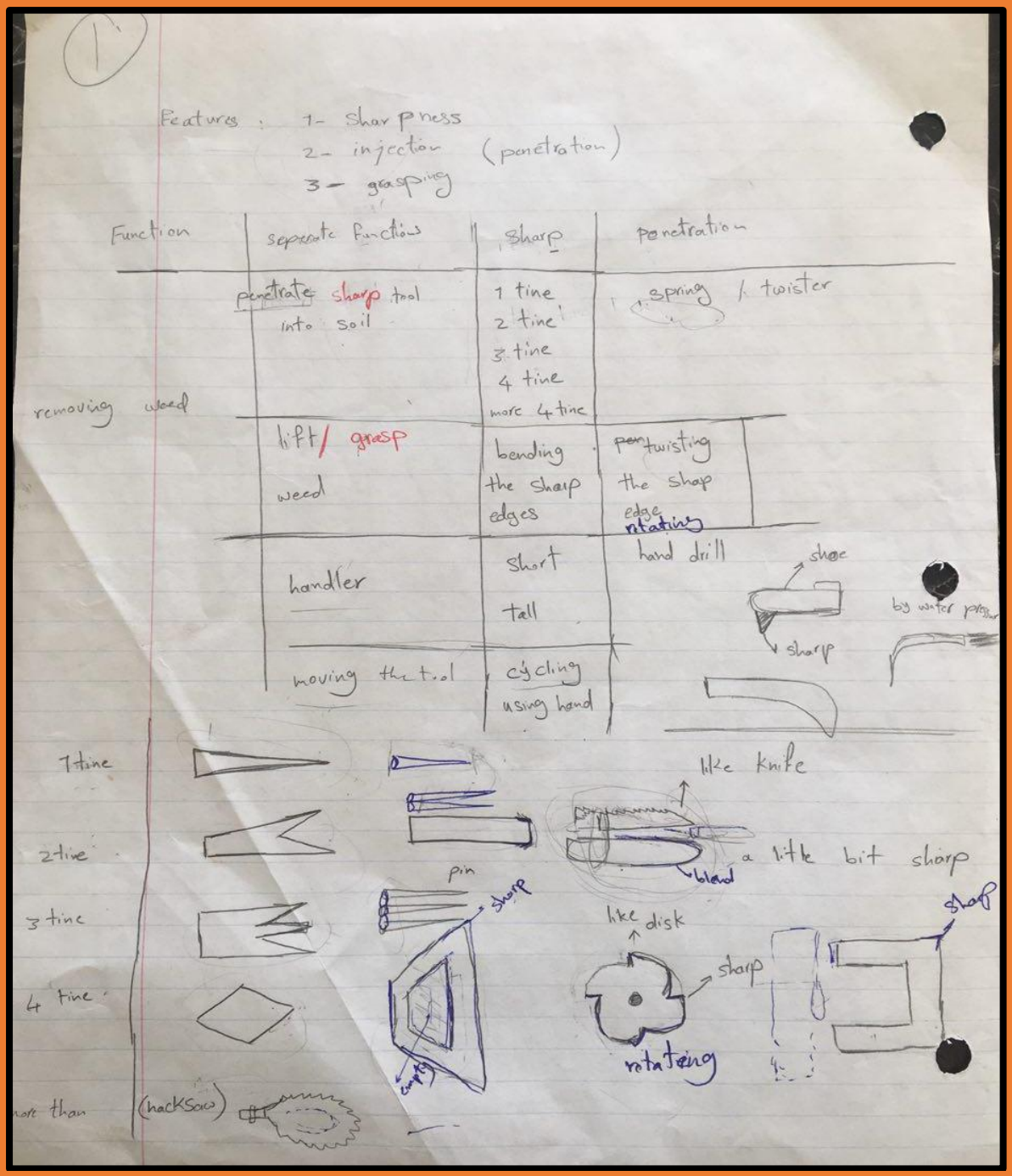


Figure 23 Rough work on the basic concepts

*Refers to the design process section

8

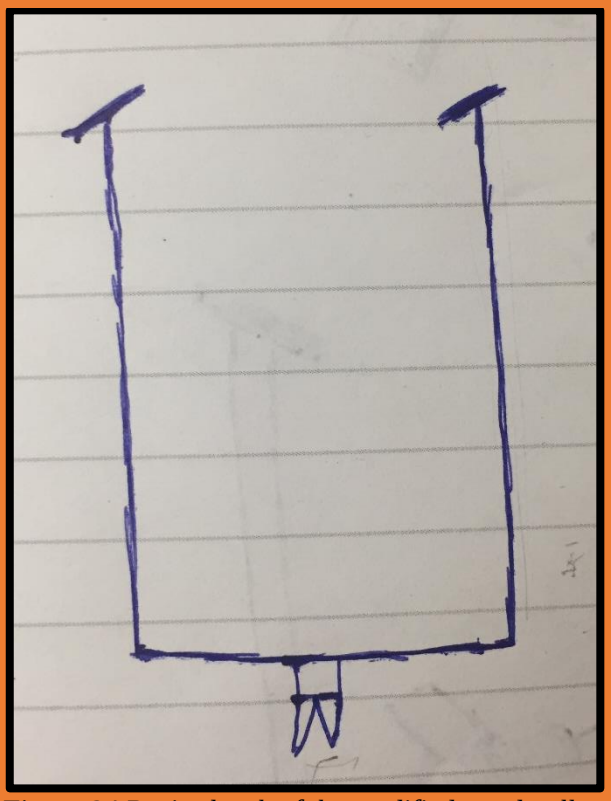


Figure 24 Basic sketch of the modified weed puller

9

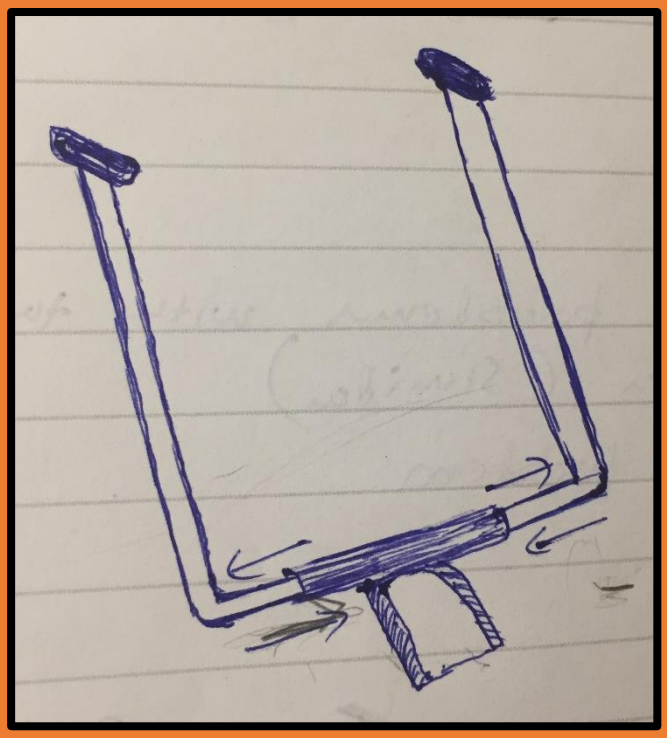


Figure 25 Another sketch of the modified weed puller

*Refers to the design process section

10

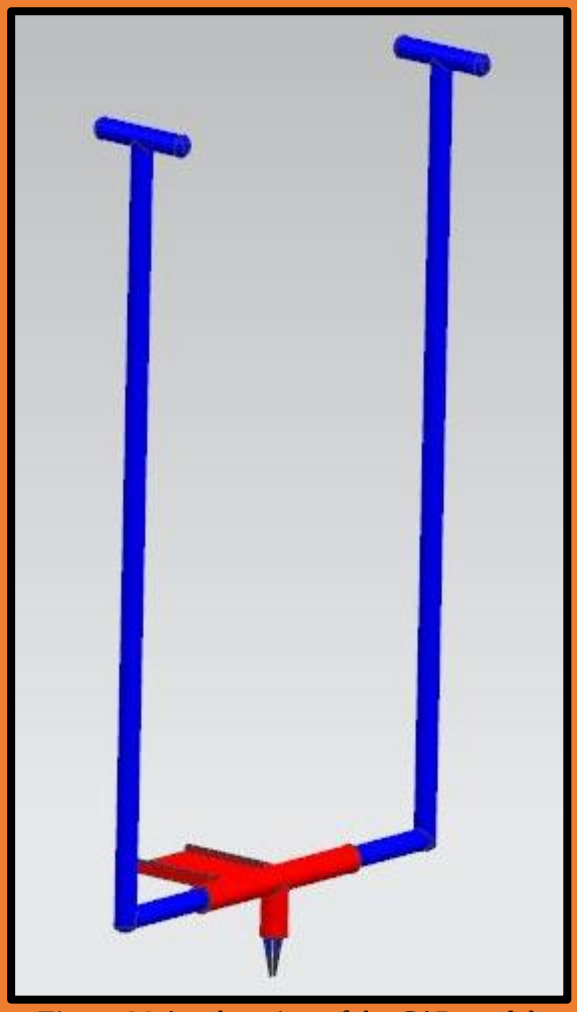


Figure 26 Another view of the CAD model

Video Link

https://drive.google.com/open?id=15vM2mMufxQWVue6CuA_uIJ2jMmnsu6Mf

*Refers to the design process section

Figure 27 Initial prototype

*Refers to the design process section

12

Figure 28 Mr. Bondu testing the modified prototype

*Refers to the design process section