

# LUX

From the Sunlight Project

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## Overview

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The problem: There are approximately 1 billion people worldwide suffering from Vitamin D deficiency, and somewhere between 20-30% of people living in altitudes similar to Seattle that suffer from Seasonal Affective Disorder (SAD). People try to find ways to deal with their mood, but have trouble tracking and remembering to receive treatments. The solution: Both SAD symptoms and vitamin D deficiencies have been shown to be directly correlated to the amount of serotonin produced by the brain. Serotonin production from the brain has been shown to be directly correlated to the amount of sunlight that is received that day. While vitamin D deficiencies come with more physical health concerns, we've determined that users are more concerned about their mental health (i.e. SAD). So our intended solution would focus on helping the users deal with their SAD symptoms through a series of monitoring tasks, reporting tasks, and reminder tasks. The solution would use these facts about serotonin and vitamin D and the users' preferences to help the user handle SAD on their own terms.

## Contextual Inquiry Targets

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Subject 1: We first wanted to gauge the interest in a user who we thought might need access to more light. We found a male CSE student who was born and raised in Seattle to do our first inquiry. We conducted the observation/interview in their natural habitat- the CSE labs, obviously. We thought this would be a good environment since it's a basement with no windows for natural light that students often spend up to 8 hours at a time. Our interview took a bit of a different direction than we had expected. What we found to be unique was this individual's outside perspective of the basis of our initial project proposal. He made it clear that our initial proposal would be used for nothing more than a novelty. After further discussing the issue we came to the conclusion that it would be best to make our solution have a more specific scope. The student had lived in Seattle his entire life and did not suffer from Seasonal Affective Disorder. However, the subject did have some experience with SAD as his mother (who is from out of state) does experience the disorder. Because of this, the subject responded very positively towards our proposal of a system focused more on combating SAD instead of simply tracking sunlight/vitamin D intake.

Subject 2: After our first inquiry we wanted to talk to an expert in the area so we could get a more in depth understanding of what people actually want help with. We found a male therapist at the UW Counseling Center from Chicago who recently moved to Seattle in July 2014. We met with the subject at the UW Counseling Center where he works. The UW Counseling Center provides short term therapy for UW students regarding any number of concerns that those students may have about their mental health status. Along with the typical psychotherapy offerings that the counseling center has, they also offer Light Therapy to help students cope with SAD and other forms of depression. The entire counseling center has a calming atmosphere in part because of the relative silence and in part because of the weather and nature sounds that played outside the various offices. The subject took us to his personal office to talk to us about the depression in general and showed us the room where light therapy is provided where we spoke specifically about light therapy. Something unique that we got out of this inquiry was the variety of

treatments and results. Having seen many cases of depression and mental health issues, the subject was able to answer assumptions we had about SAD that we would not have been able to get from talking to a student.

Subject 3: The information we got from the expert allowed us to get a better understanding of possible solutions and now we wanted to see what someone affected by SAD is struggling from. We found a male INFO student attending UW who experiences symptoms of SAD. We met with the subject in the INFO co-lab located in the basement of Mary Gates Hall. The subject spends a decent amount of time in this lab, and labs like it, for the purpose of group work. He was born in Los Angeles, California and moved to Kent, Washington when he was four years old. Four years ago he moved to Seattle for college and this was when he started noticing the symptoms of SAD. Most of his knowledge about SAD is through internet forums, articles on the internet and through word of mouth. When asked if he had seen a doctor or sought any form of help, he has not because he feels that he has not lost control of the situation. Something unique that came out of this inquiry was the subject's insight on dealing with SAD. To reduce stress, he enjoyed jogging and even walks to class which takes around 20 minutes. For his jogs he liked using an application called Runtastic, which tracks running and one part that he found useful about it was the audio feedback after every mile. From this we asked what features he would like to help him manage stress and SAD. Some of the topics included; having a good enough break in the middle of the day, more control over his busy schedule, and monitoring his time indoors because he has trouble dealing the lack of light and cold, which causes him to want to stay in bed longer and not go outside.

## Contextual Inquiry Results

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The first subject's interview suggested that our original intended solution may not make for the most interesting app or device because not only are a large number of people ignorant of vitamin D deficiency, but an even larger number of people probably aren't interested in their vitamin intake. This is supported by the fact that while the symptoms of vitamin D can be extreme including depression, heart disease, obesity, and even cancer, these symptoms usually come with their own set of symptoms that do not present themselves until it is too late to fix with a simple increase in vitamin D intake. Basically, people don't care about vitamin D deficiency until it becomes serious because its symptoms go unnoticed until that point. Subject two effectively confirmed this by describing the most common symptoms that people hope to treat with light therapy as general sadness, loss of interest, and sleep trouble. The third subject also described his most noticeable symptom as "losing interest in the world" which solidified for us the fact that people care more about their mental health than the physical consequences of vitamin D.

Subject three also gave some interesting insights into when the symptoms of seasonal depression are most prevalent, aside from the simple fact of being winter. He noticed that elevated stress levels often lead to symptoms of SAD. Examples of these situations are days where he's spent many hours in a row studying, when he has to go from one meeting to another for several hours in a row, approaching deadlines, etc. Our extreme user, subject two, also spoke a lot to the fact that stress can play a huge role in the onset of SAD and depression in general. Both of these interviews suggested that better stress management could decrease SAD symptoms. Another area that was common between the subjects was

the issue of education and knowledge about symptoms and treatment. Subject two had pointed out that a small percentage of the university knows about the counseling center and the treatments that they provide. Subject three reiterated this because he had never heard of light therapy and one of the reasons that he has not sought advice is because he is not informed enough to decide when he should seek help. One of the things that the subjects pointed out that is useful is understanding what tasks they are doing or can be doing more of that are useful in helping treat SAD for them. Also monitoring signs of worsening symptoms can be helpful as well because most users are not usually aware of things they are doing and having some feedback and outside guidance can help them take the next step in trying to gain better and more useful treatment.

## Task Analysis

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### *Who is going to use the design?*

With up to 1 in 4 people living in latitudes similar to Seattle suffering from Seasonal Affective Disorder, we think there is a large range of potential users in that group; specifically in the Pacific Northwest where the winter is dominated by gray looming clouds and constant rain. We also think that there could be another decent number of users who come from a place of wanting to help someone they know handle SAD, as well as from just wanting to be aware.

### *What tasks do they now perform?*

Many people combat seasonal affective disorder in a variety of ways such as light therapy, professional counseling and psychotherapy, taking vitamin D supplements, or even antidepressants. Those who manage to self mediate their SAD symptoms do so through stress management and organization, seeking out social activity, and even participating in physical activity. In extreme cases, people may even move to a sunnier region.

### *What tasks are desired?*

All interview subjects expressed interest in seeing how much sunlight they receive per day, which allows for self comparison of exposure rates to SAD symptoms. The subjects also showed that better stress management could do their SAD symptoms a world of good. The two of these concepts combined could be used to provide feedback to the users on their sun exposure and give them suggestions on how to supplement low exposure. Another task that a user desires is having reminders for their current treatments.

### *How are the tasks learned?*

Our extreme user interview with subject two really emphasized the difficulty of SAD treatments because there are so many external variables that there is no one-size-fits-all treatment. Because of this, tasks regarding how to handle SAD symptoms are learned primarily through exploration and experimentation. The more self mediated tasks are typically learned through internet articles and forums, word of mouth, and expert advice through some non-in-person medium. Some tasks are simply found by the patient to be helpful.

### *Where are the tasks performed?*

Task performance areas can range from doctor's and therapist's offices, to a user's bedroom, to the gym, to public venues in general. SAD doesn't hang out in any one location, it follows people around wherever they go, and so must the tasks to handle it. Ultimately the type of treatment dictates both the location of task performance and the medium (phone, computer, light, etc.).

### *What is the relationship between the person and data?*

A primary set of data would be sunlight exposure. In this case, the user is directly related to the amount of sunlight they received that day, which can be measured in lux or time. Another data set would be mood measures for each day, which is another direct relation to the user because they are actually feeling those moods. Combined these data can indirectly relate to the user through a correlative display of exposure to mood measures. This can be taken a step further by correlating this data with a particular treatment the user is using, all ultimately allowing for self reflection and mediation of SAD symptoms.

### *What other tools does the person have?*

Most have access to a Smartphone and internet. In certain cases people have access to some sort of light therapy whether it is at a university or simply a personal device they already own. People also usually have access to a stopwatch and the ability to judge their mood on a 1-10 scale, and an excel sheet to track those things in, but it is incredibly unlikely that anyone would use such a large amount of tools to track these things. Another set of tools that is integral to treating SAD is the instructions from the doctor; what remedies to do/take.

### *How do people communicate with each other?*

Many people who suffer from SAD participate in support groups. However, just as many people choose to keep to themselves regarding their symptoms and attempt to self mediate their feelings. Depression and its symptoms is a personal subject and it takes great deals of time to be on a personal level with someone. When people do manage to reach that level, they may talk to their friends and family about whether they also suffer from SAD or not.

### *How often are the tasks performed?*

Most tasks are performed daily. Most people don't mind investing a few minutes per day in exchange for better quality of life, and both mental and physical health. However, because weather is a major player in the symptoms of SAD, if there is a break of sunny weather in the dead of winter a user could go a few days without feeling the need to perform any tasks.

### *What are the time constraints on the tasks?*

Tasks associated to SAD and depressive disorder treatments in general do not have time constraints in the traditional sense. People who suffer from these are aware that finding the right combination of tasks that serve as their treatment can take large portions of time. There is a soft-constraint of frequency associated with doing treatments and tracking them; since humans have imperfect memories, it is important to record the remedies and treatment effectiveness. Most users currently expect instant access to the summaries of what they have done to combat SAD (their daily sun exposure, remedy adherence, etc.) since currently this is done by just looking at the tracking forms they have filled out.

### *What happens when things go wrong?*

There must be a delicate balance to this question as mental or physical health “going wrong” usually cannot be solved by technology such as an app or device. These can most certainly be managed and maintained by technology, but when health fails there is no substitute for a professional or some sort of professional assistance. If you think of “going wrong” as simply not fulfilling a task, then our device could assist in the process of remembering by warning the user about consequences or just reminding them that a task usually helps them deal with SAD. It is important that the patient do *something* for treatment, so it could also remind the user of other tasks more persistently if a patient is missing parts of their routine.

## Tasks

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### One: measuring daily sunlight exposure

One of the primary tasks that people suffering from Seasonal Affective Disorder (SAD) should be to measure the amount of sunlight they receive in a day. The amount of sunlight people receive in a day can be measured in either time alone or in time spent exposed to a particular amount of lumens, which measures the intensity of the light. The primary purpose of this task is to open the door to other analytical tasks that can assist in handling the symptoms of SAD. Measuring daily sunlight exposure for the majority of people is a new task. For the few that do, not only can it be a cumbersome, but simple task, that is often done in a non-data driven way, which is where we intend to fill the gap by giving accurate metrics of how much light they have been exposed to.

### Two: recording how one feels

Another task from people affected by SAD is documenting their feelings. Continuously recording mood is a tried and true practice that can help one who is affected by SAD identify patterns in their mood swings. This is a fairly easy task if people actually remember to put the few minutes of effort in to reflect on their day and make a quick note about their mood. Recording feelings is mostly an existing task for people working to overcome SAD.

### Three: comparing feelings to the amount of sun they received that day

A separate task will be more analytics based to find correlations between the user’s happiness and light exposure. Happiness tracking paired with the light exposure tracking mentioned above make the perfect data set for identifying patterns in one’s mood relative to their sunlight exposure. If a person can see that they tend to feel better on days they receive more light exposure and worse on days that they stay inside all day, then actions can be taken to ensure a particular level of light exposure on a daily basis. This is a completely new task. Currently doctors do check if the current habits are “helping” but that is not on the same level as looking for helpful patterns in months of data. This allows the user to reflect on the things they are doing and have a better understanding of their mood and habits.

### Four: finding suggestions for everyday ways to deal with SAD symptoms

Another task people currently do is find suggestions for everyday ways to deal with SAD symptoms. For example, when someone is sick they will frequently search Google for help with symptom relief. This is the same for SAD. The internet provides easy access to suggestions, but one of the issues is

finding the right answers; SAD treatment is heavily dependent on the individual. One treatment that helped someone might not have similar success for another.

### Five: remembering to receive treatments

After deciding to try a treatment, people face the task of actually remembering to get their treatments. This task can range in difficulty because the more treatments that a person requires, the more difficult it is for them to maintain proper use of those treatments. Sporadic use of therapy or supplements will likely not yield the desired results, but their effectiveness cannot be properly determined due to the sporadic use. Humans often have faulty memories, especially with age, and are not likely to be able to remember a treatment schedule without some kind of tool.

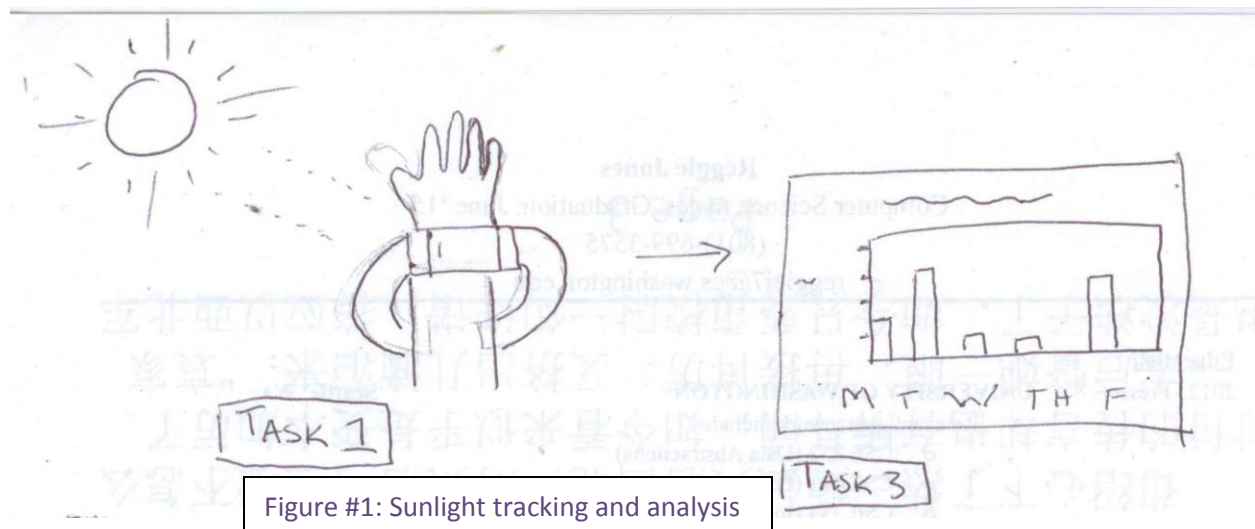
### Six: getting access to treatments

One of the issues with some types of treatment is accessibility. For example, there is no clinical prescription for the light box so someone suffering from SAD must find or buy one of their own, which can often be expensive. Students can walk into the UW counseling center to receive light therapy. The issue here is that most students do not know that this is available to them. Also, if they are not students of the UW or other University or institution that offers light therapy, they are not necessarily allowed access to it.

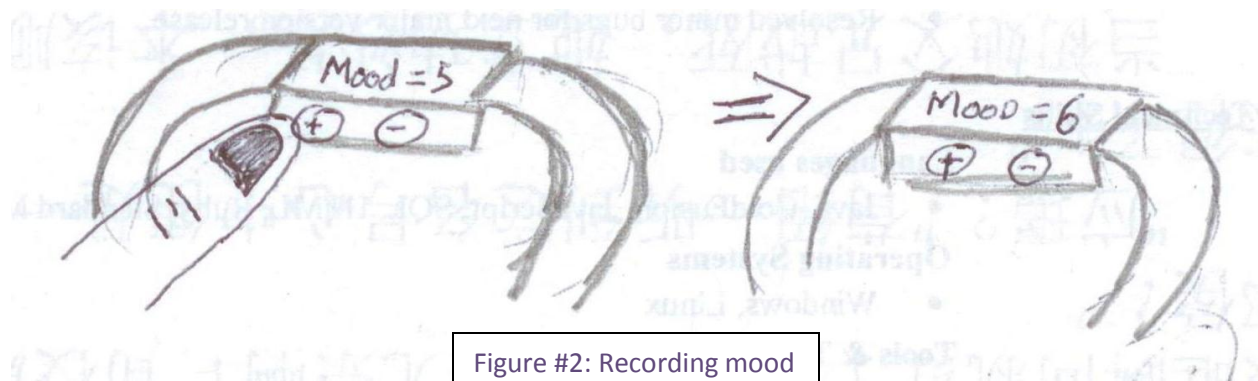
## Design Ideas

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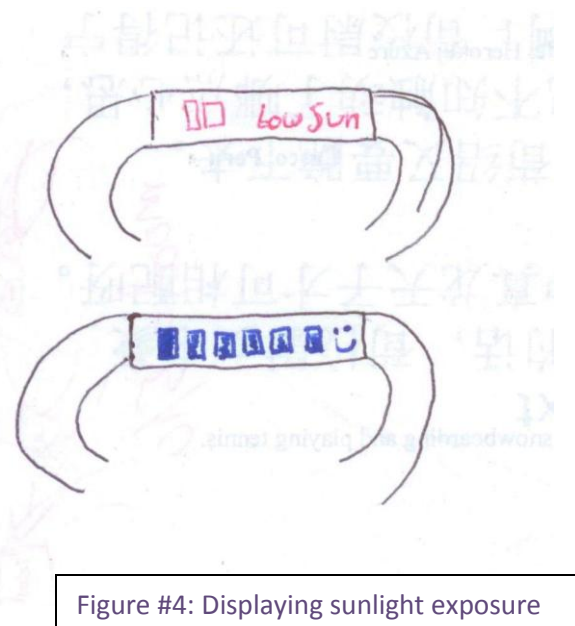
### Design 1: Lux Bracelet



The first design is a watch-like device that has light sensors or mini solar panels and a way for the user to record their mood. To accomplish task 1, the user would wear the watch and the watch will collect data the entire day (figure 1). We decided on a wearable for this design because it would be with the person all day, allowing for more accurate data to be collected. To accomplish mood tracking (task 2) we were thinking of a simple way to indicate someone's mood and a numbering scale was one idea. To track their mood, a user would just enter their mood at certain times during the day (figure 2).



Additional tasks supported by this design would be the reporting of these two tasks in a visual way that would allow for self reflection (task 3) and, hopefully, motivation for the user to seek additional help if needed (task 4) (figure 1). The way for someone to remember to record their mood would be to use a vibration to notify the user at certain times to record (figure 3). Another option is a light exposure meter on the wearable to indicate how much light someone has received and if they have reached their goal for the day (figure 4). This meter provides immediate feedback compared to the analysis of both mood and sunlight throughout the day which will provide a much more detailed report. The goal is to be simple and to focus on just light and mood so that the user can easily understand the data that is displayed to them.



## Design 2: Lux Doctor

For the second design we wanted to focus more on analysis to provide users suggestions on ways to improve their happiness. The primary task supported by this design is finding treatment suggestions (task 4), which is made possible by the user recording their sunlight exposure and their mood. The user is able to log their data from their phone on the amount of sunlight they received and their mood throughout



the day. We were thinking of collecting data by having the user log the amount of time they spent in the sun or having GPS data from a phone track the user's light exposure (task 1) (step 1 of figure 5). Mood would be collected by having the user indicate their mood with their phone (task 2) (step 2 of figure 5). We would have algorithms to analyze the sunlight exposure, mood, and other treatments (task 3) to provide users treatments and suggestions that other users in similar situations found useful (step 3 of figure 5). Options are provided for the user where the user can reject or accept a treatment. If the user rejects, different treatments will be suggested. If the user accepts, more information will be provided on where to look further (step 4 of figure 5).



Figure #5

### Design 3: Lux Puppy

Instead of directly focusing on themselves, a pet robot puppy can act as a unique form encouragement and motivation for the user to go outside and remember to get treatment. This design would primarily support the task of remembering to get treatment while also consuming the data that comes from tasks like: measuring sunlight exposure, recording mood, and recording current treatments. The puppy would follow the user around both indoors and outdoors with a light sensor or solar panel that will activate a timer and record the amount of time the puppy and the user were in the sunlight (task 1) (figure 6).

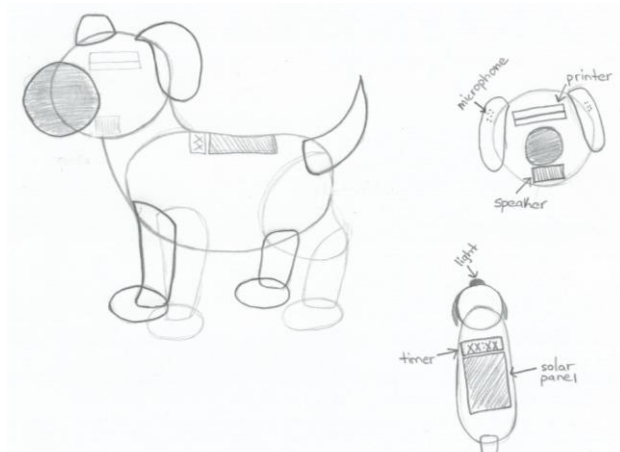


Figure #6: the puppy and sunlight capturing

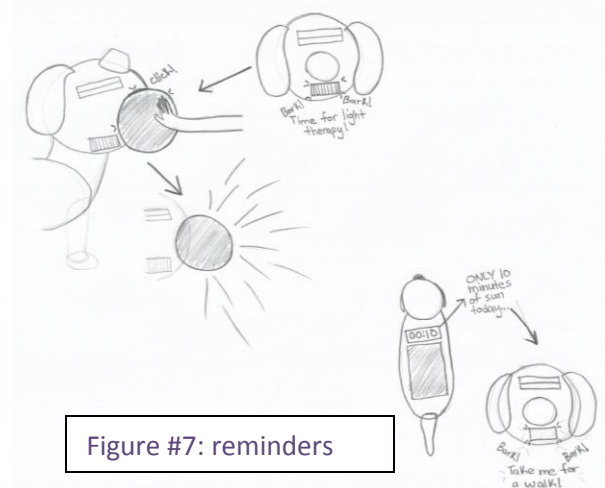


Figure #7: reminders

There are fewer burdens on the user because they do not have to wear anything or keep a log themselves. Using various levels of light exposure, the puppy would also prompt the user to record their mood (task 2) (figure 8). This record would be voice captured which provides a more detailed collection of mood data for potential analysis later. As seen in figure #, the puppy has a speaker and uses barking to remind the user to go outside or get some other treatment (task 5). The puppy can use either a measure of sunlight or a pre-programmed treatment cycle to decide when to bark. To assist the user in receiving light therapy, the puppy has a built in light lamp in order to actually assist the user with more than just a reminder (task 6) (figure 7).

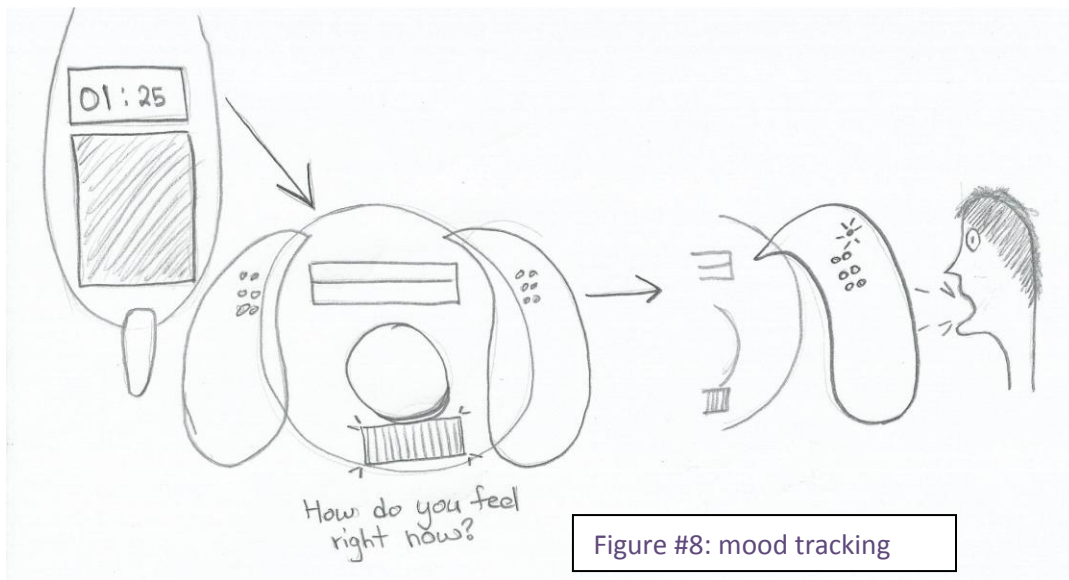


Figure #8: mood tracking

## Selected Design

It came down to deciding between the wearable and the puppy, and we ended up choosing the puppy because of the unique emotional aspect that a wearable cannot provide. We may end up not having an actual robot puppy, but we think that this design and its affiliated tasks allows for the most potential. We

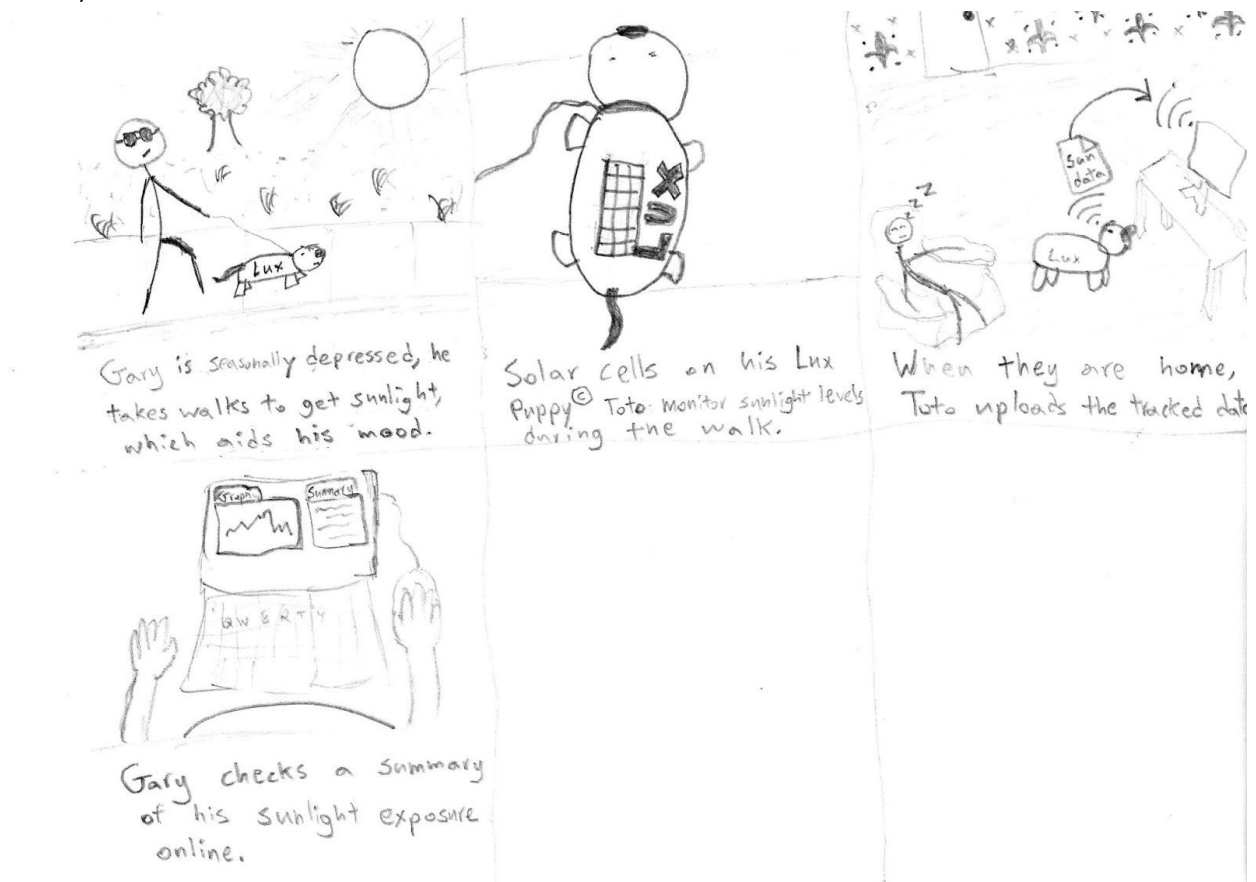
also think that the tasks primarily supported by this design are the most important to the users and most likely to benefit the user if they have a system to assist them.

One of the main issues we discussed while designing was motivating the user. By using this design we can better understand what will keep a user on schedule with treatment. Our research looked into current rudimentary solutions for treating SAD and a common theme among these was a large amount of hassle on the user's end. In addition to streamlining the user experience, the puppy introduces an emotional aspect into the treatment process. A cute bark to signal it is time to go outside or receive light therapy is much more likely to persuade a patient than simply putting it on their mental to-do list.

The two tasks we decided to focus on were remembering to receive treatment and analysis of sunlight exposure. These tasks were more compelling than others because we discovered a large factor in treating SAD is remembering and allocating time for treatment, which is much more difficult than simply taking a pill like many other medical conditions require. Also, an issue that came out of our contextual inquiries was tracking sunlight exposure because it is a difficult area to continuously measure. The other tasks are important in managing SAD, but focusing on these two tasks together will more directly improve the patient's symptoms and provide better feedback.

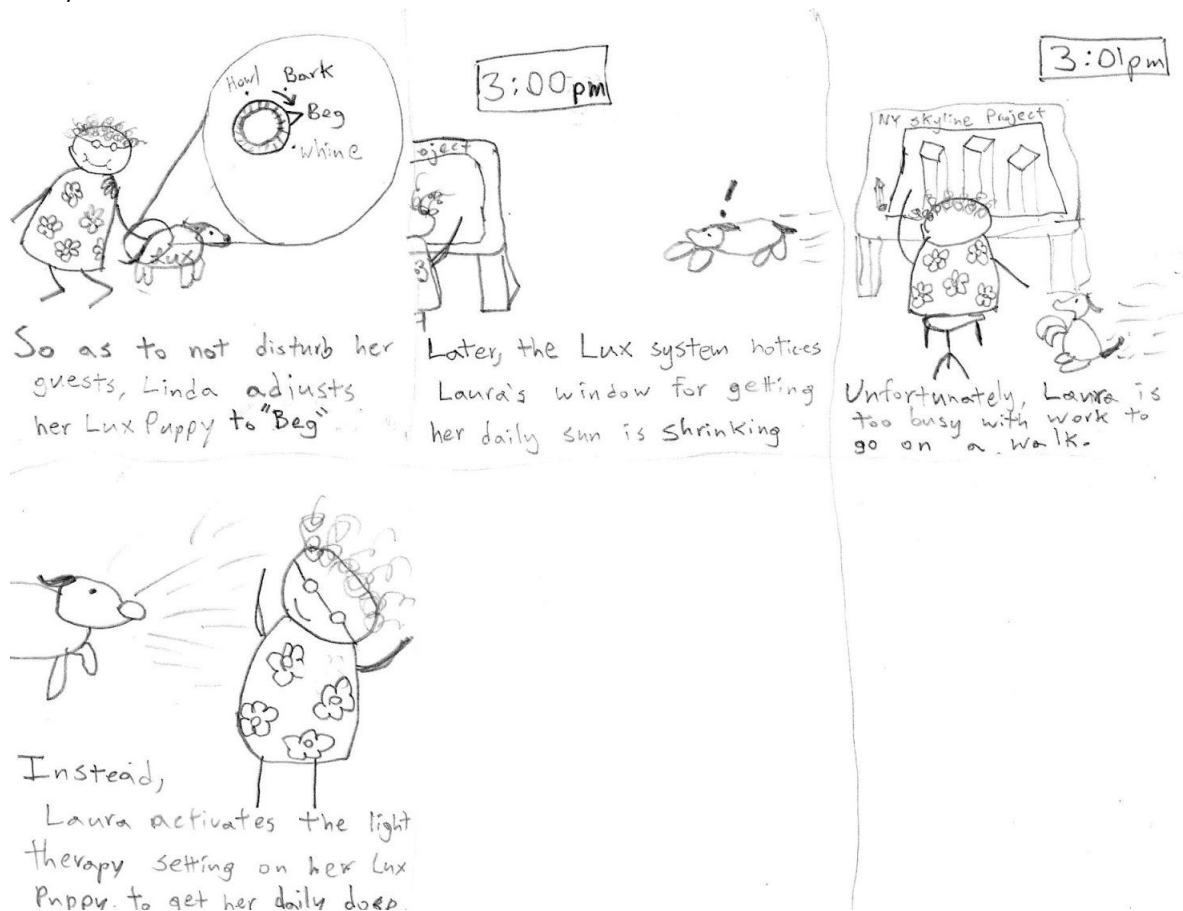
## Storyboards and Scenarios

### Storyboard and Scenario One



Gary has been experiencing symptoms of Seasonal Affective Disorder for several years and has not been able to find a reasonable solution to help him cope. A friend of Gary's has recommended that Gary try to get more sunlight and to keep track of how much sunlight he gets to help him monitor his seasonal symptoms. To aid Gary, his friend refers him to a Lux Puppy distributor. The next sunny day, Gary decides to take a walk outside with his Lux Puppy who he has named Toto. During the walk, Toto's solar cells are activated and the amount of time and quality of sunlight that Gary is getting is recorded. After they have been walking for awhile, Toto's tail begins to wag, indicating that Gary has gotten a good amount of sun today. As Gary returns home, Toto automatically connects to Gary's router's wireless network and uploads the data that was gathered on today's walk. The data is stored in the Lux database for later lookup. Later that week, Gary decides to check his progress and goes online to his Lux account and where he sees visual representations of his sunlight exposure. He clicks the summary tab on the website and sees a concise few sentences about his sunlight experience over the past week. Finally, he clicks the optimization tab, and sees the locations and times where he was able to get the most sun exposure since he began tracking his progress.

## Storyboard and Scenario Two



Linda is an elderly woman who has recently been experiencing sleep issues and a lack of interest in her usual activities. With some of her friends also experiencing similar things while battling depression, Linda becomes concerned that she may not be getting enough sunlight. Linda has trouble remembering to go outside and after many repetitive conversations her daughter finally bought Linda a Lux Puppy as a present. Linda has been with her Lux Puppy for several weeks and today her grandchildren are coming over and she doesn't want her Lux Puppy to bark while the kids are over. She switches the setting on the puppy from bark to beg and identifies a time where she is free to go for a walk. Later in the day, after her grandchildren have left, Linda is doing some work and the Lux system notices that it is getting close to the deadline to go on a walk (since the sun will go down soon). In order to encourage Linda to get her desired sunlight, the puppy tries to get her attention by begging. Unfortunately, Linda is too busy to go on a walk, so she ignores her Lux Puppy and continues working. That night, to make up for missing her daily sunlight, Linda decides to get some light therapy instead. She presses the Lux Puppy's nose and a soft, healing light (such as the light produced by light-boxes) emanates from the puppy.