Team Engineering Empathy

Support System to Destigmatize Mental Health in the Black Community

ENGR 110 - Perspectives in Assistive Technology - Winter 2016

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1. ABSTRACT

Segments of the African-American community are significantly more likely to report severe psychological distress and are significantly less likely to receive treatment [1]. After interviewing 11 people from the community with varying relationships to mental health disorders and working closely with a student with a history of anxiety, we discovered there is a group of people who are willing to make the initial request for help, but are wary of continuing treatment because they are unaware of the outcomes. To address this problem, our team selected a project with the aim of destigmatizing mental health within the African-American community. The main goal of our prototype is to use virtual reality as an educational tool that could be implemented in community centers and counseling offices to destigmatize seeking treatment for anxiety disorders for those in the African-American community who have already made the initial inquiry for help. The virtual reality experience simulates a personal narrative of someone with anxiety and exposes the user to the benefits of therapy while empowering the user to continue seeking help. The user begins by hearing, seeing, and feeling the story of someone having an anxiety attack. Then, the user is guided through a breathing exercise so that they have a better understanding of what to expect in therapy. Finally, the user is given a list of black therapists in the area that they can choose to call, as well as the option to participate in an online community so they do not feel alone.

2. INTRODUCTION

African Americans make up 13.2% of the US population, or about 42 million people [2]. This population, according to the US Department of Health and Human Services: Office of Minority Health, is 20% more likely to report having serious psychological distress [1]. Also, African Americans living below the poverty level, as compared to those over twice the poverty level, are three times more likely to report psychological distress [1]. They are also more likely to experience homelessness and exposure to violence, which are both correlated to increasing the likelihood of developing a mental health disorder [1]. Some of the main psychological

disorders experienced are major depressive disorder, attention deficit hyperactivity disorder, suicide, and PTSD, which is considered a form of anxiety [3]. However, aside from PTSD, anxiety disorders have been historically misdiagnosed as schizophrenia in this community [4]. Today, only 13% of African Americans are seeking help from formal methods, which is 23.9% lower than the national average [4, 5].

Some of the main factors that create this equity gap are:

- Lack of understanding and misinformation about mental health
- Historical and current stigmatization
- Faith, spirituality, and community
- Reluctance and inability to access mental health services
- Medications
- Provider bias and inequity of care

3. OBJECTIVES

Given the lack of awareness and myths surrounding mental health disorders in the African- American community and the reluctance in reaching out for help, our team, Engineering Empathy, seeks to bring about an awareness and a sense of comfort with the treatment options. We also seek to provide a support network that can help the patient navigate the treatment experience to which we expose them. Finally, we seek to bring about empathy in the general public so that they can serve as a support system for the patient, which is especially key in health issue such as these. Our four core objectives may thus be summarized as follows:

- Create awareness about the symptoms of anxiety disorders: The first objective is for the individuals to realize that the symptoms that they are experiencing reflect a health condition that requires medical attention. This helps to avoid reluctance on the part of the individual due to the non-familiarity with the symptoms of the disorder.
- Destigmatizing the treatment options: Often, even when individuals realize that they require help, they are hesitant to see counselors. The second objective thus seeks to

make the individuals more receptive to the various treatment options by familiarizing them with these options and their positive impact.

- Providing a support network: We hope to provide a support network of counselors and individuals with similar experiences to help the individual ask questions or share concerns that he/she might not be able to share with the counselor.
- Sensitization and creating empathy about mental health issues in the African-American community: To ensure that the individual can receive support from other people in the community, the final objective seeks to bring about empathy in community members around these issues.

By addressing these components, we aim to make a concrete difference in the perception of mental health treatment in the African American community. In addition, we aim to encourage people to continue requesting help when they need it.

4. DESIGN CRITERIA

We interviewed 12 community members with varying relationships with mental health disorders:

- A high school counselor
- Two current residence deans at Stanford
- A past Sexual Assault and Relationship Abuse Office crisis counselor
- The Associate Dean of Residential Education at Stanford
- A pediatrician in the emergency room
- An internal medicine doctor at a VA
- Parents of a child with an anxiety disorder
- Someone who experiences depression
- Someone who experiences bipolar disorder
- A therapist specializing in multicultural issues
- Someone with an anxiety disorder

- A student with ambivalent feelings towards therapy

From these interviews, we discovered there was a lack of awareness about the support available and that the symptoms of mental health disorders are common and can be treated. Also, the African-American community is unique in that there is such a large amount of stigma about reaching out for help stemming from both religion and lack of awareness.

We decided that virtual reality would be the best way to approach this problem because there has been plentiful research showing that it is one of the best mediums to raise empathy and awareness. For example, Chris Milk's company VRSE, has collaborated with the UN to develop virtual reality experiences on social issues to develop empathy in world leaders [6]. This is also in line with a study that shows that the more senses that are involved while learning, the better the user is able to remember the experience [7]. Besides the technology being utilized to foster empathy, we also came across virtual reality technology being used as a treatment for several phobias, and analyzed experiences developed by several international companies such as Virtually Better and CleVR [8,9]. Finally, we explored the ongoing research at Stanford's Virtual Human Interaction Lab and toured the lab to better understand the key components of an impactful VR experience, and met with a PhD student who studies avtar development and VR acceptance in communities of color to make sure our prototype would be accepted into the community [10].

Therefore, to be an impactful experience, our virtual reality project includes 3D video, 3D audio, and haptic feedback to incorporate multiple senses so the user would be more likely to remember that the symptoms are common. Afterwards, the user is automatically shown a map of African-American counselors in the area because our interviewees mentioned that having to find therapists on their own was a stressful task. Finally, we facilitate requesting help by allowing the user to optionally participate in an anonymous forum with other African Americans and chat with a 24/7 counselor.

5. METHODS AND BRAINSTORMING

We started the project by brainstorming the most viable channels of technology that could be utilized for our project. The potential ideas included:

- A wearable device that detects physiological symptoms such as increased heart rate and produces a relaxing response.
- Developing an educational training course that could be distributed to and taught within schools and community centers.
- Creating an immersive experience that a user could participate in that exposes them to simulations involving anxiety episodes. **Figure 5.1** shows illustrations of possible wearable devices where tactile sensors would be placed in items such as shoes, watches, and even necklaces.

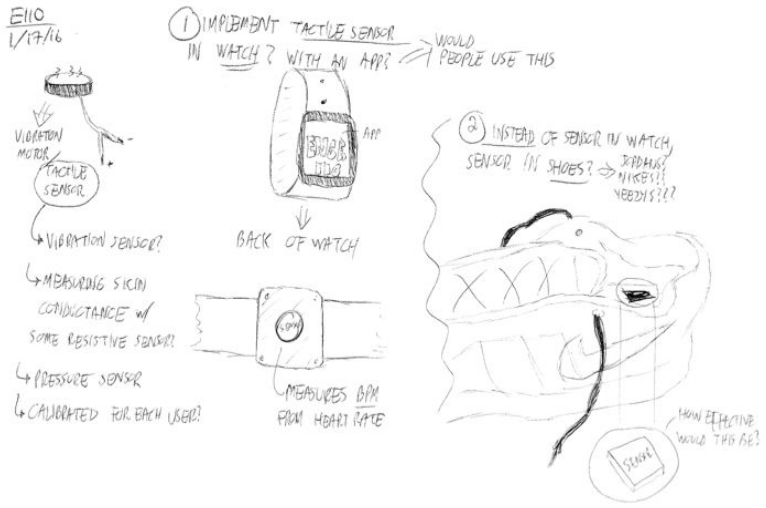


Figure 5.1: Wearable technology brainstormed ideas

A wearable component, initially our favorite idea, had too much risk of basing conclusions of the person's health on false positives. For example, an increased heart rate is a possible symptom of an anxiety attack, but also occurs during an intense physical activity. We only briefly considered the educational course for elementary schools before realizing the difficulty that we would encounter implementing a new educational plan within already

established curriculums. A portable experience such as a collapsible booth where one person fits inside and observes a media display with educational statistics described in **Figure 2** in Appendix A could be brought to local schools, counseling offices, and community centers for anyone in these spaces to utilize. Our team came to the conclusion that for our target audience, building an immersive experience would be the best solution, however, we estimated constructing a space such as a collapsible booth might take more time and money than we would initially presume. A programmed virtual reality experience, however, allows for the user to truly observe what one person with anxiety may experience and this leads directly into our goal of destigmatizing mental health because some users within our target audience would be given the opportunity to have anxiety and its treatment options explained to them in a way that encourages acceptance of the disorder. In addition, this type of prototype eliminates the possibility of measuring physiological false positives while also being less costly for our team.

6. TECHNICAL ASPECTS

The Engineering Empathy experience employs 3D video, 3D audio and haptic feedback, followed by a listing of the counselors near the user, an anonymous forum, and a 24x7 personalized chat to create an immersive, effective and comprehensive experience. Further, our prototype addresses both the mental symptoms of sudden overwhelming fear and a sense of detachment from the world, and the physical symptoms of fast breathing rates, fast heart rates, and trembling [11]. In this section, we discuss the technical considerations of these components.

The 3D video component captures the story of a patient with an anxiety disorder, providing a glimpse of the major physical symptoms, a typical counseling session and the positive impact of the session. The 3D video involves splitting the image in half and placing the two videos slightly off-center w.r.t. each other as seen in **Figure 6.1**. By doing so, we create a visual illusion of the person seeing the situation in the real world. Since the project is targeted at a specific community, we also wanted to ensure that the video represents the community to help the patients and community members better. Therefore, all of the patients and counselors

in the video are African-American. This is also in accordance with our interview observations wherein some people expressed the importance of representation for acceptance of the experience into the community. The 3D audio or binaural audio employs a similar approach, and manipulates the characteristics of sound (such as azimuth and amplitude) to create a real-world experience. We also intersperse it with everyday sounds such as nature sounds to make the experience even more authentic.

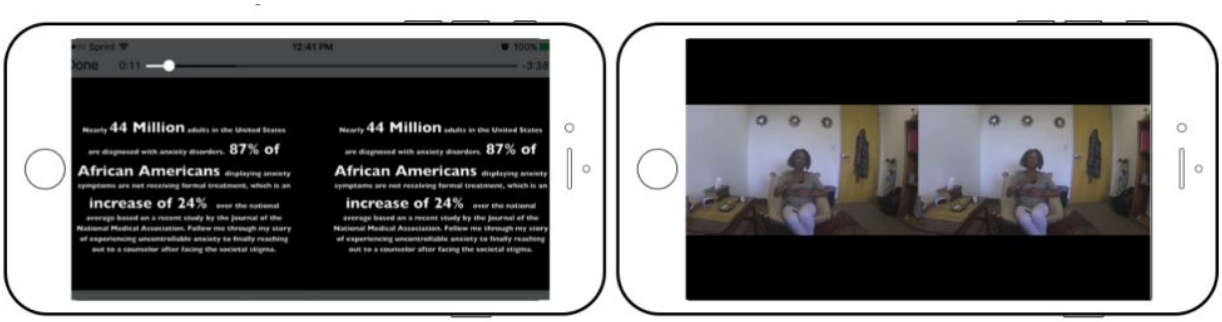


Figure 6.1: Our video displayed on an iPhone

Moreover, we learned from our interviews that it is important to not only address the mental symptoms, but also the physical symptoms. Our team therefore decided to add a tactile element to our virtual reality program. Our initial idea included a vibrating handle that someone undergoing the virtual reality treatment could hold. This idea is illustrated in **Figure 6.2** where the motors would be mounted inside a 5” hollow aluminum tube which would be turned on a lathe. From there, it would be mounted on a 24” PVC pipe with an outer diameter of 1.315”. This pipe would also use an opening to connect the vibration motor wires to an Arduino. The pipe itself could be a part of a larger setup that supports an attached Google Cardboard.

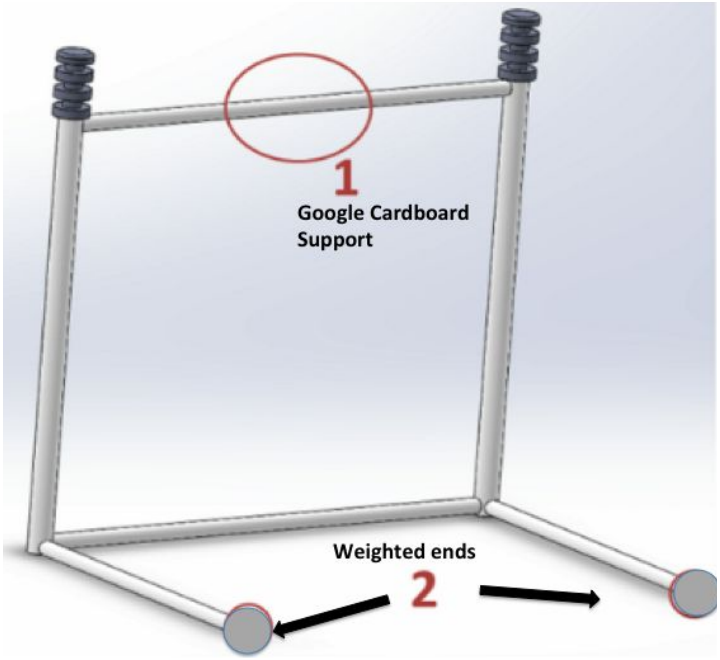


Figure 6.2: Sketch of entire VR system. Weights included to avoid tipping moments.

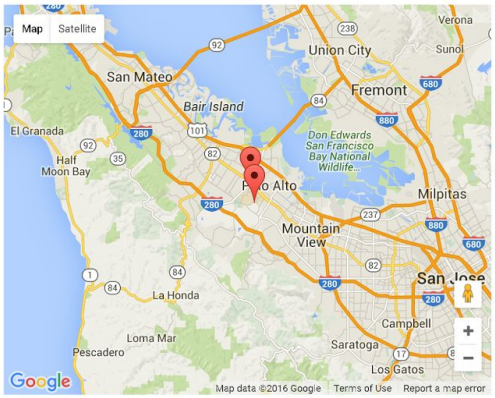
As our team designed this PVC system, however, we were concerned about the accessibility of the setup. A few of our concerns included if someone was not able to grab the aluminum handles firmly or if the height and location of the motors was at an inaccessible or uncomfortable position. After brainstorming more solutions, we decided upon our final tactile element illustrated in **Figure 6.3**. We attached miniature Arduino vibration motors to the insides of adjustable velcro straps so the users' hands would not need to grab anything firmly. The usage of adjustable straps was also important to ensure a stable yet comfortable position for the motor against the user's wrist. To ensure that we capture these physical symptoms as accurately as possible, we are also very deliberate in terms of the timing of these symptoms. As an example, the motors were programmed in sync with the video segments so that body tremors stop after the second round of breathing exercises according to a counselor.

Figure 6.3: CAPS counselor Dr. Walters wearing our vibration motors while using Google Cardboard

The immersive experience ends by connecting the user to black therapists in the area near them using their phone's GPS. This is important because as discussed in our interview, many people do not know where they can reach out for help. We tested a paper prototype of the application, seen in **Figure C1** in Appendix C, with Dr. Meag-gan Walters, a current therapist at Stanford's Counseling and Psychological Services. After she commented that the application should show more specific information about the counselor, we added pertinent information such as specialty and accepted insurance. One of our initial iterations portrayed in **Figure 6.4** uses a web application that integrates with Google maps and displays all necessary information for the user. Our final design is displayed in **Figure 6.5**.

Thank you for completing Engineering Empathy's VR experience! We hope you feel more relaxed and confident now.

To enhance the impact of this experience, we have identified a few counselors near you (refer to the map and the table below). We highly recommend you to share your experiences and concerns with them.



Name	Address	Phone number	Specialization	Insurance
Simon Tan, PsyD	213 Quarry Road, Palo Alto, CA 94304	650-723-6469	tbd	Cardinal Care
Cathy Lee	Vaden Health Center, 866 Campus Drive, Stanford, CA-94305	650-498-2336	TBD	Cardinal Care

Click here to chat with other patients and counselors

Figure 6.4: Second iteration of map of the information of therapists near the user.

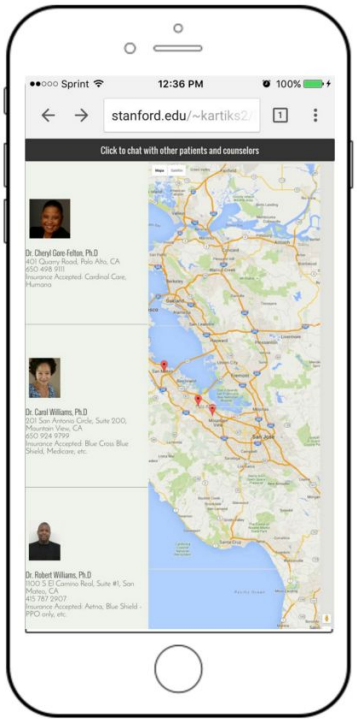


Figure 6.5: Final design of map of “counselors near you”.

Another component of the application is an online forum that connects the user to an online community of people in the area who are also experiencing anxiety disorders if the user

so wishes. After our meeting with Dr. Walters, we discussed that an online community would be extremely helpful because many people feel isolated while experiencing anxiety attacks. We tested a low-fidelity paper prototype of this idea with Dr. Walters as shown in **Figure C2** in Appendix C. We also tested multiple iterations, with one design shown in **Figure 6.6**, in order to finalize the design as shown in figure **Figure 6.7**. To ensure a positive virtual environment, however, these posts are constantly moderated by counselors which not only enables us to provide help to a user who might be posting life-threatening or depressive messages, but also ensure that these feelings do not negatively influence other participants. The online 24x7 chat allows users to get personalized assistance from a dedicated pool of online counselors. Similarly to the virtual reality experience, we ensure that all counselors, both on the "counselors near you" page and the chat, are from the community. By doing so, our hope is that the patients will be able to relate more with these counselors and will be more open about their experience.

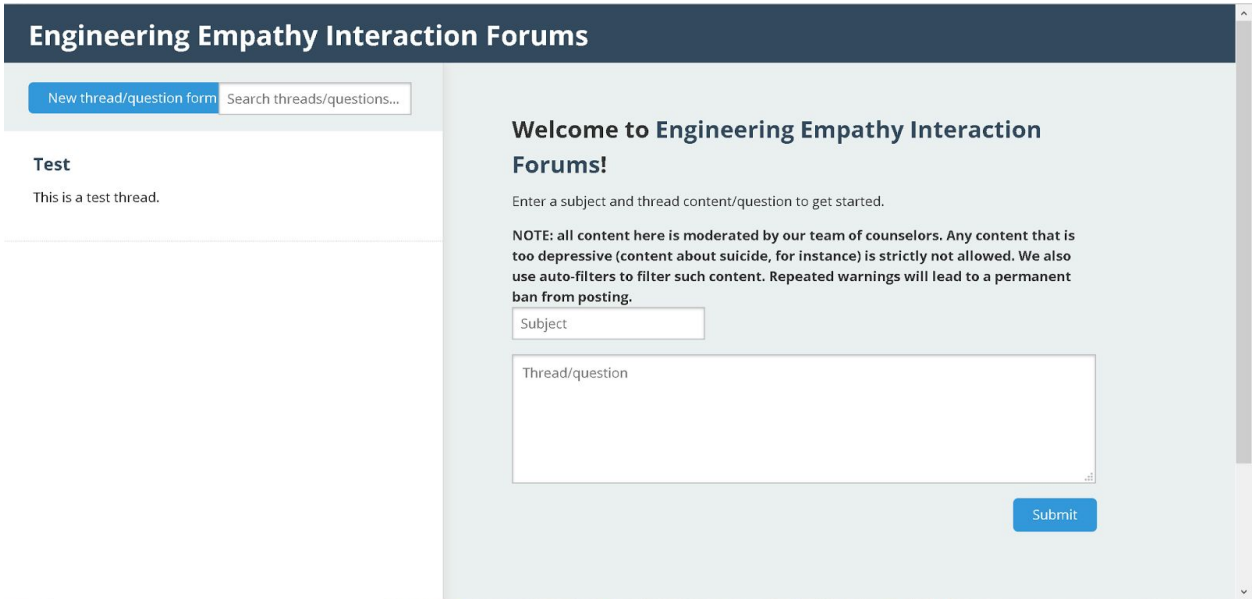


Figure 6.6: Second iteration of forum application.

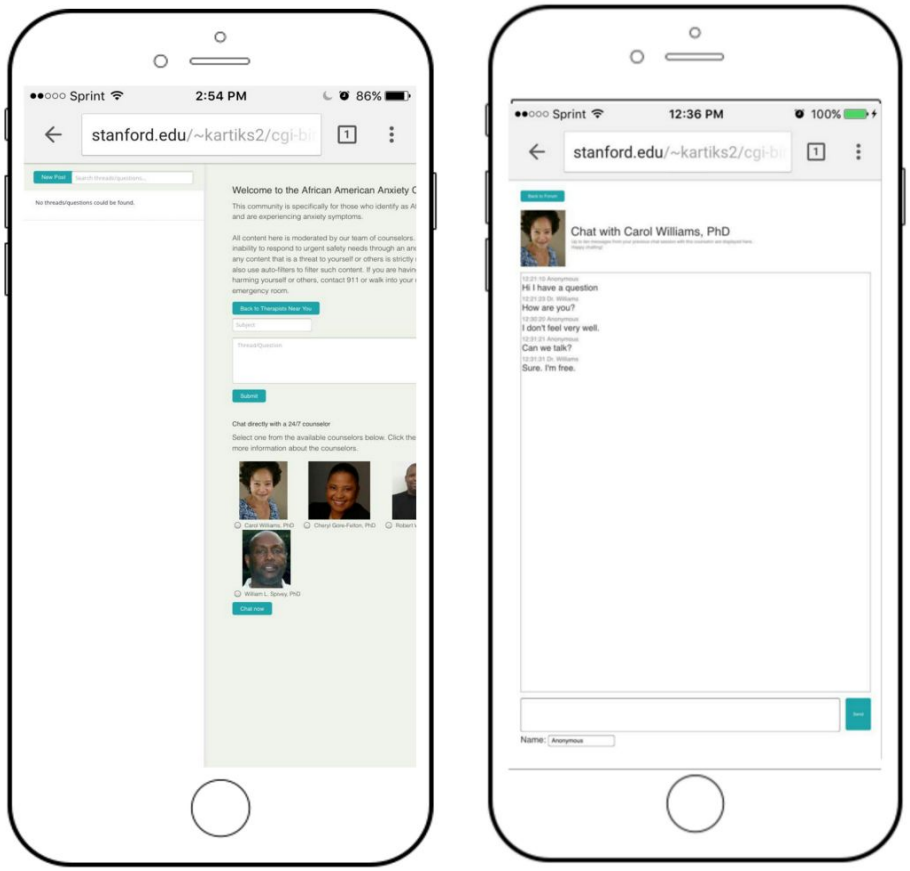


Figure 6.7: Final design of chat and forum application.

7. RESULTS

User Testing and Feedback:

Our team decided on two metrics of success for an effective technology:

1. Approval of our technology by a Black/African-American counselor.
2. Approval from a user who experiences an anxiety disorder/positive feedback from a user with no prior experience of mental disorders who gains some understanding from our product.

Our final prototype is shown in use in **Figure 7.1**. We worked almost weekly with Dr. Walters and a student with an anxiety disorder to continuously build and iterate on the content of our project. Overall, we had 18 different sounds recorded for the 3D audio, about 5 total

movie iterations for the 3D video, and made cosmetic changes to the map and forum about 5 times.

Figure 7.1: Anonymous user testing complete prototype.

To test the effectiveness of our virtual experience, we asked our users to first list what they knew about anxiety disorders and then list what they knew about therapy. After the virtual reality experience and using the forum, we asked the user these same questions. We saw that the user was able to list more characteristics of both therapy and anxiety disorders after using our product.

More generally, users shared positive comments regarding our product:

> Dr Walters stated she, "**liked that the arm vibration ended after the second round of breathing. It felt very accurate,**" and she also "**liked how user friendly the app was.**"
>
> The user with ambivalent feelings toward therapy mentioned they, "**liked how immersive it was...not just that [multiple of his senses] were involved, but also that you are directly brought to a counselor. You are immediately doing something about anxiety.**"

Many of the suggestions were cosmetic. For example, Dr. Walters pointed out that there were no back buttons during one of our iterations. Also, Dr. Walters suggested that there should be pictures next to the 24/7 therapists names so that users could see who they were talking to. The student with ambivalent feelings towards therapy suggested areas where we could improve the experience of the virtual reality to make it seem more realistic as well.

This feedback also lead us to make significant changes to our video several times. For instance, we originally tried to act out what could happen during a potential anxiety attack. However, the user with anxiety said that it did not seem realistic at all and that the message was not clear since anxiety triggers were so personal. Therefore, we did more research on how to effectively convey a personal message, and saw that taking the user through a story where the user did not act out anything and the user just saw scenery was the most effective.

Current Limitations and Future Work:

Since the three main components of our project are the virtual reality experience, the map of African American therapists in the area, and the anonymous forum community, most of the challenges and improvements are specific to these areas. However, we have also identified suggestions that will potentially benefit the overall experience.

- Based on our tour to the Stanford Virtual Human Interaction Lab and our review of similar videos created by Chris Milk's company VRSE, we have created an immersive scale for virtual reality experiences:
    1. Regular TV
    2. 3d TV
    3. 3d TV and surround sound
    4. 3d video w/ goggles/ glasses
    5. 360 video with goggles
    6. 3d video with 3d audio w/ goggles/glasses
    7. **3d video, 3d audio, haptic feedback**
    8. 360 video, 3d audio
    9. **360 video, 3d audio, haptic feedback**
    10. **Graphics immersion -- interaction with environment, 3d audio, haptic feedback**

Here, 1 represents the level of immersion offered by television programs, while 10 represents a completely immersive real-world experience with head tracking (i.e. these are 360º videos that account for head motion as well). Based on a careful analysis of the features in our prototype vis-a-vis professional VR experiences, we have identified our prototype to be at a 7. Getting it to a 10 requires the use of professional VR development tools such as Unreal and more complicated hardware such as Oculus headsets. Unreal is also known to have a steep learning curve, and so we anticipate implementation of head tracking to be a quarter-long project. This is in line with the time devoted to such projects in computer science VR classes at Stanford such as CS210B.

- Currently, the "counselors near you" uses hardcoded data since we did not have access to a database of African American counselors. To make this feature more effective and useful, we would require a search algorithm that not only relies on keywords, but also facial recognition to identify counselors who are African-American. This is a simple computer vision problem and can be integrated with other app-specific technical aspects in this section as a quarter-long CS project.
- We hope to make the haptic feedback wireless to eliminate the need to connect to a computer for enjoying the experience.
- Currently, the chat feature does not offer any authentication services, leading to security considerations, especially given sensitive health issues. Adding authentication services will help keep the data secure, while also allowing us to identify people and provide personalized assistance. However, anonymity is a major factor that helps people feel safe and encourages them to use the forum. This is why we decided to keep our forum anonymous. Going forward, however, this will require more thought, and the pros and cons will need to be carefully analyzed.
- To implement the chat and monitor the forum, we will need to hire counselors or identify volunteers.
- The experience is also likely to benefit from increased collaboration with the student researching virtual reality acceptance in communities of color nationally.

Post-development, we hope to pilot test the experience with a larger number of students, and we hope to collaborate with Stanford Residential Education and Stanford Counseling and Psychological Services (CAPS) to do so.

Safety Considerations and Cost:

Since the VR experience simulates the physical symptoms of an anxiety attack, there is a slight possibility that the experience may induce actual anxiety. To avoid this, we include a warning before the experience, advising participants to remove the Google cardboard if they feel uncomfortable at any time during the experience. However, we think this is a low risk because received content approval from a current counselor. A tradeoff for our project is the user must have a Google Cardboard unit in order to view the virtual reality program.

The total cost for one unit of prototype lies between the range of $50-$55. This number is accounted for by the $25 for a Google Cardboard, $15 for vibration motors not including the shipping cost, and $10 more for wires and alligator clips. Our team already had an Arduino in stock, but if someone were to recreate this prototype without previously owning an Arduino the cost would increase approximately by an extra $20.

8. TIMELINE

April 2016 - June 2016

- One subgroup of the team builds the virtual environment with Unreal Engine
- One subgroup of the team creates the search algorithm to populate a database of counselors in the area
- One subgroup of the team does research on virtual reality acceptance in the African American community nationally

July 2016 - April 2017

- Hiring counselors for the 24/7 chat and forum moderation
- Pilot testing with Stanford residential education and CAPS

9. REFERENCES

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[3] NAMI: National Alliance for Mental Health (n.d.). African American Mental Health. Retrieved from https://www.nami.org/Find-Support/Diverse-Communities/African-Americans

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[6] Milk, C. (n.d.) Bio. Retrieved from http://vrse.works/creators/chris-milk/bio/.

[7] Embodied Learning (2016). SmallLab Learning. Retrieved from http://smallablearning.com/embodied-learning/

[8] Virtually Better, Inc (2014). Anxiety and Exposure Therapy. Retrieved from http://www.virtuallybetter.com/anxietyandexposuretherapy/.

[9] CleVR (n.d.). Highly Interactive Virtual Reality Solutions. Retrieved from http://clevr.net/

[10] Novacic, I. (2015, June 18). How Might Virtual Reality Change the World? Stanford lab Peers Into Future. CBS News. Retrieved from http://www.cbsnews.com/news/how-might-virtual-reality-change-the-world-stanford-lab-peers-into-future/.

[11] Web M.D. (2016). Anxiety and Panic Disorders Health. Retrieved from http://www.webmd.com/anxiety-panic/guide/anxiety-attack-symptoms.

10. ACKNOWLEDGEMENTS

We would like to thank the following individuals who have helped us with our project:

- Dr. Meag-gan Walters - Counseling and Psychological Services Therapist who focuses on multicultural issues, resilience, and identity development and training. She met with us weekly to develop accurate content for the virtual reality experience and ensure the safety of the forum.
- Fran'Cee Brown McClure - current Associate Dean of Stanford Residential Education
- Angela Exson - current Residence Dean at Stanford and past Sexual Assault and Relationship Abuse Office Crisis Counselor
- Carolus Brown - current Residence Dean at Stanford
- Abby - experiences bipolar disorder
- Gina Watkins - current High School/Middle School Counselor
- VA doctor and parent of child with an anxiety disorder who wishes to remain anonymous
- Person who experiences depression, pediatric ER doctor, and parent of a child with an anxiety disorder who wishes to remain anonymous
- Student who experiences an anxiety disorder who wishes to remain anonymous
- Student with ambivalent feelings towards therapy who wishes to remain anonymous
- The Stanford Virtual Reality lab for giving us a tour and showing us the key components of virtual reality
- Kareem Edouard - a PhD student who specifically studies avatar acceptance in minority communities who provided us with insight on the key components of virtual reality targetted at people of color

11. APPENDICES

Appendix A: Web Application Links

- Live Web Application: http://stanford.edu/~kartiks2/EngineeringEmpathy/
    - NOTE: This web application is meant to only be viewed on a mobile device. The formatting is not standardized for a computer, so it will not render properly.
- Github Link For Web Application Code: https://github.com/sawhney-kartik/e210-EngineeringEmpathy.git

Appendix B: Brainstorming Sketches

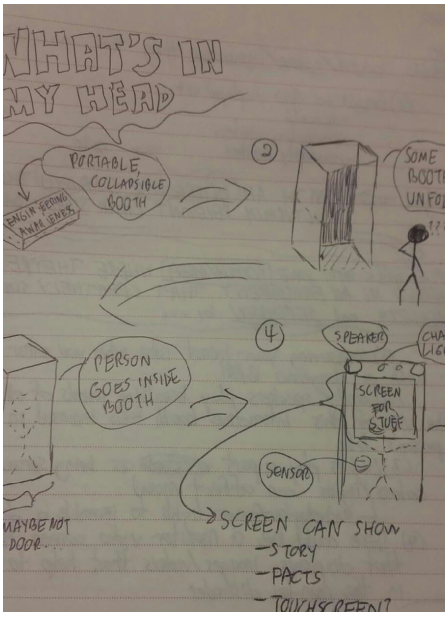

Figure B1: A portable immersive experience where someone enters a booth and is exposed to media regarding anxiety.

Appendix C: Low-Fidelity Software Prototypes

Figure C1: Low-Fi Prototype of map of "counselors near you."

Figure C2: Lo-Fi Prototype of online forum.

Appendix D: Vendor Information

[1] **Google Cardboard**

Unofficial Cardboard. Retrieved from http://www.unofficialcardboard.com/

[2] **Vibrating Mini Motor Disc**

Adafruit Industries. Retrieved from https://www.adafruit.com/product/1201

[3] **Velcro Wristbands**

Retrieved from ACE Hardware (875 Alma St, Palo Alto, CA 94301)

[4] **Alligator Clips and Wires**

Fry's Electronics (340 Portage Ave, Palo Alto, CA 94306)

Appendix E: Arduino Code

```
int motorPin = 3;
int mPin = 10;
```

```
void setup()
{
  pinMode(motorPin, OUTPUT);
  pinMode(mPin, OUTPUT);
  digitalWrite(motorPin, HIGH);
  digitalWrite(mPin, HIGH);
  delay(10);
  digitalWrite(motorPin, LOW);
  digitalWrite(mPin, LOW);
  delay(76000);
  digitalWrite(motorPin, HIGH);
  digitalWrite(mPin, HIGH);
  delay(101000);
  digitalWrite(motorPin, LOW);
  digitalWrite(mPin, LOW);
  delay(100);
}

void loop()
{
}
```

Appendix F: CAD Models

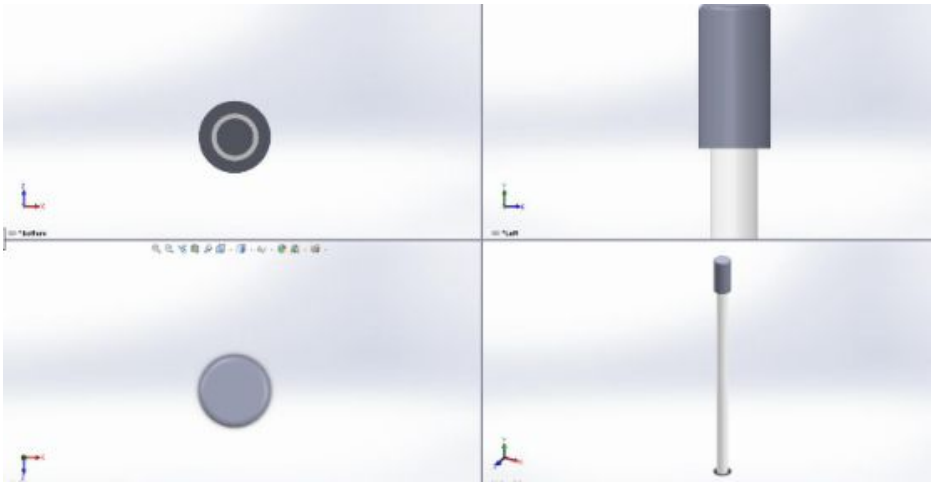

Figure F1: Initial CAD designs for one vibration motor PVC stand handle

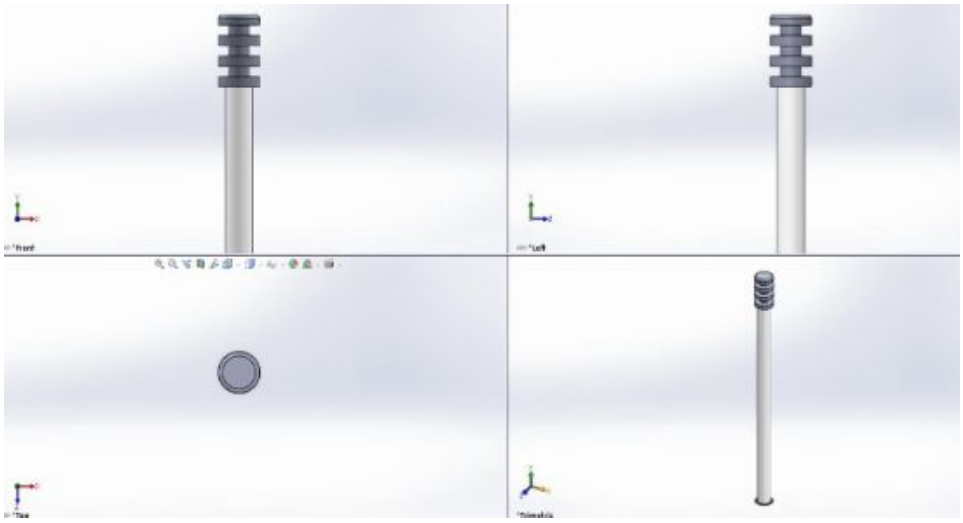

Figure F2: Improved vibration handle design with grooves for fingers