The Engineering Design Process

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In this report, we go through the process that we took to come to the product that we decided to design for our project. As shown, it will include defining the problem, the process of gathering information, generating multiple solutions, analyzing these solutions in order to pick the one best suited for our needs, and finally, testing and implementing the solution we decided on. Here are the links where information was pulled: [International OCD Foundation](https://iocdf.org/wp-content/uploads/2014/10/OCPD-Fact-Sheet.pdf), [FDA Drug SSRI](https://www.fda.gov/Drugs/DrugSafety/InformationbyDrugClass/ucm283587.htm), [Harvard - Symptoms](https://www.health.harvard.edu/newsletter_article/what-are-the-real-risks-of-antidepressants), [NAMI - Lexapro Facts](https://www.nami.org/Learn-More/Treatment/Mental-Health-Medications/escitalopram-(Lexapro)).

## **Defining the Problem**

### *Identifying and establishing the need:*

When this project was first assigned, my group and I did not really know what to base our project off. We met for a couple of weeks to come up with ideas, but most of them were either too complicated or just outright impossible with the technology in the world right now. Every day we started by listing off a multitude of well-known disabilities. Then, we would go one by one down our list and spit out the first invention ideas we got. However, after two weeks of doing this, we realized it was not the most productive way to come up with an idea. Thus, when the DRC came to visit our class, we were opened to a whole new list of topics, ideas and potential products. The DRC talked about a bunch of problems, but one thing that really caught our attention was the problem they dealt with trying to accommodate students with mental illnesses. This was something we had never really even considered. It was not something that came to the mind at the mention of the word “disability.” However, as the speakers from DRC revealed, mental illnesses are the most common and the biggest disability students face. Therefore, we decided that this was the problem we wanted to tackle.

Since OCPD is quite a common illness in the world, every member of the group had heard about it. Although we were not as educated on the subject, we knew what it was, and Justin specifically had experience with it through a family member. One of the first things we thought of when we heard OCPD, we thought of an almost frantic state of mind. The idea of someone with a frantic state of mind then evolved with someone who was very neat picky about everything being a certain way and following a certain order. Thus, we decided to come up with an idea that would help this problem specifically.

### *Developing the Problem Statement:*

OCPD stands for Obsessive Compulsive Personality Disorder, and officially, it is classified as a type of personality disorder. A common characteristic of the obsessive-compulsive personality disorder is rigid adherence to rules and regulations. A person with an obsessive-compulsive personality disorder is more inclined to follow rules and regulations because he or she does not feel comfortable doing anything else. Another characteristic includes an overwhelming need for order. This is is the most common characteristic people think of when they think of obsessive-compulsive personality disorder. People with obsessive-compulsive personality disorder feel the need to have everything perfect-- or at least what they perceive to be perfect. It is torturous to them when something is out of order or not perfectly aligned. Furthermore, people with obsessive-compulsive personality disorder have the unwillingness to yield or give responsibilities to others. The reason for this is pretty straightforward and simple. obsessive-compulsive personality disorder patients often feel that given a task, they are the only ones who would be able to make it their definition of perfect. There are many uncontrollable aspects they would have to consider if they let someone else do it. People suffering from obsessive-compulsive personality disorder tend to also have a sense of righteousness and are strict with the way they think things should be done. For instance, if action is traditionally done in one way, people with OCPD tend to believe that, that way is the only right way and needs to do like that every single time. They seldom stray from this pattern.

There are many symptoms one must exhibit in order to be diagnosed with an obsessive-compulsive personality disorder. For one, they must express excessive devotion to work. While this same behavior can be seen in life on a workaholic, the thing that sets them apart is the effect. With OCPD, the obsession to work might impair social and family activities and/or relations. Similarly, they have excessive fixation to lists, rules, and minor details. This is a big one. People experiencing OCPD get caught up in the small little details and have trouble focusing on the bigger picture. They get distracted from the task at hand quite easily by some minute detail that they are unable to stop thinking about. Their need for perfection interferes with finishing tasks. If there is a minor detail that catches their eyes and it is an imperfection of sorts, they will not be able to focus on what they were doing until that thing is fixed. Depending on the magnitude of their obsessive-compulsive personality disorder, the problem could be as minor as a piece of lint. Another symptom of people with obsessive-compulsive personality disorder face is lack of generosity. In other words, there is an extreme frugality without any reason. It is almost unexplainable. We are not trying to say that this is a bad attribute, but it is not one that society looks upon favorably. Furthermore, people with OCPD also tend to exhibit boarding behaviors.

The diagnosis of obsessive-compulsive personality disorder is made when traits such as the ones listed above result in “significant impairment in social, work and/or family functioning” (International OCD Foundation). It is not necessary to have all of these symptoms in order to be diagnosed with OCPD.

There are many differences between people with obsessive-compulsive disorder (OCD) and obsessive-compulsive personality disorder (OCPD). For instance, people with OCD are aware of their thinking. They know that some of their thoughts are unreasonable, however, people with obsessive-compulsive personality disorder believe that their way is right and the best. Many symptoms, behaviors, and thoughts common to OCD are not seen as life-threatening or life restricting, however, with OCPD, people are so fixated on the procedure, it interferes with their day to day life. Furthermore, people with OCD want to get treatment; they are generally fed up with their unwanted thoughts. However, with OCPD, people are okay with it. They think it is better that way and they do not see how detrimental it is to them.

Approximately 1 out every 100 people in the United States of America suffer from an obsessive-compulsive personality disorder. It is twice as common in men than in women. As far as the cause of obsessive-compulsive personality disorder goes, there really isn't a confirmed one. However, there are many theories. People think influences such as parents, genetics, and culture might play a role in the development of obsessive-compulsive personality disorder.

Some treatments for OCPD are psychotherapy, medicine, and some relaxation techniques. Psychotherapy such as cognitive behavioral therapy is sometimes helpful for some people. It helps lessen expectations and helps people with obsessive-compulsive personality disorder realize how to value and prioritize close relations. Medicine such as SSRIs, Selective serotonin reuptake inhibitors, can help as well in addition to the therapy. Some common SSRIs are citalopram, escitalopram, fluoxetine, and sertraline.

### *Establishing our criteria for success:*

The criteria for success are the requirements for a product set by the engineers for a product to sell well and do what it is meant to do. In this case, there are many criteria that we have set for ourselves to be successful and they are as follows.

* The product must be low cost
  + The reason for this is that the goal of the product is not to burden people who already pay a handsome amount to pharmaceutical or insurance companies. Instead, the product should be low cost but still prove to be worth every penny when someone buys it. This will ensure that there are more sales as opposed to it being unsold forever and just not worth buying even though it may help them.
* The product must be safe for use
  + As with all products, this one should be safe for people to use, any part of the product should not be able to come close to hurting any user. That is...
    - No wires should ever come into view or be able to touch the skin
    - The device should never overheat if it is on a person’s body
    - The device should not have any sharp areas that could cut someone.
    - Along with these, there are many more that should be observed; however, in this case, these are the several that need to be paid attention in order for the product to be a success.
* The product should not hurt the environment unnecessarily
  + The goal of this product, of course, is to help people; thus, it does not make any sense to create a product that would be detrimental to the environment considering the harm that would have on people in the long-run. Therefore, the materials used in this device should accordingly be safe for the environment.
* The device must be aesthetically pleasing
  + This is important because the product is going to be used by people at some point in the day. As someone with Obsessive Compulsive Personality Disorder wants perfection, they would be obsessed with all of the imperfections of the product, and instead of wanting to use it to help, they would not even want to look at it.
* The design of the system must be ergonomic
  + If the system is not easy to use, the user would just ignore the device. This would spread and poor reviews would come in. The user experience is always what comes first, and if the product does not meet the user expectation, they would not be willing to use it. This is especially true in the case of people with Obsessive Compulsive Personality Disorder as they need to have everything be up to their standards, to perfection.

## **Gathering pertinent information:**

In this section, it is necessary that we go through all solutions to the problem that there are currently. This part will involve sources like the FDA and researching the other methods available. The sources used can be found at the top of this document.

* Is the problem real and its statement accurate?
  + The problem is real and the statement is accurate. Though this disability is treatable through medicine there are still ways to help those with Obsessive Compulsive Personality Disorder. Some of these ways include helping them remember to stay on the task at hand and not go into details on everything. The pills do help in this situation; however, there are products that can be made to help these people in a different way than a drug does especially since the drugs may have side effects that could prove to be potentially harmful to the OCPD patient’s overall wellbeing.
* Is there really a need for a new solution or has the problem already been solved?
  + There is a need for a better solution. There are pills in existence that help with Obsessive Compulsive Personality Disorder; however, with an optimized technological solution, anyone that has OCPD may be able to go through their day more easily than those that do not have it. This would benefit anyone that has OCPD because they could take the pill and use the product, or they may be able to just use the product instead if it does a good enough job.
* What are the existing solutions to the problem?
  + The most common solution to the problem is a pill. The pills used are the same medications prescribed as antidepressants to people with depression. These medications are called Selective Serotonin Reuptake inhibitors (SSRIs). These are known to be helpful if taken with psychotherapy.
  + There are also psychotherapy treatments available to help a person increase insight. This is all to help “lessen rigid expectations and learn how to value close relationships, recreation, and fun with less emphasis on work and productivity.”
  + Lastly, there are relaxation techniques that can be taught to a person with Obsessive Compulsive Personality Disorder. These help them to decrease their sense of urgency and stress.
* What is wrong with the way the problem is currently being solved?
  + Currently, the main solution to the problem is just a pill which many people may not want to take or may not feel is as effective as it should be. Along with this, many of these medications (i.e Zoloft, Prozac, Lexapro, Celexa, etc.) come with unwanted side effects that may or may not show when people take them.
    - Physical Symptoms
      * Insomnia, skin rashes, joint or muscle pain, upset stomach (which can lead to nausea or diarrhea), involuntary movements, and less ability for blood to clot.
      * All of these symptoms are typically short and mild except for the ability for blood to clot. This symptom can lead to internal bleeding in patients.
    - Sexual Effect
      * In many patients, there is a decrease in sexual desire, drive, passion, and performance.
    - Effectiveness
      * As with all drugs, human bodies become less responsive to them over time because they get used to the medication. This can be resolved by switching to another Selective Serotonin Reuptake Inhibitor, but eventually, there might not be any that work.
    - These symptoms all come from taking the medication that is supposed to help someone with Obsessive Compulsive Personality Disorder; however, it seems like anyone taking these medications is at more risk taking the medications.
  + Along with the medication available, there is psychotherapy available which may prove to either be ineffective or inconvenient for someone who along with Obsessive Compulsive Personality Disorder has a busy life and needs to tend to every day matters as well.
* What is right about the way the problem is currently being solved?
  + The ease of solving the problem is what the pill has going for it. For example, taking one pill typically lasts for a full day. This makes it a very easy solution for anyone with Obsessive Compulsive Personality Disorder as it allows them to take one or two seconds out of their time every day to take the medication and not feel the perfectionism and stress that someone with Obsessive Compulsive Personality Disorder tends to feel on a daily basis. Along with this, the psychotherapy sessions can help someone be more insightful and be able to tell when they begin to give into their obsession with perfection. This allows them to be able to stop themselves if they realize they are giving in.
* What companies manufacture the existing solution to the problem?
  + There are many companies that manufacture the medication available for people with Obsessive Compulsive Personality Disorder. These companies include the following:
    - Allergan (bought Forest Labs): Celexa, Lexapro, Sarafem, Viibryd
    - Lilly: Prozac, Symbyax
    - Solvay: Luvox
    - Jazz Pharma: Luvox CR
    - GlaxoSmithKline: Paxil
    - Apotex: Paxil CR
    - Sebela: Pexeva
    - Pfizer: Zoloft
  + Along with this, relaxation tactics and psychotherapy can be taught or practiced far and wide in civilizations.
* What are the economic factors governing the solution?
  + The economic factors are not high in number by any means. These solutions should be relatively cheap. This would appeal to many of the consumers as they are most likely paying a decent amount of money currently for the medications they need. Along with this, the psychotherapy is not cheap at all. The consumers are already paying a very large amount of money for these treatments and more; therefore, a cheaper product would certainly be better for them as it will help, but not take too much out of their wallet at the same time. Outside of the customer’s ability to afford the solution, there are no economic factors as the solution just needs to be able to fit the need without becoming too expensive to make or sell to people with Obsessive Compulsive Personality Disorder.
* How much will people pay for a solution to the problem?
  + Because this product is not going to be replacing anything and instead is more of a helper device to the person with Obsessive Compulsive Personality Disorder, it is necessary to consider it as a side product. Since people are already paying somewhere near one-hundred dollars per month for medications like Lexapro. Sometimes this cost is driven even further up around two hundred depending on the pharmacy and insurance. People would most likely be willing to pay somewhere less than or, at most, equal to what they pay each month. Otherwise, not many people would be willing to pay to have a product do what a pill already essentially does and may even be willing to suffer the side effects to save the money.
* What other factors are important to the problem solution (such as safety, aesthetics and environmental issues)?
  + People with Obsessive Compulsive Personality Disorder lack insight. This means that they do not know that the way they want things to be done and the way they are thinking is not normal. People with OCPD believe that their way is the only way and they adhere to the strict system or procedure they set for themselves. Accordingly, the important factors of this product should adhere to a certain standard.
  + These important standards are as follows:
    - Safety
      * It is always important for a product to be safe, especially if someone who has any disorder is going to be using it. If they’re shaky or depressed, there cannot be any way that they could be able to harm themselves with the product. It would not be worth making anything at all if someone that buys the product is able to get hurt with it.
    - Aesthetics
      * It is always important for the product to look good especially if it is out in the open. This is especially true for people that have Obsessive Compulsive Personality Disorder because they need to be able to function on the use of the product as opposed to how it looks where it is. There would be no one that buys the product if it does not look good because they are concerned with perfection. We should not give them anything else to stress over when they are using the product.
    - Ergonomics
      * The ergonomics of the device are important for the same reason those aesthetics are important. The device needs to be easy for the user to use because we do not need to add anything else to their plate because they already have a lot to deal with as it is. For example, if the product is hard for the user to figure out how to use, the product would not be any good for them. For this reason, the product should be easy to use and be able to do most anything that the user needs to make their lives easier as opposed to harder.

## **Generating Multiple Solutions:**

* Earpiece
  + If we were to make an earpiece that could help the person with Obsessive Compulsive Personality Disorder gain insight it would help a lot. With a prescription medication like Lexapro, Prozac, or Zoloft, this earpiece may be able to help the patient calm down and recognize what they were doing. It could also occasionally remind them to listen to other people in order to maintain relationships that people with OCPD tend to push away without realizing they are doing so. The main purpose of this product would be to assist those with OCPD in rebuilding and maintaining relationships.
* Rose Colored Glasses
  + If we were to make “Rose Colored” glasses, it would greatly help anyone with Obsessive Compulsive Personality Disorder because it would help them to believe that there is not anything imperfect about the world they are seeing at the time. It would not become easier for them to function without getting caught up on all of the minor details of life, instead, they could focus on what they need to in order to get what they need to do done. The main purpose of this product would be to assist those with OCPD in regaining their confidence and raising their self-esteem.
* Wristband
  + This would be a more practical version of the “Rose Colored” glasses. Instead of having the user wear a pair of glasses all day long just to make them believe that the world around them is functioning exactly as they would prefer it to, the wristband would function more like a minimal earpiece. Every now and again, the user would feel a small vibration that is there to remind them that they need to stay on track and to not focus on the little details of any of their work. Along with this, the wristband could come with other capabilities to make it more suitable to use anywhere and not just be a nearly useless piece of jewelry that a person walks around wearing to feel an occasional vibration. This main purpose of this product is similar to “Rose-Colored” glasses except it takes a different approach in allowing the OCPD person to feel good about themselves around others.
* Mirror
  + With a mirror, it would be something like more of a helping device to the medication the person takes. This mirror would be able to help the person stay on task as they get up in the morning and do other activities they have to do during the day. This would be something like the vibrator wristband; however, it would be a little simpler because it is just in the background and will keep a person doing what they need to do in order to get their day started at the least. Though this device would not be able to stay with a person all day, it would at least be able to get them off to a good start without losing track of time focusing too much on something that is unnecessary. The main goal of this device is for it to not get in the way of the person when they are working on anything and just casually remind them that they may need to leave for work, or be done getting ready by whatever time it is. The pace of someone’s day begins with the tone at which they start it-good starts = good days and bad starts = bad days.

## **Analyzing and selecting a solution:**

In this section, we will compare all of the solutions we came up with. All of them will be analyzed for function, ergonomics, mechanical strength, electronics involved, manufacturability and testability, safety and liability, economic strength, and regulatory and compliance. After rating all of these, we will select the solution that best fits our needs. When analyzing the products we will rate the importance for what we want to achieve in as stated above as we discussed the OCPD disability in respect to the problem and project we would like to tackle. To assist you in your understanding of our rubric, here is a quick description of what we want:

1. Functional Analysis-Will the thing function the way it should? If not it is a failure immediately.
2. Ergonomics Analysis-Talk about how people will interact with the product that we would make.
3. Mechanical Strength Analysis-Will it holds the load it is subjected to? Weight may end up being a huge factor in designing a feasible product.
4. Electronics Involved-Brief description of the complexity of the electronics and circuitry needed to build product-in-question.
5. Manufacturability/Testability-How much time will be needed to construct and test the product so it functions the way we want it to?
6. Safety and Liability-Safety to humans is obviously the biggest concern but there’s also safety to the environment and the property of the person. Liability is what would happen if a person used to make sure it’s functionally reliable.
7. Economic and Market Analysis-Relation back to what was previously said in previous sections in regards to what the market is like for the industries that could help build and utilize the functionality of the product that we choose to create.
8. Regulatory Compliance-How are we going to take steps to comply with the various laws, policies, and regulations that may pertain to the said product?

#### *The Earpiece:*

* Functional Analysis
  + An earpiece would be similar to a hearing aid but instead of for deaf people, it would be designed for someone with OCPD; therefore, there are some valid functionality points in this product idea. Unfortunately, now in modern times, an earpiece is viable only if it is Bluetooth wireless and fits comfortably in the ear and looks good. Also, this would require us to program in a virtual assistant which is delving into artificial intelligence. This could be pretty fun to tackle but due to inexperience, would be near impossible to do within the time constraints.
* Ergonomics Analysis
  + People who use this product would wear it like any wireless Bluetooth earbud that they would buy for the phone but instead of using it to exclusively listen to music or watch videos, there will be an integrated virtual assistant that could interact with the user as a “guiding imaginary friend.”
* Mechanical Strength Analysis
  + Since it is an earpiece, it does not need to hold any weight but rather be able to be taken out of the ear easily and conveniently and also stay in place without the user having fear of losing them because they fell out.
* Electronics Involved
  + There would be quite a bit of electronics involved especially as we would need to fit in a tiny circuit board with a rechargeable battery, Bluetooth receiver, mini speaker, and the microcontroller that could host the virtual assistant.
* Manufacturability/Testability
  + There would be quite some complexity in building this from scratch so we may need to modify a pre-existing product that has similar features. This would then limit our testing cases as we would have to configure them to fit the pre-existing product’s specs.
* Safety and Liability
  + The only safety and liability cases that could prove to be major legal cases are if the product blows up in the ear or while someone is holding it and if someone swallows it because it is a small product that is supposed to fit in ears.
* Economic and Market Analysis
  + While this product would only target people with OCPD, people with this disability could still use it as wireless Bluetooth earbuds as the virtual assistant will probably have a function where you can turn it on or off. The market audience should mainly be teenagers to young adults, but in reality, any person of any age could use this product.
* Regulatory Compliance
  + We would probably research OSHA laws or any other safety laws that could pertain to the commercial advertisement and use of this product during the testing phase of this project.

#### *The Rose Colored Glasses:*

* Functional Analysis
  + This purely a placebo effect gimmick that would work for the first few times the user uses it, but the effects would die out as the user realizes that he or she bored with looking through rose-colored glasses.
* Ergonomics Analysis
  + People would sunglasses that are designed to target the psyche through color manipulation and psychological analysis. It would utilize a placebo-type effect that would depend upon the user’s willpower.
* Mechanical Strength Analysis
  + Sunglasses should be able to handle the weight of a person’s hand on it and a light push, but any more force would require more expensive materials and more in-depth testing.
* Electronics Involved
  + There are no electronics in a rose-colored sunglass unless it is supposed to change according to the person’s mood which might require some circuitry to account for the color change and measurement tool to sense the mood changes.
* Manufacturability/Testability
  + Testing this would be a real pain as we would need to do more human testing than anything as the product testing should not take that long as sunglasses have been manufactured and tested for quite some time. Building this from scratch might also take some time to perfect the conformations of different designs to people’s faces for comfortability and functionality.
* Safety and Liability
  + The safety and liability concerns that have the highest probability of showing up would be environmental activists of all kinds accusing us of contributing towards the extinction of some rare material of either plant or animal origin. Another one that could show up would be a bug in the mood-changing rose-colored glasses if that feature ends being added.
* Economic and Market Analysis
  + Sunglasses are by no means a cheap accessory to purchase especially for a good pair that has other functions than blocking the sun’s harmful UV rays. Luckily for businessmen, sunglasses have become a necessity in everyone’s lives especially those interested in fashion or work in the fashion industry.
* Regulatory Compliance
  + We would probably research OSHA laws or any other safety laws that could pertain to the commercial advertisement and use of this product during the testing phase of this project.

#### *The Wristband:*

* Functional Analysis
  + There are already products like this that exist; however, their successes are short-lived because of the controversy that they aren’t psychological scams to make a consumer think they work (Shark Tank had a very similar product). If they can be proven to work with some concrete facts instead of abstract feelings, this product would have huge potential.
* Ergonomics Analysis
  + People would wear the wristband like any bracelet except it preprogrammed to vibrate towards a task on someone’s schedule telling them they need to do something. OCPD users will most likely follow a specific procedure of tasks for each day of the week.
* Mechanical Strength Analysis
  + Bracelets would not be tested to handle the weight but rather how light they can be so that it is comfortable for the user.
* Electronics Involved
  + There would some kind of circuit that could be programmed to vibrate at different times and maybe some blinking LED lights to get the attention of the user for anything could require the attention of the user or those surrounding him/her.
* Manufacturability/Testability
  + The product to build it may take a while as we would need to research the molding process of building the bracelet and then testing the structural stability of the bracelet. Testing the bracelet would be very painful as there would be so much physics to account for and we would need some human trials to make sure people would like the feel of the bracelet.
* Economic and Market Analysis
  + There is potentially a market for this product as it essentially a fashion statement accessory geared towards anyone with OCPD. The audience while will probably include anyone of both genders and any age, there is a probability that more females of the younger ages will purchase bracelets. This of course purely based upon speculation.

* Regulatory Compliance
  + We would probably research OSHA laws or any other safety laws that could pertain to the commercial advertisement and use of this product during the testing phase of this project.

#### *The Mirror:*

* Functional Analysis
  + Mirrors are meant to be used to look upon oneselves and organize their outer appearance. They have also used in literary works a figurative representation of our inner self. This product is supposed to incorporate the second definition inside a “smart” system while keeping the simplicity of the first definition. Now while this sounds all perfect, this is all reliant on the person with OCPD to be very organized which could cause some tough hypothetical situations.
* Ergonomics Analysis
  + The user can interact with the mirror like any other normal mirror out there, but the smart system gives the mirror features such as the news, the weather, reminders, and scheduled events for the day to allow the OCPD person to organize his/her life to whichever way they want.
* Mechanical Strength Analysis
  + It should not have to carry any loads, but it should be tested to see if it is durable to hold up by itself and then it should be tested to make sure that it is not too heavy to put a dent or hole on the wall as it hangs. A huge part of this will be finding the perfect body to glass ratio.
* Electronics Involved
  + There will be a huge electronics part to this project as the whole smart system will be powered by a raspberry pi. This part will also include some programming and require the team to have knowledge of circuits. The electronics will all be assembled on a breadboard that will then be attached to the raspberry pi and be powered by a battery unit.
* Manufacturability/Testability
  + The building of the actual mirror should not be too difficult as it essentially a huge assembly with some minor modifications and/or improvisions. The hardest and most time-consuming part will be programming the raspberry pi and then connecting it to the breadboard and battery. Testing it also should not be too difficult as it will be a huge debugging session with a few human trials for the user interface of the “smart” system.
* Safety and Liability
  + Safety and liability cases for this product would actually be subject to quite a lot of cases such as electrical malfunction/electrocution or weaponizing of the mirror and its frame and some other bizarre scenarios. This can all be disclaimed or put under some kind of limited warranty (contractual obligations).
* Economic and Market Analysis
  + With mirrors having practically an unlimited lifespan in the economy, there is no way an excess should occur the whole supply and demand scheme of things. And also with everything undergoing a technological revolution or becoming “smarter” adding a ‘smart’ system is one of the smartest ideas anyone could have come up with for the mirror. Although the audience can be anyone of any age, most likely it will be older people with jobs who will purchase said mirror.
* Regulatory and Compliance
  + We would probably research OSHA laws or any other safety laws that could pertain to the commercial advertisement and use of this product during the testing phase of this project.

### *The Decision Process*

We chose the mirror as our best product option to tackle our OCPD disability “problem” as we felt that it had the most feasibility to be used by someone who might actually need it. Also, it was the one that fit all of the criteria without raising too many hypothetical questions. It was the one that seemed most viable given the time constraints, available tools, and experience/knowledge of the team. As a team, the smart mirror really clicked with also because there are previous attempts at this project to guide us in case we mess up and of course, it seemed like a really fun and cool project to complete.

## **Test and Implement the Solution**

### *Prototyping*

In order to prototype the mirror, we need to first think about how we want the final product to look like and gather those materials. Once we get an idea of how the final product is going to turn out, we need to find materials that could emulate the materials we had in mind and allow us to build a smaller scale version of the final product. If we are tight on time, we will prototype only the important features of this mirror which is the housing compartment of the electronics within the frame and glass of the mirror. These materials for the final product will most like include the following (susceptible to change): mirror, wood, glue, raspberry pi, software for programming the pi, monitor. To prototype, we will use balsa wood and tape.

Along with gathering the materials, we will need to program the mirror to be able to do the following: provide the news, the weather, give reminders, and the scheduled events for the day. Our stretch goal is to integrate Google Assistant within the raspberry pi. As we are programming the mirror we will be testing it concurrently as we fit the rest of the mirror together. Testing will definitely be the most time-consuming part of prototyping for both the project build and software side.

### *Concurrent Engineering*

To engineer this product concurrently, we will be splitting the hardware and software aspects of the device. Part of the work will be coding it to take certain commands and ensure the interface is user-friendly. On the hardware aspect, we will be constructing the mirror and making sure that it works and the screen can be seen through the mirror. These will most likely be done separately but at the same time as one another in order to have efficiency. The hardware aspect will be fairly easy to accomplish and can be finished first. The software aspect needs to be started when the hardware aspect of the project begins but can be paused and continued after the hardware aspect is completed. As a team, we will probably get a hardware journal and software journal to document the day's progress and everything we learned while working on the project.

### *Documentation*

As mentioned before, there will be two journals for the time: one will be a hardware journal that will keep track of daily progress and what we learned during that day’s build time and the other will be a software journal that will document all the new coding skills we will obtain. This will also serve as a daily team reflective time for how we felt during the course of the project up until we have to present the actual product.

### *Applying for Patents*

The team will not consider applying for patents until after the final presentation and only if we do extremely well with the project as a whole. While it would be fun to get some legal protective rights to our idea, there have been already numerous attempts at creating a smart mirror before. Our best fighting argument is the fact that we designed the mirror as a supplementary tool for assisting those with OCPD. Even then the team would like to avoid tedious legal battles as much as possible. We would need to create an exceptional product that knocked the course objectives out of this ballpark.

### *Testing and Verification*

In terms of testing, the team would need to test different areas of the project. After prototyping the functionality of different compartments in the frame, we would need to test the appearance and practicality of the mirror. We would then have to experiment with the weight and body-to-mirror ratio of the mirror. After building the actual mirror, we would have to test the structural integrity of the product. This is just testing the hardware aspect of this project. We would then have to start testing the programming aspect of the project which will be the hardest part as programming languages are nitpicky or too free which could cause some bugs to be really annoying to find or even fix, sometimes even both. After testing the software, we would have to test how it looks on the mirror. Aesthetics are very important if this mirror is to be mass-manufactured and put to good use by people with OCPD in the world. We want to mention that we may run in some problems and the order in which we test may change as we fix our schedule. In order to verify what we are testing, we will try our best to find something online to follow by, but chances we will use a very rationalized “by trial and error method.” Overall, this project should be very fun and gratifying to attempt to complete and even complete, if everything works out.

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