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CLC Number UDC Available for reference □Yes □No Undergraduate Thesis Thesis Title: Design of Digital Art Installation Based on Human Biological Signal Student Name: Student ID: Department: Program: Thesis Advisor: Diyun Lu 12011537 Computer Science and Engineering Intelligence Science and Technology Associate Professor Yuxin Ma Date: June 7, 2024 COMMITMENT OF HONESTY 1. I solemnly promise that the paper presented comes from my independent research work under my supervisor's supervision. All statistics and images are real and reliable. 2. Except for the annotated reference, the paper contents no other published work or achievement by person or group. All people making important contributions to the study of the paper have been indicated clearly in the paper. 3. I promise that I did not plagiarize other people's research achievement or forge related data in the process of designing topic and research content. 4. If there is violation of any intellectual property right, I will take legal responsibility myself. Signature: Date: June 7, 2024 Design of Digital Art Installation Based on Human Biological Signal [ABSTRACT]: Through the analysis of quantifiable bio-signal data, abstract emotions can be translated into visual representations. This interactive installa- tion engages audiences' real-time biology data like facial expressions and heart rate to display their emotional state, aiming to raise the question of the exis- tence of self-recognition. Within the mirror's reflection, emotions are depicted as tangible entities surrounding users, despite their intangible nature. The dis- tance created by the mirror and the designed display of emotion helps to con- struct the understanding of the psychological self and emotions. Through the interaction between humans and the mirror as well as the visual stimuli in the mirror, users are invited to explore the complexities of their inner emotional feelings and the nature of self-awareness. This work explores the potential of leveraging technology to bridge the gap between abstract emotions and tangible visual representations, fostering a deeper understanding of the human psyche and the concept of self. [Key words]: Affective Design, Emotion Recognition, Visualization I [摘要]：抽象的情绪可以通过建立与可被量化的生物信号数据之间的联系，而被转化为具体的视觉表现形式。本文中的互动装置利用用户的实时生物数据，如面部心情和心率，来展示实时的情绪状态。情绪作为认知的一部分，该作品通过镜子对情绪的可视化，意图引发用户对自我认知的思考。尽管情绪本身是不可触摸、无形的，但在镜子的反射中，情绪被描绘为具体的图像，环绕用户的人像。镜子中的"我"是被情绪环绕但却无法真正被触碰、被抓取的。镜子构造的物理距离本质上是对感知心理自我的存在的提问。这样在镜中世界的互动以及情绪本身的可视化设计带来的视觉刺激，邀请参与者在这个过程中探索内在情感感受的复杂性以及自我认知的本质。本文的装置作品探索了如何利用技术去架起抽象情绪和具体视觉表现之间的桥梁，引发作品使用者的思考，促进对心理认知和自我的概念的反思与理解。 [关键词]：情感设计；情感识别；可视化 II Content III 1. Introduction Self-recognition is a widely discussed concept in many fields from philosophy to robotics. Famous philosopher Albert Camus summarized the complex feeling of trying to know one- self in The Myth of Sisyphus: "For if I try to seize this self of which I feel sure, if I try to define and to summarize it, it is nothing but water slipping through my fingers"[1]. Human emotion is of great complexity that cannot be comprehended in a simple dimension, leading to the research area of Affective Computing[2] which constructs systems for understanding human emotion in a computational way. Ekman and his team proposed the classification of six basic emotions: emotions have categories that are inherent and universal across cultures[3]. With the assumption of the basic emotions, more approaches exist to quantify research. One of the most used descriptors is the 2-dimensional Valence-Arousal model[4]. This model proposes that emotions can be mapped along these two dimensions; valence refers to the positivity or negativity of an emotional experience, while arousal measures how activated an emotional experience is[4]. This measurement enabled researchers to project emotions to the valence-arousal coordinate for a universal description. Inspired by the elusive nature of self-recognition, the mirror was introduced as a part of the installation. As Rochat and Zahavi concluded, mirror reflection externalizes the physical body we perceive internally, which can form the experience of questioning one’s own existence[5]. To enhance awareness of one’s own mental world and contribute to a more concrete un- derstanding of one’s existence, an installation artwork was created. This artwork visualizes the six basic human emotions by capturing biological signals. Emotions are a key display part of self-awareness, which is aimed at invoking users’ thoughts further and helping to ex- pose the spiritual world. Prompts are created describing the mappings between physical fea- tures, valence-arousal level, and six basic emotions. Then, the generative AI was deployed to provide design drafts for the emotion display. The emotion recognition technique was used to establish the connections between the users’ facial expressions and the pre-designed emotion visualization. Additionally, heart rate will be used as another indicator associated with the dynamic features of the visualization to enhance the immersive experience further. Since heart rate is rather challenging to manipulate and solely controlled by the nervous and endocrine systems, it aids in revealing actual emotions more objectively. The cooperation between facial expressions and heart rate is also the interaction between the heart and brain. Throughout the history of science, philosophy, and literature, the role of these two organs in self-recognition has been extensively discussed. By combining the visualized art display and emotion recognition together, the installa- tion aims to arouse the question of the intangible essence of self-awareness and to make an effort to try to understand more about intrinsic humanity. 2. Related Work Emotion recognition and visualization design are two main parts of this work. First is to retrieve users’ emotion, then to display the corresponding visualization. For the emo- tion recognition part, the combination of facial expressions and heart rate as indicators was proven to be usable by many studies. Algorithms extracting heart rate and facial expressions’ features were proposed to classify emotions for different purposes: maintaining game users’ experience[6], preventing physiological disorders in advance[7], and building a complete sys- tem for inferring emotions[8]. In terms of design, many researchers have studied the intricate connections between abstract emotional states and specific visual stimuli such as color, texture, and literature de- scriptions. To effectively map emotions to discrete color categories, experimental surveys are commonly employed, with participants tasked to match colors with emotions under var- ious circumstances. For instance, Kaya[9] conducted experiments among college students to collect evidence to show the relationships between emotional responses and five principle hues. Similarly, A. Manning and N. Amare also did experiments on university students and developed a model to demonstrate a stable emotion-spectrum response[10]. In real-life prod- ucts, the correlation between colors and emotions also indirectly relates products to specific moods for consumers, which may affect individuals’ choices[11]. Moreover, there exists a wealth of information feedback from the texture of the subjects that often goes unnoticed. As visual textures may trigger viewers’ specific emotional qualities and expectations[12], it is also an important factor to be considered in product design. Together with the dynamic features introduced by measuring the emotions’ valence and arousal, various spatiotemporal dynamic textures can have different effects on human emotion[13]. To enrich the contents of the visual display further and invoke more concrete associ- ations, literature descriptions of given emotions are also taken into account. There is one master metaphor form for emotions according to Kövecses: emotions are forces. Specific variations are like describing emotions as physical force, natural force, or pressure against containers[14]. By reviewing metaphors in different languages describing the same emotion, a more detailed category was proposed by Mashak[15]. More specifically, six basic emotions can be mapped to classical symbols, such as flower and light for joy, heat, and fire for anger. Regarding the implementation of the concept mirror detecting bio-signal data, various approaches have been explored. The work Magic mirror used a projector to display the pro- cessed data collected from the fitness tracker to visualize the Quantified Self[16]. Another installation called Aware Mirror was created by attaching an acrylic board to a monitor to enable the mirror to detect human faces, with a toothbrush serving as an indicator to activate the program[17]. In addition to Aware Mirror, the installation work Mirror Ritual also incor- porates a two-way mirror glass attached to a display with a camera to create a virtual mirror world[18]. 3. Design and Implementation The work collects audiences’ bio-signals, including facial expressions and heart rate, that are further processed by algorithms to distinguish emotions. It is represented as a mirror, and all devices are connected to the processing computer for further backend use. The whole pipeline is established in figure 1. Figure 1 Design Overview 3.1 Installation Connotation The work provides designed visual feedback when users observe themselves in the mir- ror. The visual representation of the user’s emotion will surround the people in the mirror, which can never be grasped. The visual display avoids the area of the observer’s image inside the mirror as if the water is sipping through our fingers. Creating the intangible emotional space inside the mirror aims to invoke users’ reflections on their emotions. Furthermore, ob- serving the reflection inside the mirror provokes self-examination: both observing and being observed, knowing oneself and being known, occur simultaneously, generating relatively objective cognition in a novel way. Many philosophers throughout history have discussed the intangible essence of our in- ner selves. Philosopher Friedrich Nietzsche wrote in his work Daybreak: “However far a man may go in self-knowledge, nothing however can be more incomplete than his image of the totality of drives which constitutes its being”[19]. Jorge Luis Borges also wrote many poems about self-awareness, and he hated mirrors as the projection creates many of him, which upsets him. Though the inner self is invisible in essence, a mirror can transform the intangible self into physical reflections. The literary theorist Terry Eagleton said in the book Literary Theory: An Introduction: “My existence is never something which I can grasp as a finished object, but always a question of fresh possibility, always problematic"[20]. However, it destroys the integrity of the subject consciousness at the same time. Michel Foucault wrote in his book The Order of Things that the mirror cuts through the whole field of representation and restores the visibility of things outside the view[21]. It produces the presence of the other, confirming the existence of self-presence through the gaze from the third perspective as an other. Thus, in the installation art field, many artworks involve mirrors. Artist Olafur Eliasson from Danmark focuses on exploring the relevance of art in the world and has created many installations using mirrors. Like the Pentagonal mirror tunnel (2017): five mirrors form a circle reflecting each other's images, forming a tunnel inside the mirror; the Midnight Sun: a mono-frequency yellow lamp behind a convex mirror, constructing a distorted space; the Planetary Perspective: a semi-circle of LED lights attached perpendicular to the plane of a circular mirror, creating a ring segment inside the mirror. A simple mirror can be turned into a carrier of rich images and metaphors using its physical features and users' cognitive feelings. Inspired by the untouchable nature of emotions and cognition and the vital role of the mirror in exposing the objectivity of human existence, This interactive installation based on the mirror challenges viewers to reflect on this philosophical viewpoint of self-awareness. 3.2 Backend Process Behind the mirror is a display and a camera. The camera continuously surveils the sur- roundings to check if someone's staring at the mirror. When the face is detected, the mirror will be activated, initiating the emotion visualization. Detected faces are classified into six basic emotions using the Deepface algorithm[22]. The emotion model can classify six basic emotions as well as the neutral category. The facial expressions are vague and confusing to classify under many situations, so the test accuracy is dataset-specific. Thus, while test accuracy is a consideration, the focus lies more on usability and inference time optimization. Despite facial expressions, heart rate is also considered for emotion recognition. A sensor is connected to the backend; when the users put their fingers on it, the sensor starts to collect heart rate. Results are sent to the computer through an Arduino and then further processed. To implement the effect of the video avoiding the user, a pre-trained human segmentation algo- rithm provided by PaddlePaddle is applied. The model version is PP-HumanSegV2-Lite[23], which is based on a lightweight neural network for portrait segmentation: ConnectNet. By compressing the number of stages and channels and introducing depth-wise separable con- volution, the efficiency is highly improved, enabling fast real-time inference that can handle the need[23]. For a more stable and consistent experience, the visualization display of each emotion remains on the screen until the designed video ends. Within this interval, emotion detection will not work. A black background will be displayed when no face is detected, enabling the mirror to function normally. 3.2.1 Heart Rate Detection Heart rate detection is done through a sensor connected to Arduino. The sensor is a non-invasive sensor based on optical principles. By attaching the sensor at the fingertip or earlobe, it emits light that goes through the skin and is absorbed by the blood. When the heart pumps the blood flow, the amount of light in the blood changes, which can then be detected by the sensor. The change will be turned into electric signals and then calculated to retrieve the heart rate. Arduino helps to translate the signal and enable it to be processed by computer. Python codes further embed the heart rate in the whole coding pipeline. The sensor is attached to the mirror surface and requires users to put their fingertips on it to generate heart rate detection. a) Sensor and Arduino b) Process Steps Figure 2 Heart Rate Sensor 3.2.2 Emotion Recognition Deepface is a classification model trained on the FER-2013[24] dataset, which contains all images in the size of 48x48 in seven categories: six basic emotions and neutral. The training dataset exhibits an imbalance between classes, with the " disgust" category being the least represented and "happy" the most prevalent. This pattern is consistently reflected in the performance on the test set, with disgust having the lowest accuracy and happiness the highest. Figure 3 shows the confusion matrix of the prediction result on the test set. The deepface model can overall accurately identify seven emotions, except for "disgust". Test images are most commonly misclassified as sad and neutral, with an average misclassifica- tion score above 80%. In the design part of this work, visualization for the neutral emotion is excluded from consideration that stems from a similar reason: under normal circumstances, most facial expressions are recognized as neutral. Among all test images misclassified as neutral, 40% of the correct categories received the second-highest scores, with an average score of 75 for the neutral category. It can be roughly assumed that facial expressions clas- sified as neutral, scoring below 75, can be classified as the second-highest-scoring category with a certain degree of reliability. Figure 3 Confusion Matrix To better understand the performance of this model on the real-time videos, the data was collected through a camera. Six basic emotions were performed for an equal interval of 5 seconds each following the instruction of the Facial Action Coding System (FACS)[25]. With a camera of 30 FPS, a total of 900 frames were captured. Due to the high time consumption of the inference step of emotion recognition, about 300 emotion predictions will be made in 30 seconds. According to the FACS proposed by Ekman et al., facial expressions can be broken down into the movements of muscles, which are called action units[25]. Different action units contribute to other kinds of emotion expressions, figure 5 shows samples of the facial expressions of six basic emotions. Featured action units of six basic emotions can be concluded as table 1. Table 1 Emotion Mapping in FACS[26] Emotion Typical Action Units Combination Happy 12/6+12 Anger 4+5+7+23/4+5 Disgust 9+16 Sad 1+4 Fear 1+2+4+5 Surprise 1+2+5/5+26/2+26 Aligned with common perception, the upward lip corner means happy, and the down- ward eyebrows and lip corner indicate sad. However, when users' facial expressions are not that exaggerated, it isn't very clear to distinguish the specific type of emotion. Thus, the experiment focuses on how to categorize the detected neutral category.

Figure 4 Action Units[27] Figure 5 Sample Facial Expressions[26] Table 2 shows the average prediction data for six basic emotions. The experiment was conducted 3 times, and the average data was shown. In table 2, TDE means Total Detected Emotion, Correct Rate is the correctly detected rate, Neutral Number is the number of de- tected neutral faces, SHCR means Second Highest Correct Rate: the rate of the correctly detected emotions scores the second highest of the neutral category, SHCS means Second Highest Correct Score: the average score of the correctly detected emotions scores the sec- ond highest of the neutral category, TCR means the total correct rate counting the emotion with SHCS as correct. The following results can be concluded from the experiment above: • Facial expressions are attributed to the neutral category in a high possibility, especially when the expressions are not obvious. • When neutral scored the highest, rating the current emotion as the second highest sig- nificantly improved the accuracy. • Disgust is almost undetectable by facial expressions in a short time period like 5 sec- onds. Table 2 Deepface Performance Statistics Emotion\Indicator TDE Correct Rate Neutral Number SHCR SHCS TCR Happy 50 40% 27.67 46.44% 14.06 65.67% Angry 53.33 25.69% 19.33 42.61% 33.54 31.29% Disgust 84.5 4.16% 32 0 0 4.16% Sad 54.67 17.12% 41.67 91.91% 6.79 87.50% Fear 50.33 45.62% 24.67 83.56% 18.39 83.43% Surprise 52.67 61.32% 11 27.48% 11.12 65.72% Furthermore, specific unavoidable classification errors provide insights into artificial intelligence judging human emotion, which may arouse users' thoughts of their genuine emotions and doubt about AI judgments behind the scenes. Micro expressions may be cap- tured by the camera, which is made by subtle muscle movements and lasts short[28]. These expressions show people's true thoughts instead of facial expressions when trying to hide something. Such instances may inadvertently expose users' inner thoughts by displaying emotions. 3.3 Visualization Design Facial expressions and heart rate are indicators mapping users' emotional state to the visualization display. Facial expression determines the category of detected emotion, and heart rate helps rank the emotion's degree and correct the disgust classification. The design process consists of static and dynamic parts and is bidirectional as figure 6 shows. Figure 6 Design Process 3.3.1 Original Static Drafts For the design, mappings between six basic emotions and literature symbols, colors, textures, and display speed are constructed. The original drafts were created by generative AI Midjourney using the mapping provided in the table below. Six basic emotions are dis- tributed in the valence-arousal coordinate as Figure 7. Under these two dimensions, Wilms conducted experiments to examine how hue, saturation, and brightness affect people's cog- nition towards valence and arousal levels[29]. The results were proved to be aligned with what Kaya proposed[9], and also the same as Nijdam concluded[30]. High arousal emotions tend to be perceived as highly saturated chromatic colors, and high valence is seen more in chromatic color stimuli. For texture, both haptic and visual aspects have been paid much attention to in research. Iosifyan experimented with haptic textures: participants rated the emotion level touching dif- Figure 7 Valence Arousal Model[31] ferent tactile surfaces[32]. Liu proposed a calculation model that evaluates the most significant 15 features in visual texture affecting emotions[33]. Thus, the haptic descriptions are refer- enced along with the visual texture as input. The final mapping is as Table 3. Combining the results and the aesthetic consideration, original drafts were produced as Figure 9 shows. The working process is as Figure 8 shows. Figure 8 Working Process Table 3 Design Mapping Emotion Description Color Texture Valence Arousal Happy Light, Flower, Up Yellow, Red, Pink Soft, Velvet High Low Angry Heat, Fire Red, Black Metal, Rough Low High Fear Vicious, Eyes Gray, Black Misty Low High Sad Low, Cold Blue, Black, Gray Flowing Low Low Surprise Daze, Thunder Orange, Red Fancy High High Disgust Dirty, Unappetizing Green, Yellow Toy Slime Low High a) Happy b) Angry c) Fear d) Sad e) Surprise f) Disgust Figure 9 Design Drafts 3.3.2 Dynamic Output Dynamic textures include visual patterns that vary from time, which can be either con- tinuous or discrete[13]. They also contribute to arousing emotions in many ways just like static features. Motion features like speed and amplitude were found to have unpleasant effects, while the consistency of the dynamics may amplify the impact of the video content in elic- iting emotions[13]. Since dynamic content can draw more visual attention and specific ones can cooperate to regulate the degree of the displayed emotion, original drafts were turned into short videos of about 4 seconds using the keyframe animation in Adobe Photoshop. In addition, the dynamic design also incorporates the elements in the static drafts to provide a more immersive experience. The dynamic design followed table 4 patterns. Detected heart rate helps to classify the output visual display in more detail and can help to reduce the classification error caused by using facial expressions only. According to Table 4 Dynamic Design Patterns Emotion\Change Color Texture Motion Happy Saturation Blur Flower Animation Sad - Twisted Wave Effect Anger Color Balance Sharpen Blow Up Effect Disgust - Liquidation Dripping Process Fear Contrast - Eye Blinking Animation Surprise - - Firework Animation, Sudden Base Picture Change experimental results, heart rate increases when people are angry, decreases when in a state of disgust, and is lower when people are happy than in the neutral mood[34]. And compared to the sad state, the average heart rate of the happy state is lower[35]. A specific rank of heart rate was concluded by Kenneth, M. et al.[36], which was concluded from the experimental results. Figure 10 Heart Rate Data of Six Emotions[36] Combining the heart rate performance and the dynamic texture performance together, the final dynamic design considered the following aspects: • For Anger and Sad, heart rate will be distributed to 3 levels: high, medium, and low. When the heart rate is high, the visualization video will be played at a faster speed following the equation HHRRbnaoswe × vori × 1.2. HR is short for heart rate, vori is the original speed of the video. The video was accelerated by skipping frames. • When the heart rate is low, Anger and Sad will be classified as disgust. • Since heart rate may range widely for different people under different conditions, the hierarchy is based on data under general situations. HRbase is 70, 60 to 80 is in the medium range, above 80 is high, and below 60 is low. 3.4 Installation Setup The installation comprises a double-way mirror, a monitor, a camera, a sports watch, and a computer. The complete work is shown in figure 12. The components are like figure 11 shows; the heart rate sensor is covered under a heart-shaped paper, which is about the heart level high. The mirror's frame hides the camera connected to the computer running the back- end algorithms. The mirror is attached to the monitor to display the emotion visualizations while users are looking into the mirror. Part Size/Parameters Function Mirror 380mm×247mm Concept setup Monitor 15.6 inch screen Display emotion visualization design Camera 1280p×720p, 30fps Retrieve real-time video Sensor 3.3-5V, Analog signal Retrieve heart rate Computer NVIDIA 3070ti Execute backend algorithms Figure 11 Installation Composition 4. Experiments and Results 4.1 Experiment for the Static Drafts A small-scale survey was conveyed, and 15 participants, evenly split by gender with one unwilling to reveal, were invited to evaluate the generated drafts. Among the five emotions assessed, all but surprise were reliably distinguished by at least 80% of the participants. De- spite being recognized as one of the basic emotions, surprise proved challenging to define due to the complexity of the concept itself. Notably, a study by Nijdam in 2009 revealed that sur- prise was not explicitly associated with a specific color in any of the models he reviewed[30]. The survey findings indicated that sadness and disgust were occasionally misinterpreted as surprise, while half of the participants mistakenly attributed surprise to happiness. Without clear clarification, the valence of surprise depends on the situation it is mentioned, and static design may find it hard to reflect its dynamic nature. So, in the next version, the design of the surprise added more unpredictable changes, and the design focused on its unexpected features. As the only assertive positive basic emotion, happiness was recognized 100% right in the survey. Without any divergence, all participants thought color was the most significant feature that denoted this emotion. The table below shows detailed statistics. Participants were asked to rate the level of emotion if they put it into the right category, the column value is the average score of this level out of 5 points. The following ranks represent the relative importance attributed by participants to various components of the design sketches. PAR means Positive Answer Rate. Elements, Color, and Texture record the relative rank of these 3 parts of the drafts. Table 5 Survey Results Emotion PAR(%) Wrong Answers Average Score Elements Color Texture Happiness 100 - 4.33 3 1 2 Anger 80 Sadness, Fear 3.67 3 1 2 Fear 86.67 Anger 4.08 1 2 3 Sadness 86.67 Surprise 3.54 3 1 2 Surprise 53.33 Happiness 4.25 2 1 3 Disgust 93.33 Surprise 4.07 2 1 3 After the feedback, small adjustments were made, and static pictures were turned into videos. The pipeline of backend processing facial expressions is built. 4.2 Experiment for the Installation Work After all parts of the work had been set up, an experiment involving users to experience this work was conducted using the completed installation. 13 undergraduate students par- ticipated. The installation was set up in a classroom, allowing users to explore freely. The introduction is posted on the wall beside the poster, and participants were asked to explore the installation freely. They were asked to finish a survey before they left. And partici- pants were encouraged to leave a memo describing their emotions now or for today. The survey consists of two parts: one is about the usability of the work, and the other is about the experience of emotion visualization. a) Scene Setup b) Example of usage Figure 12 Scene of the Experiment The usability ratings are overall high, scoring an average of 4.15 out of 5. All partic- ipants have left positive words in the survey to describe the experience. More specifically, about 80% of the participants thought the interactive process left them with deep impressions, while over half thought the visual display attracted their attention. Aligned with the previous study of static drafts, color is still the most significant element representing emotions, while However, for the emotion recognition parts, the feedback showed divergence. Half of the participants approved of the installation's emotional feedback, while the other half felt uncertain about the recognized emotion. One of the most confusing usage experiences was that the work only showed six basic emotions, which cannot conclude the complex emotional experience. Another reason was that participants agreed that their self-perception was vague and may be affected by the environment. At the end of the survey, participants were invited to share their overall experience. What they had in common was a positive attitude towards the form of the work and the connotation behind the installation. However, a few aspects of the work listed below were not aligned with intuition and can be further improved. • No direct instructions on collecting heart rate and no direct feedback after heart rate collected. • The length of the visualized video is too long, causing users to be confused about the response pace. • Most of the participants asked for further explanations about the work. The whole setting was not immersive enough to allow users to get lost in their thoughts. 5. Future Work and Conclusion The installation has successfully set up the pipeline of recognizing users' emotions from their facial expressions and heart rate and then mapping the results to a visualization display. For the process, the connection between different emotions can be added since the experi- ence of emotion is often mixed. The segmented human portrait now is the floating effect, which lacks interaction between the user and the visualization. A more immersive experience environment can be created to be more thought-provoking. The work not only provides a portal of thinking but also has the potential to apply it to mental health care. Recognizing your emotions correctly helps to improve mental health significantly. The form of this work is highly expandable, enabling expanding the current framework to incorporate additional bio-signals and developing a more comprehensive sys- tem, which would significantly contribute to its effectiveness and relevance in various do- mains. An innovative approach to visualize emotion and invoke users' thoughts about self-awareness is proposed. Detecting facial expressions for displaying emotion visualization in the mirror provides the chance to know oneself's inner spiritual world by exposing it. This process of self-exploration through the external representation of emotions encourages in- trospection and fosters a deeper understanding of one's emotional state. Preliminary user surveys have indicated a positive reception to the processed work, val- idating its potential for engaging users and promoting self-awareness. Further improvements in usability and the fertility of the installation artwork will be made at the next stage. The work is a highly thought-provoking and expandable form of art that relates computer science and recognition science together. The displayed visualization can have a further emotional effect on users rather than only a reflection of their facial expressions, which is a multidi- rectional exchange of information that can be explored for future applications in psychology and emotional well-being. References

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Based on Respiration[C]. in: 2015 37th Annual Interna- tional Conference of the IEEE Engineering in Medicine and Biology Society. 2015: 6134-6137. [36] PRKACHIN K M, WILLIAMS-AVERY R M, ZWAAL C, et al. Cardiovascular Changes During Induced Emotion: An Application of Lang’s Theory of Emotional Imagery[J]. Journal of Psycho- somatic Research, 1999, 47: 255-267. Acknowledgement Thank you to everyone who protected me from dreaming in my own rough world: my family, academic advisors, dear friends, and all those who supported me. Thank you for all the encounters, the love, the understanding, and the fantasies. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24