FLIPPED

An Interactive Installation Working as Social Catalyst for Social Anxiety Disorder Students

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Abstract. This research attempts to use an architectural design approach to increase the opportunities to participate in social activities and the chances to establish friendship for social anxiety disorder students. By analyzing the cause and treatment of social anxiety disorder, we propose an entertaining, therapeutic interactive installation named Flipped which working as a social catalyst for social anxiety disorder students. In order to build the installation space intelligent and friendly, a variety of advanced technologies have been embedded into the design. The paper will detail the development of the design concept, the technical implementation of the construction, and the problems encountered during the experience activities.

Keywords. Interactive Installation; Social Anxiety Disorder; Therapeutic Interactive Environment; Social Catalyst.

1. Background
Nowadays, anxiety is one of the most common mental illness in the world. According to Collegiate Mental Health report in 2017, anxiety and depression are the top reasons that college students seek counseling, and nearly 1 in 5 university students are affected with anxiety or depression. Among all the anxiety disorders, social anxiety disorder (SAD) is the most rapidly developing disease with the most significant number of patients during the past several years. The students with SAD are more likely to develop into subsequent depression illness, and it has present a highly positive correlation with dropping out of school early (M. Stein & D. Stein, 2008).

With social anxiety disorder problem, students are very reluctant to meet new friends and avoiding face-to-face communication. Although with the fast developing of the Internet, online communication acts like the effective medicine for the illness and college students reported that they would like to use the Internet...
to meet people because they found it could reduce their anxiety about social interaction (D. Knox, V. Daniels, L. Sturdivant, & M. Zusman, 2001). However, the high dependence on the Internet may be counterproductive to SAD. A research shown that excessive Internet use will trigger psychological problems and the problematic Internet use is significantly correlated with levels of SAD (H. Odaci & M. Kalkan, 2010).

In this situation, we are wondering, as architects, how can we help the SAD students? What kind of space can we provide to relieve their anxiety conditions and to stimulate them to talk to others for achieving friendship?

2. Related Works

2.1. THERAPEUTIC INTERACTIVE ENVIRONMENT

By providing an immersive environment, the appearance of the architectural space could efficiently affect the psychological changes of the users. With multiple cutting-edge technologies, such as interactive technology, Virtual Reality, Mix Reality, etc., have been frequently adopted into architectural space design, the nature of architecture shift, ranging from pragmatic to therapeutic to provocative (L. Urquhart, H. Schnadelbach & N. Jager, 2018). Fruitful environmental space design projects with healing effects born and appeared in people’s field of vision.

MEDIATE, an interactive environment which generates real-time visual, aural and vibrotactile stimuli, designed for promoting creativity, exploration, and enjoyment in low functioning autistic children who have no verbal communication (N. Parés, A. Carreras, et al., 2005). Hooo, an interactive environment project which designed for helping people to decrease stressfulness when they are waiting in the hospital, by alternating their focus on the relationship between the interactive moving tentacles and their breathing rate (A. Halim, C. Liu & E. Siu, 2011). ScreenPlay, an interactive media display located in the healthcare waiting spaces (E. Buddiss, A. Mcpherson, et al., 2013). By providing an accessible, positive, engaging experience for children and adults, it could improve the patients’ waiting experience and reduce their anxiety, which could potentially lead to positive health outcomes.

For the SAD patients, the immersive environment with interactive technology is beneficial for relieving their anxiety condition. It has already been proved that Virtual Reality technologies are profoundly usefulness for treating SAD individuals’ fear of public speaking than the traditional standard methods (E. Klinger, S. Bouchard, et al., 2005). Also, by pre-rehearsing in front of the positive and static virtual audiences, the patients can effectively alleviate their anxiety when facing real audiences (D. Pertaub, M. Slater, C. Barker, 2002).

2.2. SOCIAL CATALYST

In the book City: Rediscovering the Center, William H. Whyte stated a great place should act as social catalyst, which means “This is the process by which some external stimulus provides a linkage between people and prompts strangers to talk to each other as if they were not” (W. H. Whyte, 1988).
According to the previous studies, numerous approaches could be considered as a social catalyst to help individuals to talk to each other and achieve friendship. The interactive installations with information display functions are commonly playing as a social catalyst role in the public space. Through the use of a kinetic sculpture, the *Carousel space*, designed by Kyratso Karahalios, bridged together the sensory experience from two spaces, encouraged people from different spaces interactive and communicate with each other (K. Karahalios, 2004). Meanwhile, the uncertain state of surrounding dynamic conditions is also conducive to the generation of social activities. *Blender*, *Heads Up of The Table* and *Social Whirls* are part of a series of art installations designed by Robb Mitchell. Via presenting participants with a shared dynamic physical obstacle, the installations encouraged the participants to foster positive face-to-face interactions between strangers who may not otherwise interact (R. Mitchell, 2009). Moreover, tracing back to history, the game has always been an effective way to motivate social activities. *Capture the Comets* is an interactive tabletop game designed by Huong Thu Nguyen. By adopting multiple interactive technologies and the Icebreaker games playing rules, the game aims to not only attractive and entertaining for players but also encourage users to communicate and interact with each other (H. T. Nguyen, 2006).

As the research conducted by John S Gero, the interactive activities between different individuals could positively change people’s mind, feeling, and emotions. For the SAD patients, encouraging and attracting them to be engaged in social activities smoothly, could effectively mitigate their anxiety issues.

### 3. Design Concept of Flipped

Since we are pursuing social activities and friendship for SAD students, there is a necessity to understand the friendship development process. In the process of the development of interpersonal relationships, individuals would go through five stages: Stranger, Acquaintance, Casual Friend, Close Friend, and Intimate Friend. During the Stranger stage, people always lack awareness of another’s existence, and if they noticed the other individual and started to have occasional interactions with this person, the relationship would upgrade to Acquaintance level. The difference between Casual Friend and Acquaintance is that the interactions between casual friends are intentionally planned. Commonly, people would be effortlessly to evolve the interpersonal relationship with strangers into the third level. However, the SAD patients are always stuck in the first two.

Based on the present studies, the scarcity of self-confidence and (G. Butler, 2009 & B. Montagne, et al., 2006) the reduced sensitivity of people’s negative emotions (B. Montagne, S. Schutters, H.G.M. Westenberg, 2006) are two critical traits of SAD. Encouraging them, helping them to build their confidence, and achieving them participatory feelings are several effective approaches to treat SAD. In this scenario, we proposed an interactive installation named Flipped to provide a place that is conducive to foster social activities and contributive to develop the friendship for the SAD students. The primary task of the installation is to help the SAD students overcome psychological barriers and create opportunities for them to progress the interpersonal relationship to the third level.
To realize the design concept, we divided the whole process into two phases, from strangers to acquaintances and from acquaintances to friends.

3.1. PHASE ONE: FROM STRANGERS TO ACQUAINTANCES

The main problems of SAD students in phase one are the inadequacy opportunities to meet potential friends and the deficiency in self-confidence. In order to increase the chances for the SAD patient to encounter with other people, the design concept of the installation developed based on the “attraction-encouragement” principle. Attraction principle means to attract passers to join into the installation space and extend their stay duration by multiple means for providing SAD students enough potential friend candidates and sufficient communication time. Encouragement principle aims to help SAD patients to build confidence gradually and generate motivation to communicate with strangers.

3.1.1. Attraction

For the principle of Attraction, the installation be designed as a system consisting of two parts, one part is a space with kinetic art, and the other is an information visualization projection game. As already mentioned above, a game-like tangible interactive and constantly dynamic space could be working as a social catalyst, which has a better possibility to attract passers. The two parts are placed separately, about five meters apart. The suitable size space between two parts allows the players on both sides to be undisturbed; however, they can still observe the players’ behavior from the other side.

The kinetic art space is a 2.4m(W),2.4m(L),3.0m(H) C-shaped semi-enclosed space. An interactive artwork composes of eight fish-like shape components is placed on the vertical walls of the space. Each component is whirling around a certain point at a variable speed which determined by the individuals’ behavior or the physical information of the surrounding environment, such as individuals’ position, individuals’ emotion, environment temperature, light intensity, sound intensity, etc.. Individuals could interact with the wall by waving, exhaling, yelling, smiling, gathering, etc. to change the whirling speeds of the components. Besides, since we expect to increase the viscosity of space and extend the social activities duration in the art space, a telescopically adjustable bench has been embedded in the wall. If the individuals in the space present negative emotions such as exhaustion and depression, the bench will slide out from the wall, providing a place for people to sit.

The projection game is a sand painting-like game which displayed on a giant screen. The appearance of the sand painting is determined by the player’s limb movements, position, sound, and the surrounding environment information. For example, the player can determine the falling point of the sand by changing the position of the right hand, and control the color of the sand by the frequency of the sound and so on. Sand painting work usually earns a relatively long duration, which plays an indispensable role in increasing the viscosity and the popularity of the space.

Besides attracting people through the installation appearance and the content of
the game, face recognition and speech recognition technologies is also embedded in the installation. When the installation finds that someone tends to approach, it will actively invite the passers-by to enter the space.

3.1.2. Encouragement

For the principle of Encouragement, the installation was designed as a sweet-talk robot. It could choose and play diversity delightful praise words from time to time based on the patient’s figure characteristics, such as you are adorable, your eyes are beautiful and so on. By constantly expressing the friendly attitude to the patients, the patients would achieve psychologically satisfied and gradually raising their self-confidence. Also, with the memory ability, the installation could remember the individuals and take the initiative to communicate with them, making them feel concerned and beloved.

Besides, in order to increase the encounter opportunities, the installation be installed recommendation functions. Several different kinds of persuasions were installed into the installation, such as “the girl over there looks so good, you should go to say hello”, or “the girl who played the projection game has been there for quite a long time, why don’t you join the game”, and so on. Meantime, the fish-like shape components would rotate to a specific angle position, combing a heart-like shape, while the sand painting-like game would disappear spontaneously, inducing the players to transfer the focus on the on-going social activities. Since for most situations, patients are reluctant to meet new people because they have no motivation or help. Through the installation’s reminder to the patients, it can promote the patients to break through the psychological barrier and move forward to the social activities. Even if the patients refused to talk to the target person, they still can quietly and stealthily interactive with the target person via installation, since the data collected by the sensors from the kinetic art space would be shared with the projection game. The person interacting with kinetic art space simultaneously influenced the game content more or less, and vice versa, thereby Flipped could be considered as an interactive social medium for two players.

3.2. PHASE TWO: FROM ACQUAINTANCES TO FRIENDS

During this phase, the main problem of SAD patients is that they have difficulties to get the real thoughts of other people since they have the reduced sensitivity of people’s negative emotions. To solve this problem, we tried three methods that
may give impetus to friendship development.

Firstly, a smart chat robot was embedded into the installation with the expanded conversation library. The chat robot can imitate different voice characters such as men, women, children, aged and so on, thereby helping the patients to rehearse the hypothetical conversation before communicating with the target friend. Though the adequate preparation of the upcoming conversation, it would enhance their confidence in expected communication.

Secondly, we use emotion recognition technology to extract the emotional state of the individuals and augment the emotion condition by changing the color of lights. According to color psychology, different environmental colors will bring different psychological feelings to people. In this project, we selected three different light colors to guide individuals subconscious perceptions. For example, when people show positive emotions such as happy and surprise, the lights turn to pink to evoke people’s feeling of warm and caring; when people show aggressive emotions such as anger and disgust, the lights turn blue to help people calm down and ease tension; and when people show negative emotions such as depression and sadness, the lights turn green to guide people to feel the vitality and activity. By this way, the patients could not only experience the emotional adjustment unconsciously but also understand the emotional changes of their friends quickly and confidently. Thus the SAD students may avoid the embarrassment and the confusion that may occur during social interactions.

Thirdly, with face recognition technology, the installation once detected there are friends in the field which we defined as two individuals spontaneously appear into the installation space with positive emotions more than twice or present heart-like gestures, it would build atmosphere by changing the lights to pink and presenting a heart-like figure on the wall. The public confirmation of the friendship is conducive to enhance patients willingness to communicate with others.

Via the above three approaches, we believe the installation could create an interactive therapeutic environment which contributes to the SAD students’ self-confidence establishment and the sensitivity improvement and benefit to patients friendship evolution.

4. Technical Implementations

In order to achieve the numerous effects and functions which mentioned above, diversity techniques were adopted into the installation. As the installation composed by interactive kinetic art system and interactive projection system, we would like to detail the technical implementations of two parts separately for explaining the entire interactive system more clearly.

4.1. INTERACTIVE KINETIC ART SYSTEM

The interactive kinetic art system is a relatively complex system that most SAD treatment-related functions completed within it. Due to the limited information processing capability and insufficiently available pins of one processor, we had to divide the system into four subsystems, the human behavior recognition system, the interactive art system, the interactive light system, and the interactive bench
system. Via Bluetooth module, these four subsystems could share information instantly and efficiently while they interact with the individuals independently.

The main task of the human behavior recognition system is to analysis and infer people’s feelings and intentions. Within this subsystem, we selected the camera and microphone as the system sensors, Raspberry Pi as the processor, a pair of speakers as the actuators and the Python as the implementation coding language. The camera takes the pictures of the space every tenth of a second, and the microphone records the environmental sound up to ten seconds one time when the sound intensity constantly beyond 200. By collecting the image and voice data through camera and microphone separately and instantly, the Raspberry Pi uploads the latest data to the cloud server every tenth of a second, to calculated the players’ positions, emotions, gestures, questions, conversations, moods, and intentions spontaneously and automatically by face recognition, voice recognition and natural language processing technologies applications. However, in this system, the installation only performs face recognition and emotion recognition on the top five faces according to the faces size, and only talk to the person who is closest to the camera. The installation would ask the closest person several personal questions such as name, hobby, etc., then record this person’s information and related conversations into the players’ information library if the person is a stranger. However, if the player already in the library, the installation would chat with him/her based on the previous conversation keywords. During the communication process, we introduced a random parameter into the system to occasionally generate some praise and encouragement based on the player’s appearance scores and hobby records; and the system would randomly propose some suggestions which may prompt social activities from the corpus based on the players’ gender and emotions.

For the interactive art subsystem, we adopted several different kind of sensors, such as an ultrasonic distance sensor, a temperature sensor, a humidity sensor, a light intensity sensor, and a pair of sound frequency sensors (using for separating different sound frequencies of the environment in order to solve the environmental noise problem). All the sensors are connected to an Arduino Mega, and each sensor corresponds to a fish-shaped component. The magnitude of the sensor directly affects the fish-shaped component rotating speed which controlled by a series of stepper motors. Due to the limited available pins and calculate abilities of one Arduino Mega, we employed four Arduino Uno boards as the signal conversion boards to drive eight stepper motors separately in parallel. The whirling components help people to intuitively understand the physical information of the surrounding environment which SAD patients usually insensitive with and enable the individuals to interact with the installation directly and straightforwardly. Besides these six tangible sensors, we also utilize the human density and surrounding happiness value as the parameters to control the revolving speed of the rest two fish-like components (eight in total). By recording and counting the quantities of moving steps, the stepper motors can stop the movement of the fish-like components at any angular positions, thereby ensuring the fish-like components could be pointed to precise angular positions, to combine a heart-like pattern when there is a need to create atmosphere.
The primary function of the interactive light system is to provide a suitable light environment for various social activities in the space based on color psychology. The interactive light system borrowed the camera from human behavior recognition system as the sensor and controlled the light color changing by an Arduino Uno. The Arduino Uno analysis the emotions and the behaviors information which recieved from the Raspberry Pi via Bluetooth module, and choose the suitable color for the environment, then send the RGB signals to LED light driver to change the light color.

The interactive bench system works in a relatively simple way. It consists of an infrared distance sensor, an Arduino Uno board, and a retractable bench which driven by a stepper motor. As long as detected someone needs to rest according to face recognition and voice recognition results, the Raspberry Pi would send signals to the Audio Uno in the interactive bench system, and the bench would be stretch to the most extended status if the infrared distance sensor reported that the safety of the bench’s movement had been guaranteed.

![Figure 2. The Construction and Hardware Implementations of Flipped.](image)

4.2. INTERACTIVE PROJECTION SYSTEM

For the interactive game design, we picked Processing as the software platform. Kinect had been chosen as the primary player motion capture sensor to accurately acquire the information of player’s position, posture, and emotion. Other sensors included temperature, humidity, light, and sound intensity sensors. A computer connected with Kinect and an Arduino Mega connected with the rest sensors were selected as the control processors for the system.

Through the multiple sensors, we gained the environmental and behavioral information data continually which could help us to analyze and comprehend the players’ behavior pattern. At the same time, the data from the interactive kinetic art system could be also transferred and received by the interactive projection system via the Bluetooth module. The Arduino Mega would compare and analyze the data from both systems, and send the filtered data to the computer, which upload them to Processing as the parameters for the sand painting-like game. In order to let people intuitively interactive with the game, a giant display screen connected to the computer has been used as the visual interface.

5. Evaluation

The installation was exhibited in the hall of the architecture school for a week. During the exhibition, we used two video cameras to record the individuals’
behavior in the installation space. According to video records, we found that the installation had presented an impressive effect on attracting passers-by. Most of the passers-by showed curiosity to the installation, and nearly about one-seventh of them stepped into the installation space. The average of passers-by stay duration is almost one minute as the range is from three seconds to six minutes.

Among these players, a remarkable number of individuals are surprised by the communication and interaction abilities of the installation. “It is so interesting and thoughtful, and it really can get my mood.” A senior student who claimed with SAD problem commented. “The color changing light system is very delightful, and I like to play sand painting game with other people, but I still feel nervous to talk to them.” another freshman SAD student stated. Although the function of recommending friend is not influential enough, however, we found that the SAD students did not exclude discussing the installation with strangers and the installation does increase the opportunities for people to communicate.

Through the observation, a clustering effect has been revealed that people are more likely to step into the installation space when there is already someone playing with the installation. So theoretically, if we improved the stay duration of the SAD students, the opportunities of social activities and the odds of successful friendship would also be increased simultaneously.

6. Contribution and Conclusion

In this paper, we introduce an installation design which aims to increase the social activities for the social anxiety disorder students. Different from the other interactive installations which are always in a reactive position, and Flipped acts as a role that actively guides people to interact. By embracing multiple cutting-edge technologies, the installation develops into a sensitive and therapeutic social catalyst space. Meanwhile, the interactive system of the installation may transplant into the others architecture interior design, fostering an intellectual environment for the psychological problem populations.

In the implementation process of the installation, we have encountered and solved various problems as follows:

- Delayed feedback can result in reduced viscosity of the installation. Because we use artificial intelligence applications from the cloud server to realize the automatically analysis of people’s behavior, the speed of network vitally determines the performance of the installation. To improve the response speed of the installation, we have adopted a multi-threaded approach to replace the traditional single-threaded mode. By uploading multiple requirements to the cloud servers synchronously, we successfully tripled the feedback speed.

- When people interact with the installation, the active behavior of the installation may decrease people’s feeling of control, which may also weaken people’s confidence. However, as a therapeutic interactive environment space, actively guidance plays an essential role in the treatment. To solve this paradoxical problem, we need to balance the proportion of interactive and responsive behaviors of the installation. Also, when we proposed active gestures, an explanation, especially a verbal one, was proved helpful to improve the individual’s experience.
Compared to participating in the interactive process, people prefer to stand by and watch other people interacting with the installation. The feeling of strangeness and exclusion to the emerging technological products is the main reason why people are reluctant to step into the installation space. Through observation, we found that people’s willingness to participate in the installation is inversely proportional to the age, which reminds us that we should choose appropriate complexity interactive technologies according to the age of the target population in the future installation design.

Acknowledgement
Special thanks to all participants in the research of this project. Project supported by the State Key Program of National Natural Science of China (Grant No. 51538006) and Tsinghua University(School of Architecture)-Zoina Land Joint Research Center for Digital Architecture.

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