Smart Bags for Release Pressure

POLITECNICO DI MILANO
Design for Fashion System Final Thesis

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Contents

Abstract

Due to the acceleration of social rhythms and the solidification of social classes, the mental health problems of young people in big cities are now severe (mainly in China). At the same time, a new term–**involution** has become the hottest word in mainland China recently. It means that even if you work hard, the benefits you can get are getting smaller and smaller, and everyone has to work harder and harder. Withstand greater pressure.The proportion of psychological problems such as depression has increased year by year and has become younger. But many people still don't have a proper understanding of the mental illness. The stigmatization of psychological problems can lead to discomfort and shame in psychological counseling, which prevents many people from seeking help from psychological health services.

I dare not say that the research in this paper can treat depression, because the treatment of depression is still a difficult problem in the current professional field. I just hope that it can relieve some pressure through my research in this paper and the product I designed.

The main purpose of this project is to combine textile with technology. To use the principle of a polygraph (monitoring heartbeat) to change the **colors** of textiles by sensing the psychological changes of the users,It also has a very **comfortable touch** to help users relieve stress so that the user realizes that emotional depression is not difficult to tell. Instead, it will bring soothing color and texture changes to the external environment. Designed this bag named "Healing", written as " 愈 " in Chinese, using the **Arduino** microcomputer platform, detecting the heartbeat with a heartbeat sensor, and completing the interaction with the LED light board.

Even psychological healthy people can also use such smart bags because of their beautiful and interesting performance, so as to enhance communication and interaction with the surrounding people, and pass the design concept of smart textiles to more people. Enhance the psychological health knowledge popularization in China. People who are under great pressure in big cities can use this product to relieve a little pressure.

Study Background

Depression and Underlying Depression

Due to the acceleration of the social rhythm, the pressure on living, working and learning is also increasing. At present, the situation of mental health problems of Chinese people is severe. Many people still don't have a proper understanding of themselves and other people with mental illness. The stigmazation of mental health can lead to discomfort and shame in psychological counseling, which prevents many people from seeking help from mental health services. Depression is a well-diagnosed and treatable disease. But it is often underreported and untreated. Depression is a common disease worldwide with more than 300 million patients and 80 million in China. At its worst, depression can lead to suicide. Nearly 800,000 people die each year from suicide. Suicide is the second leading cause of death among people aged 15-29. Less than half of patients worldwide (less than 10% of patients in many countries) receive effective treatment. (Depression and Other Common Mental Disorders, World Health Organization, 2017)

Factors affecting effective treatment include: lack of resources, lack of trained health care personnel, and social discrimination against mental illness. Mental illness can be cured through effective psychological counseling and medication.

There are no mature applications in the market that help people guide and monitor mental health. The study on smart textiles is the continuous exploration and excavation of modern technology. At present, the functions of smart textiles, such as smart temperature regulation, shape memory, and information transmission, are becoming more and more perfect. In the future, smart textiles will be favored by consumers. Using organic combination of smart textile technology and design, it is possible to monitor the moment when the user feels great pressure, and then respond accordingly. Communicating between people through textiles or garment in life is the study aim.

Study Background

Involution

Over the past few months, Chinese people from all walks of life, be they software developers, stay-at-home moms, or elite university students, have all discovered their daily lives can be accurately described by the same once-arcaneacademic term: involution.

Originally used by anthropologists to describe self-perpetuating processes that keep agrarian societies from progressing, involution has become a shorthandused by Chinese urbanites to describe the ills of their modern lives: Parents feel intense pressure to provide their children with the very best; children must keep up in the educational rat race; office workers have to clock in a grinding number of hours.

Involution can be understood as the opposite of evolution. The Chinese word, neijuan, is made up of the characters for 'inside' and 'rolling,' and is more intuitively understood as something that spirals in on itself, a process that traps participants who know they won't benefit from it.

In a sense, it's the latest word for the negative side of China's cutthroat society, similar to sang, the mentality of people who have turned apathetic by incessant competition, or the various memes people use to decry their intensely boring white-collar jobs. But involution's academic roots and its widespread application suggest the word, to many, captures something more fundamental.

Study Purposes

1. Making fabrics that can sense pressure:

Through study and experiments on smart textiles and in-depth investigations on special people, design visually soothing textile patterns, and add a new interaction method based on the textile as extent. To make the textile can sense pressure.

The Arduino module based on MCU (Microcontroller Unit) is used to monitor the heart rate through the heart rate sensor, and the heart rate is used to represent the pressure levels. When the heart rate changes, the LED light connected with it can be changed. And LED lamp beads can interact with preset patterns and fabric texture to form more abundant changes.

2. Design the "Healing" Bags which can release pressure:

Since the heart rate sensor must be placed on the fingertip and wrist for measurement, the fabric will be used to make bags. Compared with clothing, bags are more simple, and accessories will not give users greater psychological pressure in the interaction process.At the same time, the bags has a certain practicality, and the interactive function can be turned off by dropping the bags.

Based on this starting point, the project will produce a series of bags with the theme of "Healing", which can monitor people's pressure levels, so as to gently comfort people's psychology. Of course, it will also have a soft surface touch. Also, The "Healing" bags will also use 3d printing technology and modular design to support the DIY approach to create its own unique style.

Study Status

Electronic technology has more or less affected our original way of life in many aspects such as clothing, home textiles, products, art, medical treatment, architecture, and communications. The function development of electronic fabrics is mostly based on improving the quality of life, convenience and fun. Through the application of technology in common textile products, information exchange, data transmission and monitoring feedback between people and the environment are realized. Make people full of expectations and possibilities for future lifestyle changes. The combined development form of multiple sensing technologies and electronic components is the key point of this project.

Pic 1. & Pic 2.
"Turn signal biking jacket,"© by Leah Buechley
When riding, you can turn the head to turn on the corresponding turn signal to remind the car behind.

Living Wall

by Leah Buechley

This project experiments with interactive wallpaper that can be programmed to monitor its environment, control lighting and sound, and generally serve as a beautiful and unobtrusive way to enrich environments with computation.

Run your hand across this wallpaper to turn on a lamp, play music, or send a message to a friend. The wallpaper is flat, constructed entirely from paper and paint and can be paired with our paper computing kit whose pieces serve as sensors, lamps, network interfaces, and interactive decorations.

Pic 3.
Living Wall
When a touch is detected, a flower-shaped lamp will be lit.

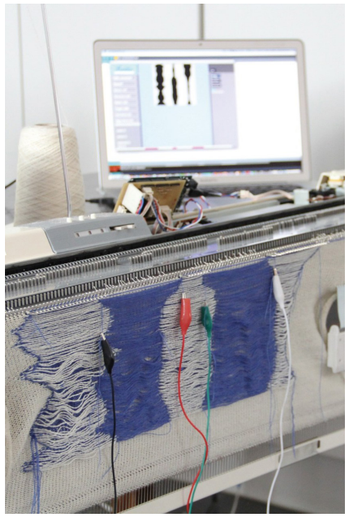
Pic 4.
Living Wall
When a touch is detected, a leaf-shaped lamp will be lit.

NeuroKnitting

by Varvara & Mar and MTG

Using a wearable, non-invasive EEG headset, we recorded users' affective states while listening to Bach's "Goldberg Variations", concretely the aria and its first seven variations. Three main features were measured: relaxation, excitement, and cognitive load. After recording, those features were converted into a knitting pattern. Hence, every stitch of a pattern corresponds to a unique brain state stimulated by the act of listening. It means the user's affective response to music is captured every second and memorised in the knitted garment pattern.

Neuro Knitting represents a novel way of personal, generative design and fabrication. An approach that brings together affective computing and digital crafts. And thus, it offers new applications and creative thinking to both areas.



Pic 5. Above Left
NeuroKnitting
Using a wearable, non-invasive EEG headset to record users' affective states.

Pic 6. Above Right
NeuroKnitting
Use the Knitic loom to weave the recorded signals.

Pic 7. Bottom Left
NeuroKnitting
The scarf has been woven.

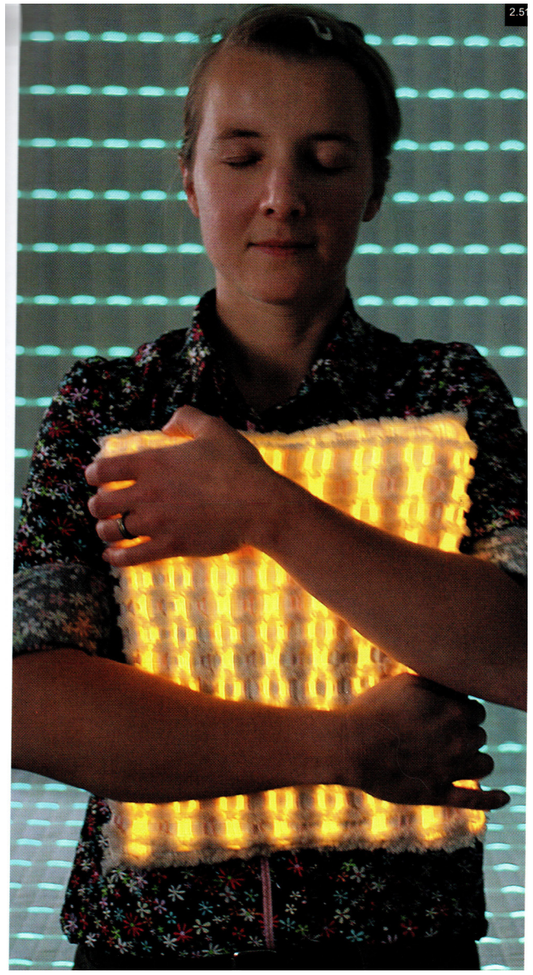
Pic 8. Bottom Right
NeuroKnitting
Try on the knitted scarf.

Interactive Cushion

by Linda Worbin

This pillow is a project designed by Linda Worbin while she was doctoral candidate in Textiles and Interaction Design at the Swedish School of Textiles in Boras, Sweden.

The use of e-textiles has lent itself to alternative assistance with patients suffering from ddementia. Utilizing Tactile Dialogues, caregivers are able to interact with patients by way of vibrations in the material, enabling communication where conventional methods might not be possible.



Pic 9. & Pic 10.
Interactive Cushion
When feel the changes in touch, the pillow will be lighted.

GER MOOD SWEATER

by Sensoree

The Galvanic Extimacy Responder (GER) is our soft sensor based on the GSR – Galvanic Skin Response which reads electrodermal activity. This sensor has been used in classic lie detector tests to show excitement levels. SENSOREEs GER sensor promotes extimacy – externalized intimacy by showcasing how you feel on the inside to the outside world. The sensors are located on the hands and reads excitement levels then translates the data into a palette of affective colors.

The Mood Sweater design of the bowl shaped, high collar is positioned with LED lights that reflects onto the self for instant biofeedback as well as act as a tele-display or external blush to communicate to the other. Located around the larynx, the visual interface offers new forms of speaking.

Pic 11.
GRE Mood Sweater
The neck of the sweater will emit different colors of light according to different mood and a list of lights corresponding to different mood.

Heart Rate Monitoring Shirt

by Nanoleq

Swiss based company Nanoleq has achieved what numerous couldn't: Washable, stretchable, reliable and accurate biosignal monitoring technology that can be easily integrated into garments with standard textile equipment.

The product called Vital Shirt measures heart rate and heart rate variability via clinical-grade ECG, giving it a competitive edge over rival technology PPG. In fact, it's proven to be more accurate than smartwatches, with the added benefit of being much more comfortable than a chest belt.

Pic 12.
Heart Rate Monitoring Shirt

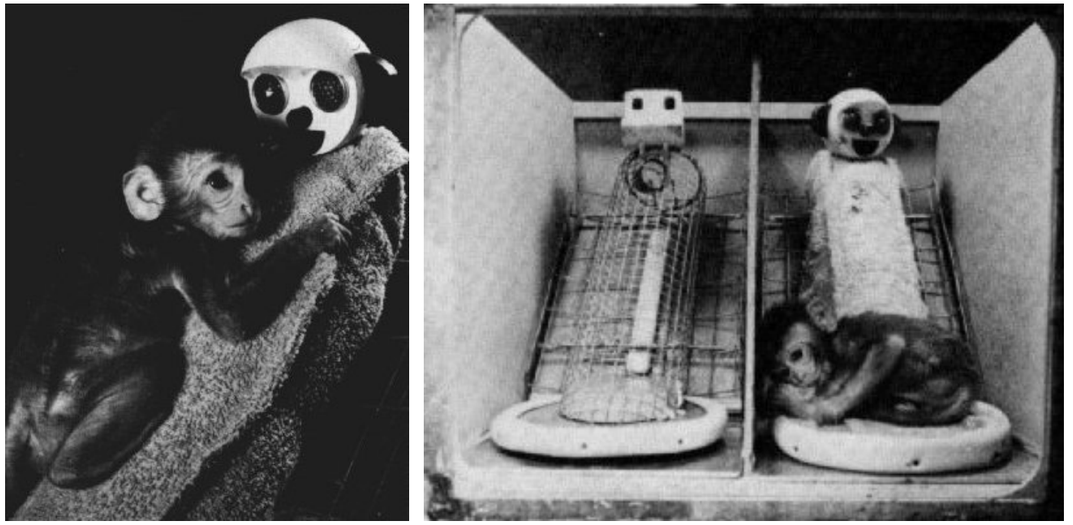
Sensors integrated with clothing can detect heart rate more conveniently.

Theoretical Support

Harry F. Harlow's rhesus monkeys experiment (1959) [1]

Each infant became attached to its particular mother, recognizing its unique face and preferring it above all others. Harlow chose to investigate if the infants had a preference for bare-wire mothers or cloth-covered mothers. For this experiment, he presented the infants with a clothed mother and a wire mother under two conditions. In one situation, the wire mother held a bottle with food, and the cloth mother held no food. In the other situation, the cloth mother held the bottle, and the wire mother had nothing.

Overwhelmingly, the infant macaques preferred spending their time clinging to the cloth mother. Even when only the wire mother could provide nourishment, the monkeys visited her only to feed. Harlow concluded that there was much more to the mother–infant relationship than milk, and that this **"contact comfort"** was essential to the psychological development and health of infant monkeys and children. It was this study that gave strong, empirical support to Bowlby's assertions on the importance of love and mother–child interaction.



Pic 13.
Rhesus Monkeys Experiment
The little monkey is more willing to stay with the "towel mother".

This resaerch realize that **"contact comfort"** plays a key role in this experiment, so the basis of this thesis is to amplify the effect of this contact comfort, so that clothing and emotions are connected and having interaction between them.

[1]: Harlow, H. F. (1958). *The nature of love. American psychologist,* 13(12), 673.

Theoretical Support

Wassily Kandinsky's Color Theory[2]

Wassily Kandinsky was one of the first artists who was able to express how different colors affected emotions, a core principle of modern art.

For Kandinsky, art was a spiritual and emotional experience. He wanted his paintings to transcend recognized forms and express feelings through colors and shapes. To him, copying from nature stifled artistic expression.

Kandinsky argued that artistic experiences were all about feeling, and different colors affected mood. Yellow could disturb, while blue might make people feel good. Kandinsky's thoughts on color were similar to Johann Wolfgang von Goethe's belief that different colors can convey certain emotions.

Pic 14.
Wassily Kandinsky. Colour study with concentric circles. 1913.
Analysis of the emotional impact of different color combinations.

[2]: Kandinsky, W. (1977). *Concerning the Spiritual in Art.* Courier Corporation.

Color	Properties	Timbre
yellow	“warm,” “cheeky and exciting,” “disturbing for people,”“typical earthly color,” “compared with the mood of a person it could have the effect of representing madness in color [...] an attack of rage, blind madness, maniacal rage.	loud, sharp trumpets, high fanfares
blue	deep, inner, supernatural, peaceful “Sinking towards black, it has the overtone of a mourning that is not human.” “typical heavenly color”	light blue: flute darker blue: cello darkest blue of all: organ
green	mixture of yellow and blue stillness, peace, but with hidden strength, passive “Green is like a fat, very healthy cow lying still and unmoving, only capable of chewing the cud, regarding the world with stupid dull eyes.”	quiet, drawn-out, middle position violin
white	"It is not a dead silence, but one pregnant with possibilities."	"Harmony of silence", "pause that breaks temporarily the melody"
black	“Not without possibilities [...] like an eternal silence, without future and hope.” Extinguished, immovable	"final pause, after which any continuation of the melody seems the dawn of another world"
gray	mixture of white and black “Immovability which is hopeless”	"sound of a trumpet, strong, harsh"
red	alive, restless, confidently striving towards a goal, glowing, “manly maturity” Light warm red: strength, energy, joy; vermilion: glowing passion, sure strength. Light cold red: youthful, pure joy, young	soundless

Color	Properties	Timbre
brown	mixture of red + black dull, hard, inhibited	high, clear violin
orange	mixture of red + yellow radiant, healthy, seriousd	middle range church bell, alto voice, “an alto violin, singing tone, largo”
violet	mixture of red + blue “morbid, extinguished [...] sad"	english horn, shawm, bassoon

Pic 15.
Wassily Kandinsky. Yellow-Red-Blue. 1925

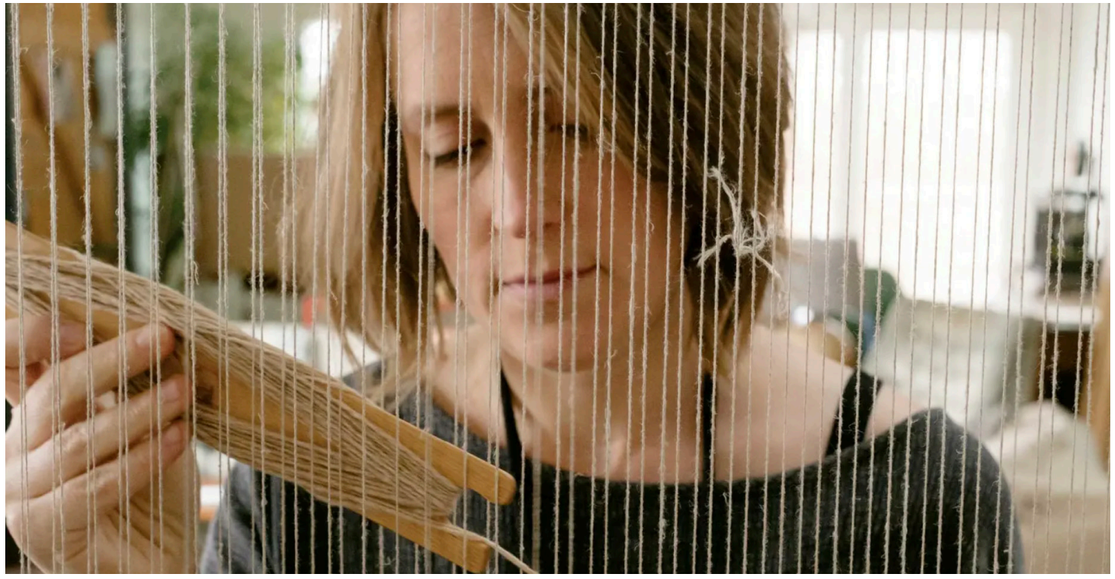
Theoretical Support

Woven Flow: Weaving As Meditation[3]

"After a few weeks of daily weaving, my anxiety decreased significantly. I began asking around and discovered that many of my fellow weavers described similar experiences."

Mihaly Csikszentmihalyi, the Hungarian psychologist who introduced the concept of "flow" in the 1970s. Growing up in World War II Europe, he noticed as a young man that some survivors were crushed by the trauma, unable to return to their lives. Others were more resilient, finding happiness even after experiencing brutality and loss. Csikszentmihalyi's research led him to discover that many of the resilient survivors were those who regularly engaged in activities that brought them into a state of flow.

Flow is something you've likely experienced at the loom, whether you knew it or not—it's that liminal place where you are so completely absorbed in a project or activity that you lose track of time and forget about your ego.



Pic 16.
Sarah Neubert working at one of her looms. Photo by Caleb Young.

Just as in meditation, the flow state allows for decreased activity in the prefrontal cortex, which is responsible for the more analytical functions of the brain such as logic, sense of self, decision-making, and social awareness. That means that your rational brain, which almost never gets a break from its constant attempts to regulate everything you do, can rest, and the more primal regions of your brain get a turn at the wheel. Your limbic system, which is instinctual and emotive, becomes dominant. The result is an uninhibited experience of creativity. You stop overthinking and can simply be.

[3]: Csikszentmihalyi, M., & Csikzentmihaly, M. (1990). Flow: The psychology of optimal experience (Vol. 1990). New York: Harper & Row.

Summary

After investigating the current situation of smart textiles, and combining the two theoretical supports mentioned above, this project will focus on two aspects:

1. Create a unique soft and comfortable surface texture of the fabric. The ones that make people feel relaxed, and make people willing to have more contact which can relax people's mood and relieve pressure. At the same time, the bag also has a certain practicability, and the style is also rich in design and trendy.

2. Through the combination of lights and patterns, after the heart rate change is detected, the surface of texture of the entire bag will become richer and more comfortable.

Emphasizing bad mood to the user is not a shameful thing, even make your accessories more beautiful. The overall lighting and color will not be very exaggerated, will not make people feel embarrassed, try to give the user a comfortable feeling.

Of course, users can also use the light as a signal. If the light of the bag changes, they can seek more communication with friends around, including chatting and hugging, to divert their attention.

3.Since weaving can make people feel calm and happy, the project uses 3d printing modular design, which allows anyone to make bags with their own surface texture very conveniently, and the production process can be eased pressure.

Target Research

The target of this project is 21-35 years old people, who live in China's first or second-tier cities, have more pressure in studying, working, family and other aspects, have little time to communicate with others, already in or vulnerable to psychological problems. They love to discover beautiful things, or work and study in the field of art, and have independent purchasing power and aesthetic requirements.

Persona

-Name: Yu Xin
-Age: 26
-Occupation: Photographer
-Coordinates: Hongkou, Shanghai
-Dressing style: Fresh color and loose Japanese style
-Hobbies: Collecting cameras, video editing, reading, painting, ukulele, jogging
-Lifestyle: Raising cats, going to bed late, like observing and recording beautiful things, like being alone but eager to share, loving life but having a certain life pressure, having aesthetic pursuits but not like drifting with the flow
-Favorite music: Blues, jazz, country rock
-Shopping habits: Online shopping, vintage shops

Persona

-Name: Jiang Yu
-Age: 28
-Occupation: Tik Tok Producer; Model
-Coordinates: Beijing
-Dressing style: Retro, casual, vintage
-Hobbies: Motorcycles, photography, vlog shooting, food, painting, electronics.
-Lifestyle: Freelancers who have a wide range of hobbies, like art, have irregular life schedules, unstable income, full of vitality, and will work hard to study what they like.
-Favorite music: Rock music, punk, funk, vaporwave, rap
-Shopping habits: Collection stores, vintage shops

Survey

This project designed a questionnaire to be distributed online and offline (the questionnaire issued will be attached to the next page). Since the target population of the survey is young Chinese, this project have prepared a bilingual version of the questionnaire in both Chinese and English. The results will be used to guide design.The questionnaire is divided into two parts.

The first part is a mental-health test, which is used to test whether the testing object has mental-health problems. The question comes from the Self-Rating Depression Scale (SDS) and was written by William W.K. Zung.

The second part is a tendency test, in order to collect data that can make people feel relaxed, such as colors, patterns and styles which can be used for guiding design.

Results

This paper collected 50 questionnaires (automatically stop after collecting 50 enough).

The first part of the psychological evaluation questionnaire, with a total score of 50 points, if the score was more than 20 points was considered to have the tendency of depression, and was considered to have depression and other emotional disorders if the score was more than 30 points. In the questionnaire I collected, 60% of the participants scored above 20, while 30% scored above 30.

The second part The data in the second part is very different. Outside activities, Loose, Moranti color system, simple and colorful pattern and waeving get the highest number of votes, so the overall design style will be more inclined to the Morandi color, weaving and loose style.

关于我们
About Us

我们是米兰理工大学的关于“情绪化”服装研究的一个项目组，我们关注现代人的心理健康问题，希望您可以抽空帮助我们完成这份问卷，十分感谢！您也可以通过扫描二维码的方式线上填写。

We are a project group of "emotional" clothing research of Politecnico di Milano. We are concerned about the mental health of modern people. We hope you can take the time to help us complete this questionnaire. Thank you very much! You can also fill in online by scanning the QR code.

基本信息
Basis Information

性别 *Gender*

职业 *Occupation*

年龄 *Age*

居住地 *Location*

关于当代年轻人心理健康状态的调查问卷
A Questionnaire on the Mental Health of Contemporary Young People

第一部分
Part 1.

1	2	3	4	5
绝不 *Never*	几次 *A few times*	有时 *Sometimes*	经常 *Often*	不断地 *Constantly*

	1	2	3	4	5
1. 您是否对生活中的很多事情感到焦虑和害怕？ *Do you feel anxious, worried or scared about a lot of things in my life?*	○	○	○	○	○
2. 您是否感到自己的担忧无法控制？ *Do you feel that my worry was out of my control?*	○	○	○	○	○
3. 您是否对自己感觉失望？ *Do you feel bad about yourself?*	○	○	○	○	○
4. 您是否感到难以入睡或醒来时没有休息的感觉？ *Do you have trouble fall asleep or not feel well-rested when I woke up?*	○	○	○	○	○
5. 您是否感到对很多事情缺乏兴趣？ *Do you feel little interest or pleasure in doing things?*	○	○	○	○	○
6. 您是否经常感到疲惫或者缺乏活力？ *Do you often feel tired or have little energy?*	○	○	○	○	○
7. 您是否难以集中注意力，比如读书？ *Are you having trouble concentrating, like reading?*	○	○	○	○	○
8. 您是否有过自残或者轻生的念头？ *Have you ever thought of self mutilation or suicide?*	○	○	○	○	○
9. 当您感觉不好的时候，是否愿意接受心理治疗？ *Are you willing to accept psychotherapy when you feel bad?*	○	○	○	○	○
10. 您会羞于对别人提及自己的负面情绪吗？ *Are you shy about mentioning your negative emotions to others?*	○	○	○	○	○

第二部分
Part 2.

1. 您平时喜欢用什么方式放松？
How do you like to relax?

A. 体育活动（足球，篮球等） *A. Sports (Football, Basketball etc.)*
B. 社会活动（看电影，KTV 等） *B. Social Activities (Movies, KTV etc.)*
C. 网上娱乐（网络游戏，在线视频等） *C. Online Entertainment (Video games, Online video etc.)*
D. 艺术活动（画廊，艺术展等） *D. Art Activities（Gallery, Art exhibition etc.）*
E. 外出游玩（徒步旅行，野餐等） *E. Outside Activities（Hiking, picnics etc.）*
F. 其他 *F. Others* _____

2. 什么样的穿衣风格最让您放松？
What kind of dressing style relaxes you most ?

A. 性感的 *A. Sexy*
B. 休闲的 *B. Causual*
C. 紧身的 *C. Tight*
D. 宽松的 *D. Loose*
E. 运动的 *E. Sports*
F. 风格化 *F. Stylization*

3. 以下什么色系，最让您感觉放松？
Which of the following color system makes you feel relaxed most?

A. 莫兰蒂色系 *A. Moranti color system*

B. 大地色系 *B. Earth color system*

C. 彩虹色系 *C. Rainbow color system*

D. 灰色系 *D. Grey color system*

E. 糖果色系 *E. Candy color system*

F. 冷色系 *F. Cool color system*


4. 以下什么纹样，最让您感觉愉悦？
Which of the following patterns makes you feel joyful most?

A. 复杂的 *A. Complex*
B. 简单的 *B. Simple*
C. 无序的 *C. Disorder*
D. 重复的 *D. Repeat*
E. 多彩的 *E. Colorful*
F. 单色的 *F. Monochromatic*

5. 您认为以下什么创造性活动会让您更容易释放压力？
Which of the following creative activities do you think will make it easier to release stress?

A. 编织 *A. Weaving*
B. 绘画 *B. Drawing*
C. 烘焙 *C. Baking*
D. 阅读 *D. Reading*
E. 写作 *E. Writing*
F. 陶艺 *F. Doing pottery*

Psychological Research

Heart Rate Variability (HRV)

The main purpose of this study is to ease negative emotions and reduce people's stigmatization of psychological intervention, so how to characterize negative emotions through heart rate or related indicators.

This study focuses on the four most common negative emotions: sadness, fear and tension. These four emotions can be linked to the heart rate variability [4], as to provide a reference for when the clothing will change.

Simply put: heart rate variability refers to the heart changes in the speed of jumping. Sztajzel (2004) proposed that heart rate variability is a simple and effective method to evaluate sympathetic and parasympathetic balance at the level of the sinoatrial node. Hypertension, coronary heart disease and congestive heart disease have been used to evaluate the severity of the patient's condition. [5]

Studying emotions can be started from three aspects: one is to study the external performance of emotions, the other is to study the physiological changes accompanying emotions, and the third is to study the inner experience of emotions. In the past, the most commonly used indicators to study the physiological changes accompanying emotions were: changes in skin electricity, heart rate, blood pressure, respiration, pupils, and norepinephrine. The use of heart rate variability can relatively easily show the change of heart rate corresponding to various emotions.

This study is concerned about whether there is a certain pattern of changes in mood in the change of autonomic nerve activity. For example, anger and fear can increase sympathetic nerve activity, cause the body to have a series of changes such as increased blood pressure and accelerated heart rate. So are the changes caused by the two the same? And are the changes caused by anger, fear and happiness, disgust and sorrow the same?

[4]: Yan, K., Zhang, W., Zhang, Y., & Feng, W. (2006). *The Application of Heart Rate Variability to Study Psychosomatic Disease and Emotion Disorder.* Advances in Psychological Science, 14(02), 261.
[5]: Sztajzel, J. (2004). *Heart rate variability: a noninvasive electrocardiographic method to measure the autonomic nervous system.* Swiss medical weekly, 134(35-36), 514-522.

Psychological Research

Stemmler (2001) concluded that both phobia and anger increased systolic blood pressure, but diastolic blood pressure increased only during anger. The autonomic response to fear is similar to the response to epinephrine injection, while the response to anger is similar to the combined response of epinephrine and norepinephrine. [6]

HRV test method can be performed by measuring the heartbeat cycle on the earlobe or fingertip by a photoelectric sensor. The more regular changes in heartbeat period indicates the higher the positive emotions and vice versa.

[6]: Stemmler, G., Heldmann, M., Pauls, C. A., & Scherer, T. (2001). *Constraints for emotion specificity in fear and anger: The context counts*. Psychophysiology, 38(2), 275-291.

Conclusion: Combining the above literature, it can be known that although it is generally recognized in medicine that emotions can be reflected on the internal physiological factors such as heart rate and HRV, there is no feasible way it is hard to quantify complex emotions through heart rate and HRV, (such as the response of excitement and fear on heart rate is very similar) [7]. In addition to the limitations of sensors on the Arduino platform, so this study divides emotions through the detection of Heart Rate and HRV Cycle Offset Rate into the following three categories: (due to the experimental conditions of this study, this method cannot be used for medical purposes):

	HRV Cycle Offset Rate	Heart Rate
Stable Emotion Type	1.1 ~ 1.2	<80
Fluctuation Emotion Type	1.2 ~ 1.3	80 ~ 110
Severe Fluctuation Emotion Type	>1.3	>110

[7]: Wang, S., Li, Z., Yang, H., Bai, X., Zhang, X. (2015) *Research on the quantitative test method and realization technology of individual emotion* Abstracts of the 18th National Conference on Psychology-Psychology and Social Developmen

Technology Research

This part of the study is mainly about the research of technology. Mainly to solve the problems of human-computer interaction, including how to complete the detection of emotion fluctuation, how to turn on the led display, how to complete the production of the finished product, and how to select materials etc.

This chapter will be divided into four parts: Arduino platform,sensors, LED lighting and 3D printing.

Arduino Platform

What is Arduino?

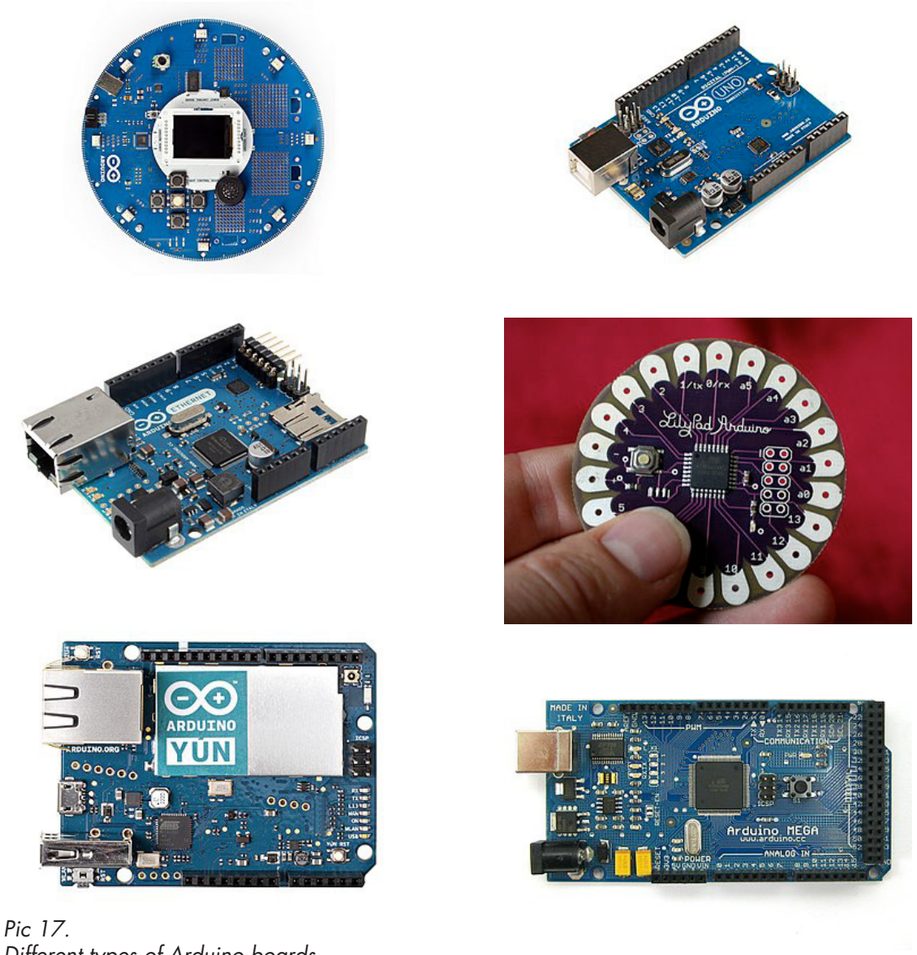
Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino Platform

What is Arduino?

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.



Pic 17.
Different types of Arduino boards
Different types of boards are suitable for different usage scenarios, and they share the same code platform, but they differ in some subtle extensions.

Arduino Platform

Why Arduino?

Thanks to its simple and accessible user experience, Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community.

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handyboard, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems: (As shown on the next page)

Arduino Platform

Why Arduino?

- **Inexpensive** - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than \$50

- **Cross-platform** - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

- **Simple, clear programming environment** - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.

- **Open source and extensible software** - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

- **Open source and extensible hardware** - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

Sensors

What kind of sensor do we need?

As a result of previous research, the most important thing about this study is that it can detect the HRV deviation of the human body and the speed of the heart rate. At the same time, the selected sensor must be used on the Arduino platform. Also, because this project is mainly a fashion design project, therefore, the principle of the sensor must be simple and easy to use, small in size, and the detection part is located on the finger.

Currently on the Arduino platform, there are two types of sensors that meet the above conditions and can test the heart rate, PulseSensor and MAX30100/ MAX30102.

PulseSensor Kit

PulseSensor started as a conversation between two professors teaching at the Parsons School of Design in New York. One summer-break and KickStarter-campaign later. World Famous Electronics llc was born in Brooklyn, NY.

Pulse Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heartrate data into their projects. The sensor clips onto a fingertip or earlobe and plugs right into Arduino with some jumper cables. It also includes an open-source monitoring app that graphs your pulse in real time.

PulseSensor Kit

1. A 24-inch Color-Coded Cable, with (male) header connectors. You'll find this makes it easy to embed the sensor into your project, and connect to an Arduino. No soldering is required.

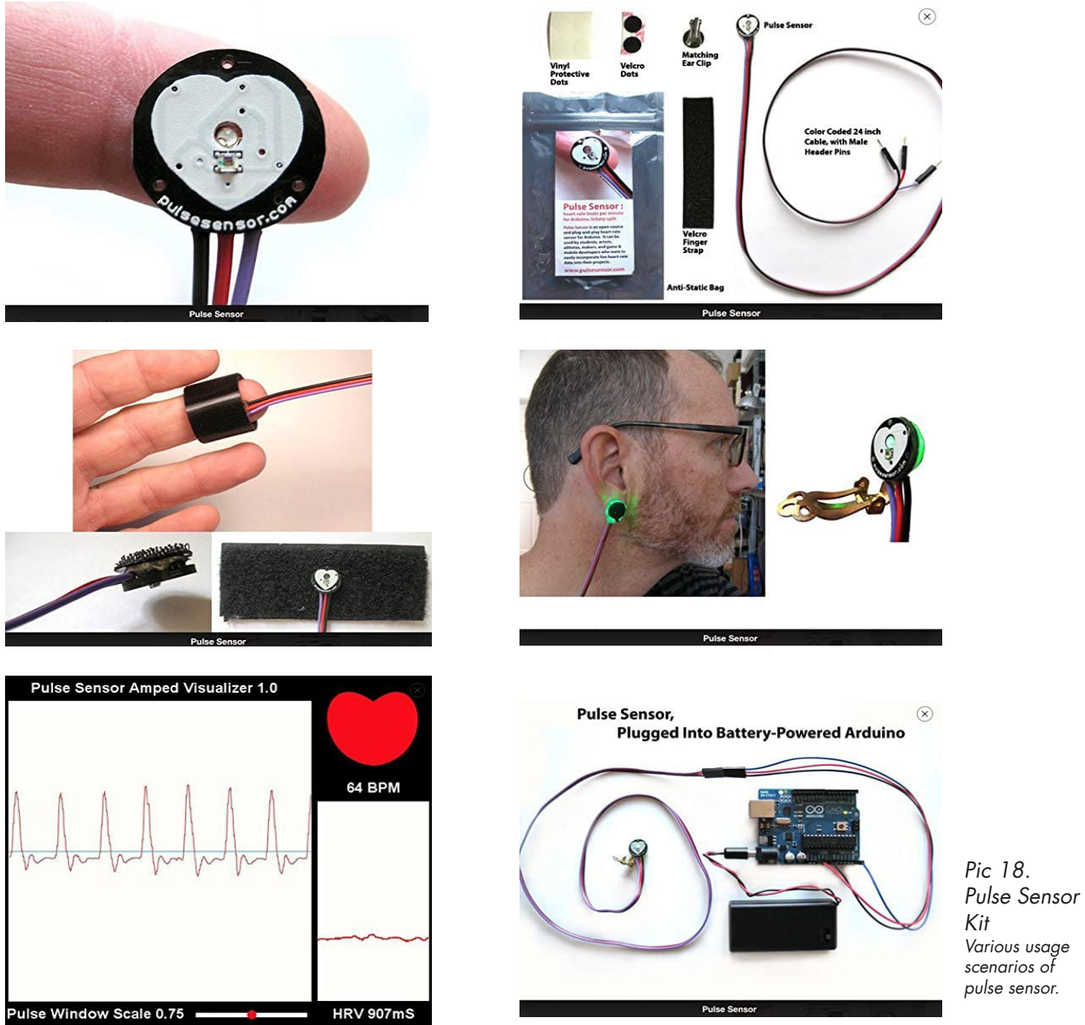
2. An Ear Clip, perfectly sized to the sensor. We searched many places to find just the right clip. It can be hotglued to the back of the sensor and easily worn on the earlobe.

3. 2 Velcro Dots. These are 'hook' side and are also perfectly sized to the sensor. You'll find these velcro dotsvery useful if you want to make a velcro (or fabric) strap to wrap around a finger tip.

4. Velcro strap to wrap the Pulse Sensor around your finger.

5. 3 Transparent Stickers. These are used on the front of the Pulse Sensor to protect it from oily fingers andsweaty earlobes.

6. The Pulse Sensor has 3 holes around the outside edge which make it easy to sew it into almost anything.



Pic 18.
Pulse Sensor Kit
Various usage scenarios of pulse sensor.

MAX30100/MAX30102 Sensor

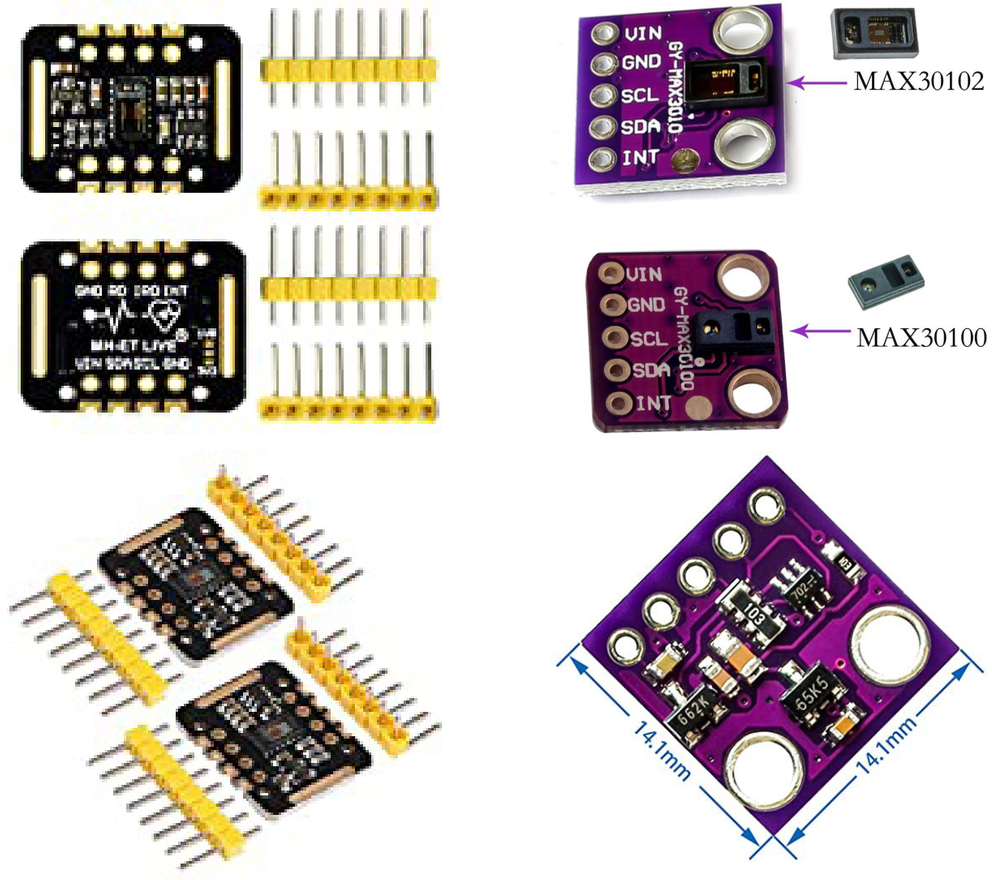
The MAX30100/MAX30102 is an integrated pulse oximetry and heart-rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals.

Key features:

- Complete Pulse Oximeter and Heart-Rate Sensor Solution Simplifies Design
  Integrated LEDs, Photo Sensor, and High-Performance Analog Front-End
  Tiny 5.6mm x 2.8mm x 1.2mm 14-Pin Optically Enhanced System-in-Package

- Ultra-Low-Power Operation Increases Battery Life for Wearable Devices
  Programmable Sample Rate and LED Current for Power Savings
  Ultra-Low Shutdown Current (0.7µA, typ)

- Advanced Functionality Improves Measurement Performance
  High SNR Provides Robust Motion Artifact Resilience
  Integrated Ambient Light Cancellation
  High Sample Rate Capability
  Fast Data Output Capability



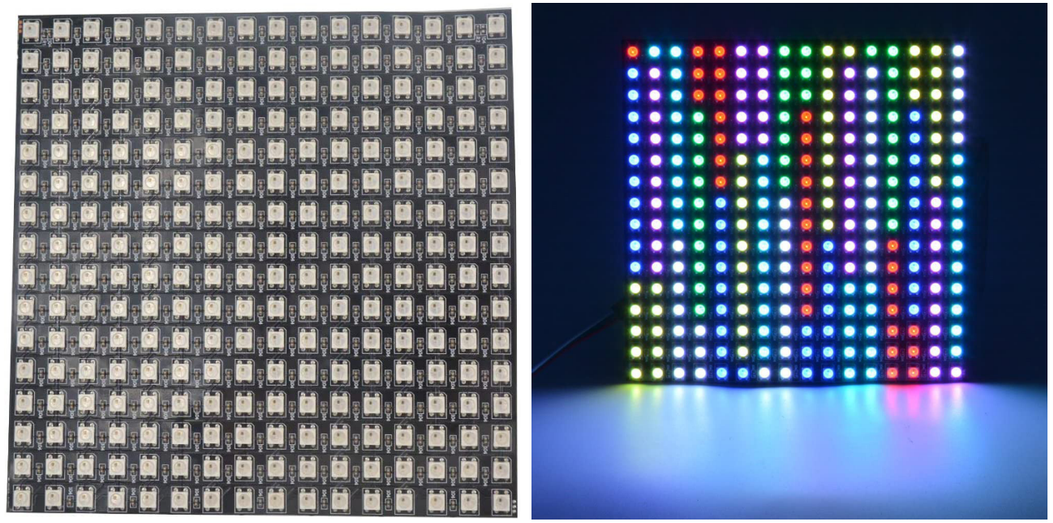
Pic 19.
MAX30100/MAX30102 Sensor
There are holes in the sensor for easy sewing on different objects.

LED Lighting

Led lighting is the most important part of this research. Led lighting will be an external expression of emotions. In order to display the effect, it is best to include a color-changing function. On this basis, it also needs to be compatible with the Arduino platform.

WS2812B 16X16

- Highly smart. Each LED is individually addressable. You can set each LED as you wish to scroll messages or draw little images.
- Wide compatibility. It works great with programmable controller, SP107E, K1000C,T1000S, etc.
- Chainable and bendable design. You can extend the panel by hooking them up one by one with the 3pin JST connectors. Flexible FPCB can be gently bent and curved around surfaces.
- Save your money. It is sturdy, beautiful and very comparable to other similar products.
- Wide application: 6.25inx6.25inx0.07in. It can be used to make led screen, led wall, advertising board and widely applied to hotel, KTV, bars, Outdoor advertising signs, Christmas or wedding party decoration, etc.



Pic 20.
*WS2812B 16*16*
Colorful display, flexible material, programmable led display.

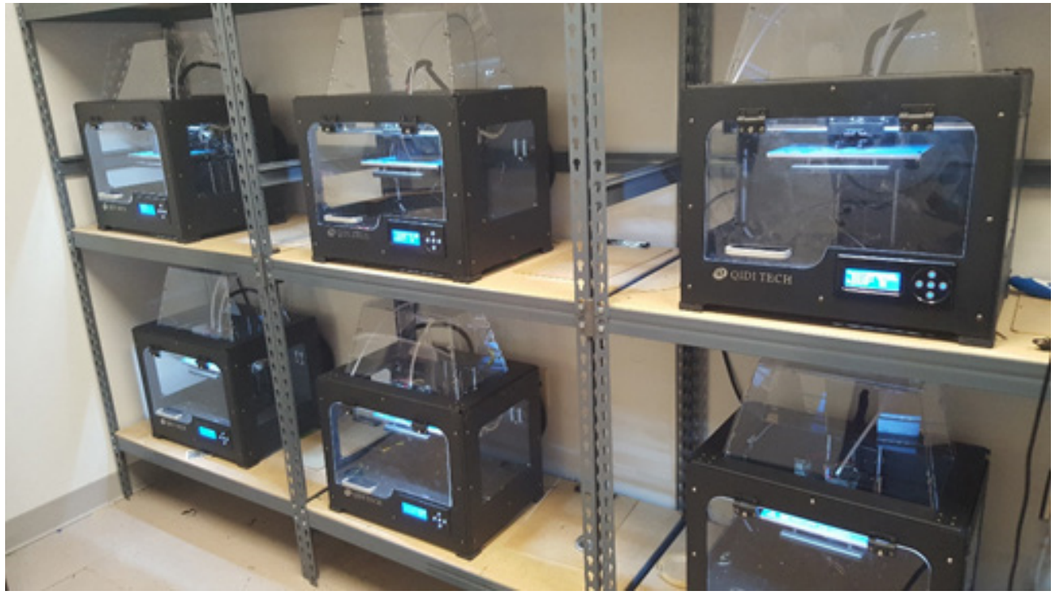
3D Printing

3D printing, or additive manufacturing, is the construction of a three-dimensional object from a CAD model or a digital 3D model.[8] The term "3D printing" can refer to a variety of processes in which material is deposited, joined or solidified under computer control to create a three-dimensional object,[9] with material being added together (such as liquid molecules or powder grains being fused together), typically layer by layer.

Why 3D Printing?

The goal of this project is to make a bag that can detect emotions, while at the same time having a soft appearance and rich colors. This is a project with a sense of science and technology. The use of 3D printing technology can not only obtain complex surface textures very quickly to provide space for subsequent fabric reconstruction, but also make it easy to make different samples.

[8]: *3D printing scales up*. The Economist. 5 September 2013.
[9]: Excell, J,. (23 May 2010). *The rise of additive manufacturing*. The Engineer. Retrieved 30 October 2013.



Pic 21.
3D Printers
with the manufacturer-provided plastic covers and doors installed, which are examples of engineering controls

General Principles

- **Modeling**

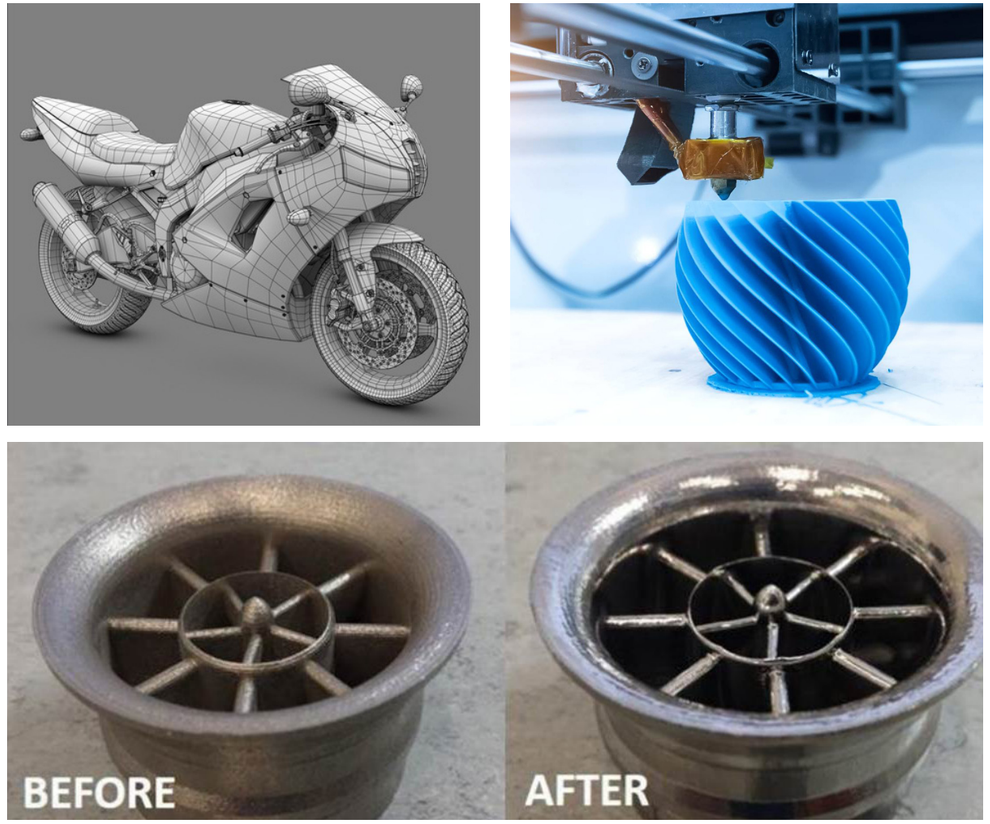
3D printable models may be created with a computer-aided design (CAD) package, via a 3D scanner, or by a plain digital camera and photogrammetry software. 3D printed models created with CAD result in relatively fewer errors than other methods.

- **Printing**

Before printing a 3D model from an STL file, it must first be examined for errors. Most CAD applications produce errors in output STL files, of the following types:holes; faces normals; self-intersections; noise shells; manifold errors.

- **Finishing**

Though the printer-produced resolution is sufficient for many applications, greater accuracy can be achieved by printing a slightly oversized version of the desired object in standard resolution and then removing material using a higher-resolution subtractive process.



Pic 22.
3D Printing General Principles
Modeling printing & finishing schematic diagram.

Main Types

- **FDM**

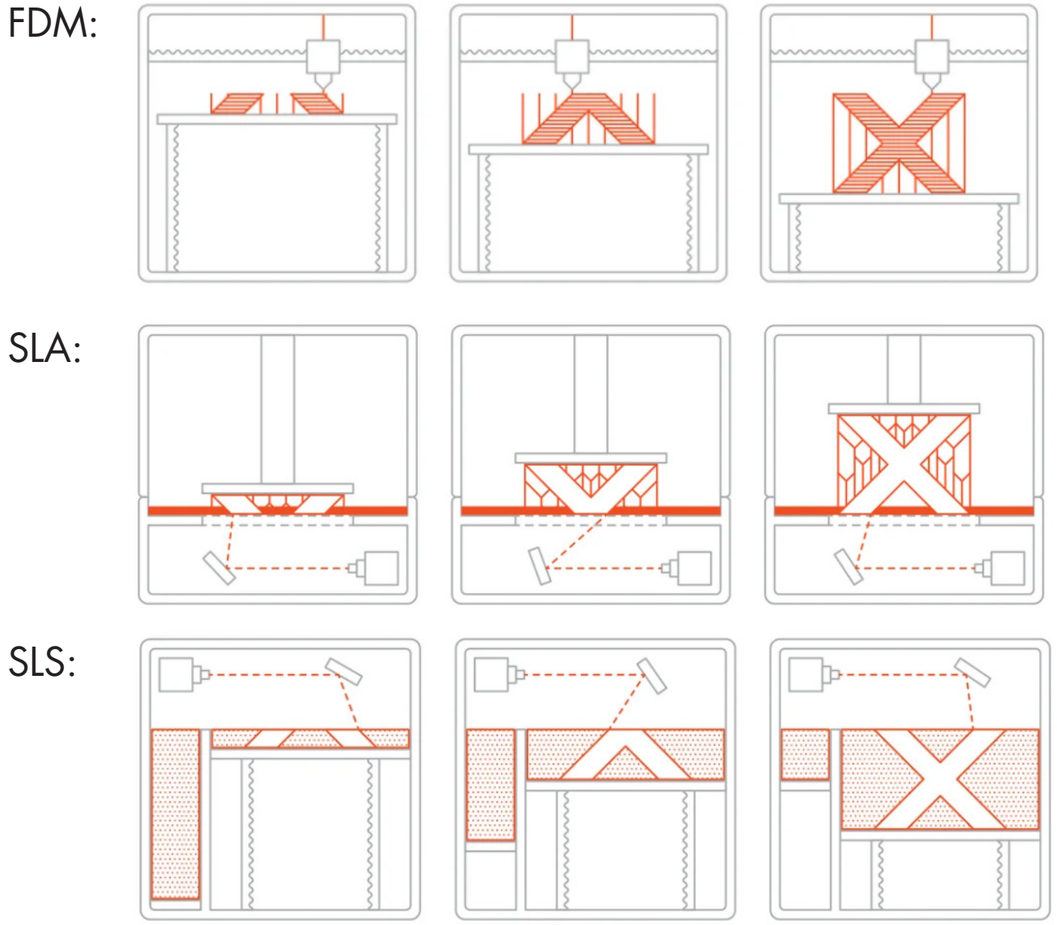
Material extrusion is a 3D printing process where a filament of solid thermoplastic material is pushed through a heated nozzle, melting it in the process. The printer deposits the material on a build platform along a predetermined path, where the filament cools and solidifies to form a solid object.
Strengths: Best surface finish; Full color and multi-material available
Weaknesses: Brittle, not sustainable for mechanical parts; Higher cost than SLA/DLP for visual purposes

- **SLA**

Vat Polymerization is a 3D printing process where a light source selectively cures a photopolymer resin in a vat. The most common form of Vat Polymerization are SLA (Stereolithography)
Strengths: Smooth surface finish; Fine feature details
Weaknesses: Brittle, not suitable for mechanical parts

- **SLS**

Powder Bed Fusion is a 3D printing process where a thermal energy source will selectively induce fusion between powder particles inside a build area to create a solid object.
Strengths: Functional parts, excellent mechanical properties; Complex geometries;
Weaknesses: Longer lead times; Higher cost than FFF for functional applications



Pic 23.
Main 3D Printing Types
From top to bottom are FDM, SLA and SLS

Traditional Materials

When deciding on what 3D printing material. This study have to factor in the application, function, and design of your component or product.

3D printing materials come in a wide array of forms. Most consumer 3D printed products are made from thermoplastics. Designers and engineers prefer creating functional prototypes from 3D printing materials that have the same or similar material properties as what's used in creating the finished product.

• ABS

Acrylonitrile Butadiene Styrene is the plastic used in Legos. It's tough, nontoxic and retains color well. (If you've ever been barefoot and stepped on a Lego, you know how tough and hard to break ABS is.)

It is also easily shaped as it melts; it becomes pliable at about 220 degrees C (430 F). This does require a large heater to reach that temperature. A printer with a heated print bed is usually needed, otherwise, it will stick. As noted, ABS gets soft and pliable when heated and then sets quickly.

• NYLON

Nylon was originally created as a replacement for silk. It has a high tensile strength (meaning it can hold a lot of weight without breaking), is nontoxic and melts at about 250 degrees C.

• PLA

Polylactic Acid is a polymer plastic made from biological materials such as cornstarch or sugarcane. It is similar to the material used in biodegradable plastic packaging. It melts between 180 - 200 degrees C, depending on other materials added to it for color and texture.

PLA is tough and resilient but not as heat tolerant as ABS. It begins to deform at temperatures higher than 60 degrees C. It is also not water or chemical resistant. There is a slight smell when it is heated but no toxic odors or vapors.

• PET

Polyethylene terephthalate is similar to polyester, it is also known as t-glase. It melts at around 230 degrees C and cools into a rigid solid resembling glass. It can be dyed while maintaining its glass-like characteristics, therefore it is available in a variety of colors.It is approved for food use, so it is good for printing utensils, cups, water bottles, and other items that come into contact with food.

• SLA RESINS

Stereolithography (SLA) resins were developed to simulate the properties of "traditional" 3D printing materials. There are SLA materials that have the durability of ABS or the bio-compatibility of PLA. Some have similar properties of wax or ceramics.

New Materials

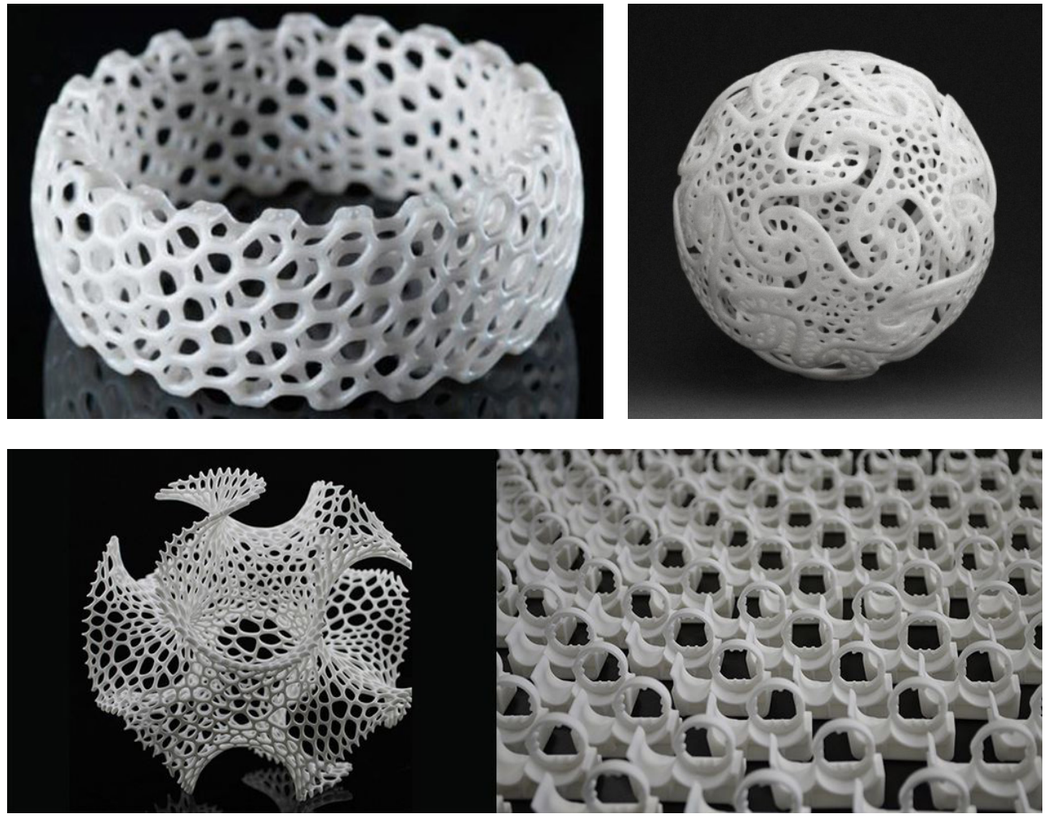
• UV-Curing Resins

UV-curing resins are materials that are polymerized and cured in a short time by the energy radiated from ultraviolet irradiation devices. These are especially used as industrial materials for sealing, bonding, and coating.

As the UV curable resin is single-component and non-solvent, it does not contaminate the work environment with any solvent. This adhesive is cured within seconds. Its excellence in mass production significantly helps reduce the production processes.

Excellent characteristics of UV-curing resins

- Because the curing speed is fast, working hour is shortened.
- Because they do not cure without UV irradiation, restrictions are few in the coating process.
- They can cure at a low temperature.
- Because of nonsolvent, one-part resin, they provide good workability.
- A variety of cured features is available.



Pic 24.
Finished products made with UV-Curing Resins
Can quickly complete various complex surfaces

Fashion Technic Research

Tapestry Loom

A loom is just a mechanical means to hold a series of threads called warp in place while the weft is woven across them. How the equipment does that varies with styles and sizes of looms. A tapestry loom can be as simple as a picture frame or as complicated as a countermarche floor loom.

Usually starting with a base of hard-wearing maple timber, the solid construction will endure high tension warps typical to tapestry weaving, warp after warp. Built for comfort the loom is loaded with adjustable features to aid warping and weaving, plus ergonomic handles and grips for fine tuning. A generous warp width, mechanical shedding device, colour-coded warp guides and cartoon holder provide endless possibility for when inspiration strikes.

The tapestry loom was chosen for this study because it is very convenient for the patterns you want. At the same time, there are various sizes and specifications to choose from, which is convenient for making samples of different sizes.

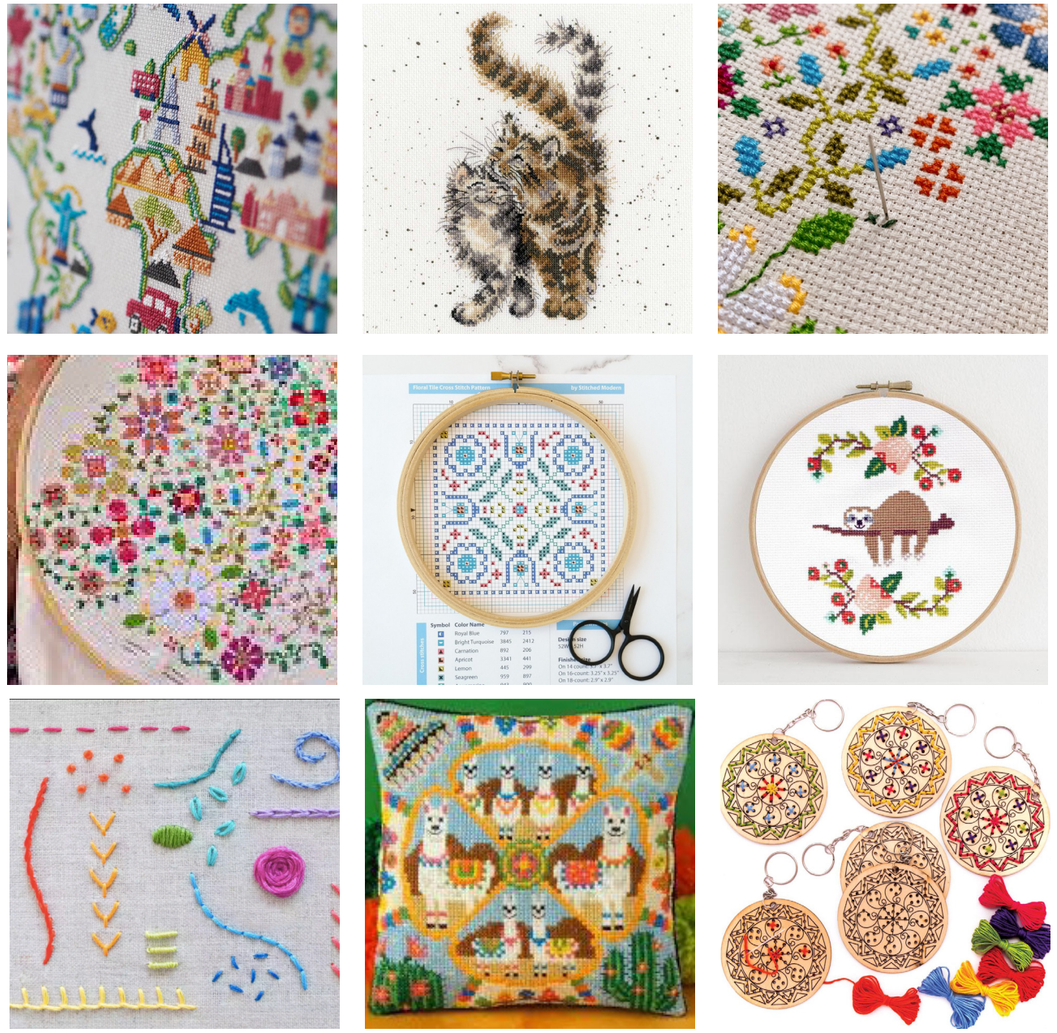
Pic 25. Tapestry Loom

Fashion Technic Research

Cross-stitch

Cross-stitch is a form of sewing and a popular form of counted-thread embroidery in which X-shaped stitches in a tiled, raster-like pattern are used to form a picture. The stitcher counts the threads on a piece of evenweave fabric (such as linen) in each direction so that the stitches are of uniform size and appearance. This form of cross-stitch is also called counted cross-stitch in order to distinguish it from other forms of cross-stitch. Sometimes cross-stitch is done on designs printed on the fabric (stamped cross-stitch); the stitcher simply stitches over the printed pattern. Cross-stitch is often executed on easily countable fabric called aida cloth whose weave creates a plainly visible grid of squares with holes for the needle at each corner.

In this study, cross-stitch was chosen because it can be easily linked with wool to embroider hollows or other special effects on the plane, and use different stitches to achieve different surface texture effects. It is also easy to combine with bag design.



Pic 26. Cross-stitch

Color Research

Morandi Colors - The Most Comfortable Color

Morandi colors refer to a muted and pale color palette, which is not bright as if covered with a layer of gray tone. Morandi colors has rich connotation without a tendency to show off, releasing the soothing elegance. In this palette hue, everything is not flamboyant and quietly shimmers the simplest charm and the direct inner happiness and tranquility, so that the visual sense can achieve a perfect balance.

Morandi colors are derived from the paintings of Giorgio Morandi, a famous Italian printmaker and oil painter. In his paintings, the subjects are simple objects that could be easily seen in our kitchen, such as cups, plates, bottles, boxes and so on. However, these everyday objects present a distinguished senior feeling through different brushes and color combinations. He abandons the personality of flamboyant color, infiltrates gray and white tones in each color and transforms the original rich and gorgeous colors into muted tones with elegant and advanced gray texture. These muted colors are gentle and cold, but such a tone of the opposite bright line makes the whole painting full of mystery, giving people elegance, novelty, sincerity and comfort.

Pic 27. Two Samples of Morandi Color

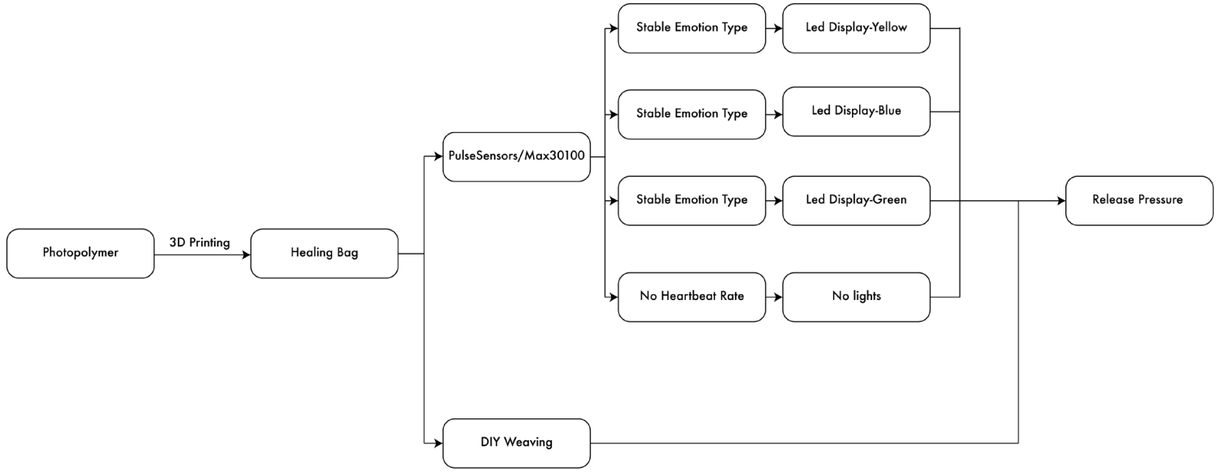
Morandi colors are also known as “advanced gray”, but they have not only one or several colors. They are based on gray but you can add whatever colors you like. This marvelously blend reduces the color saturation and give color a peaceful and pastel ethos. Morandi colors have a kind of indifferent and alienated tone, making the space downy, natural, gentle and elegant and showing the beauty of static harmony. Hence, Morandi colors are well-known as the most comfortable color.

Design Description

The theme of this project is called "**Healing**"（"愈" in Chinese）, and it will be divided into two parts.

- The first part is the human-computer interaction part, which will use the heart rate sensor of the Arduino platform to detect changes in emotions and reflect the results on the LED lighting effects.

- The second part is the DIY weaving part, which will use 3D printing to print out the porous panel as the bag skeleton, and users can create rich texture effects on the panel.The connection between the bag panels is also done with wool or silk.



Usage Scenario 1

When you need to face tension

Modern young people often need to face tense emotions in life, and their emotions will fluctuate sharply. For some scenes in life, "healing" bags can solve this problem well and give you a relaxed and happy mood experience.
Try to imagine the following usage scenario.

- 1. When you are afraid of heights but have to take a plane
- 2. Before facing a very important interview or test
- 3. Needlesickness but have to go for a physical examination

etc.....

Usage Scenario 2

In a social scene

We hope that those who are not very involved in social interactions or who are afraid of social interactions can also eliminate the nervousness in their mind, participate in social interactions better, communicate with friends, and increase happiness. The unique texture of the bag can also better help users open up the topic.
Imagine the following scenario

- Just came to a new working environment
- At a party where no one is familiar
- On blind date (a traditional Chinese activity that introduce the spouses to another one)

etc.....

Usage Scenario 3

Have been suffering from anxiety for a long time

Weaving activities can effectively relieve psychological anxiety, calm people, and quickly enter the meditation state. At the same time, you can create a unique bag of your own, and you can get good psychological feedback from this process.

Get the 3D printed components and start weaving immediately to ease your anxiety. DO IT YOURSELF.

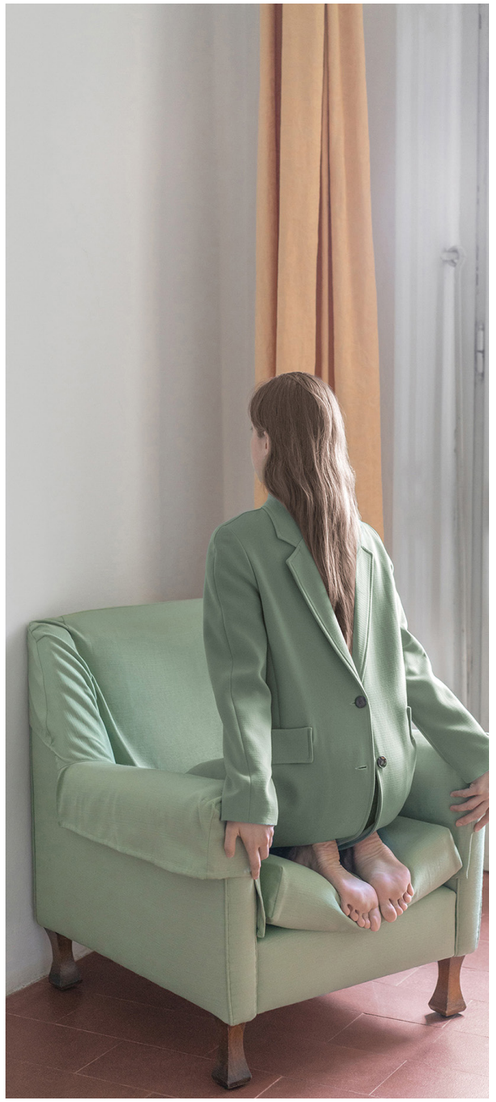
Mood Board

Design elements are extracted from wound healing, embracing interlaced feeling, decompression bubble paper, etc., to design fabric samples with healing colors, soothing textures, soft textures and natural materials. Staggered ripples, scattered points, center spread, etc.

Color Board

After a lot of research, the healing colors are usually soft, friendly, low-saturation colors. Light green and blue are usually used in the healing environment and medical equipment of mental hospitals to relieve the nervousness or anxiety of patients. This series uses yellow-green as the main color, and dark blue as the embellishment. And join the "advance gray" of the Morante color series.

The entire series will be divided into three colors, namely **Yellow, Green,** and **Blue**.



Color Board

Green: is the most common color in nature. Emotions are expressed as freshness, hope, safety, calm, comfort, life, peace, tranquility, nature, and relaxation.

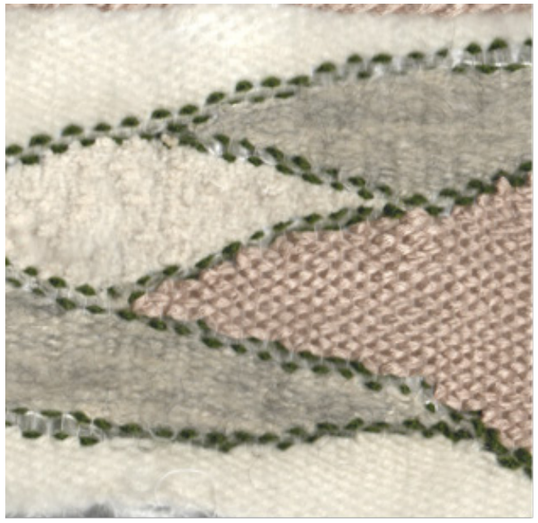
Yellow: medium-wave light color, is the brightest color among all colors. The mood is expressed as a feeling of lightness, hope and vitality, which is inspiring.

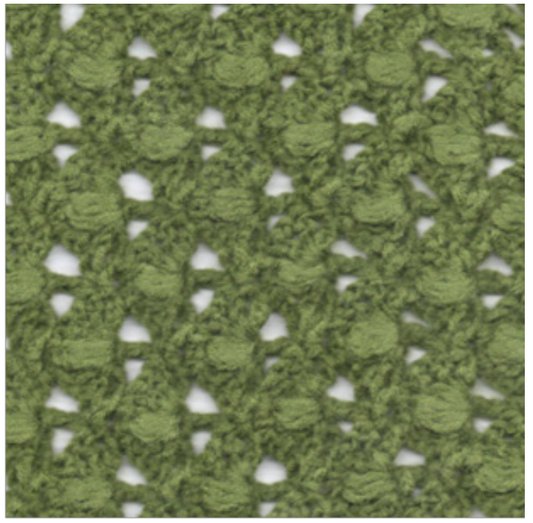
Blue: has a short wavelength and is very pure. It makes people's retina contract when viewed, making people calm and restrained. Emotions are calm, sensible, peaceful and broad.

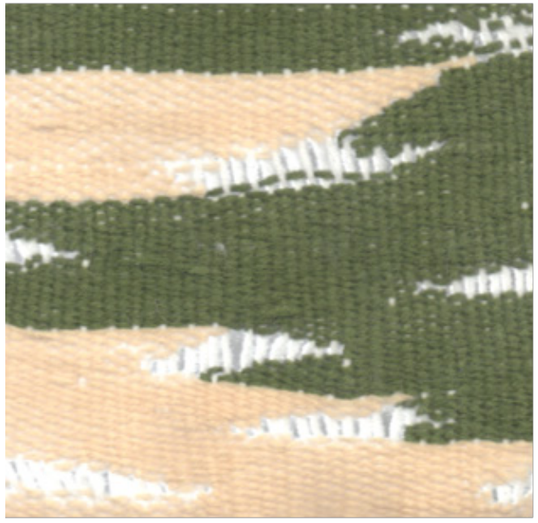
Samples

Using different weaving techniques, the surface of the fabric can present a hollow texture. It is more convenient for the light to pass through, so that the final presentation effect will be better. Through the selection of different lower contrast colors, colors with lower contrast are selected, which are closer to some colors of the Morandi color system.

After the fabric sample is done, the image is obtained through the scanner.







Sketches

Design Description:

- Round Shape

The rounded shape makes the whole bag softer and non-aggressive. The appropriate size is convenient for daily use.

- 3D Printing

The 3D printed panel using photosensitive resin (Photopolymer) material has high strength, light transmission, and flexibility.

- DIY Weaving

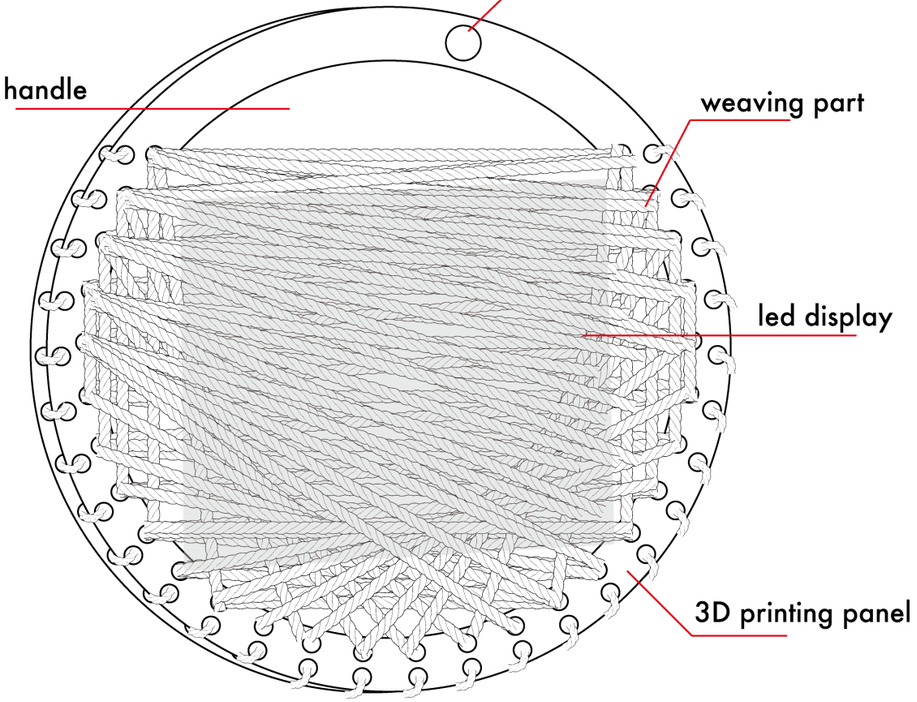
The holes of the product are divided into DIY holes (orange) and connecting holes (black). The DIY holes can be knitted with any wool or silk thread to create a unique appearance, and the weaving process can also relieve stress and anxiety.

- Led Module

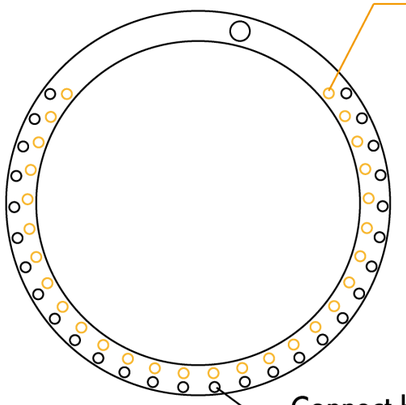
It can detect the heartbeat, and use the changes of three colors of light to show the user's psychological pressure and give a certain degree of relief.

96 | 97

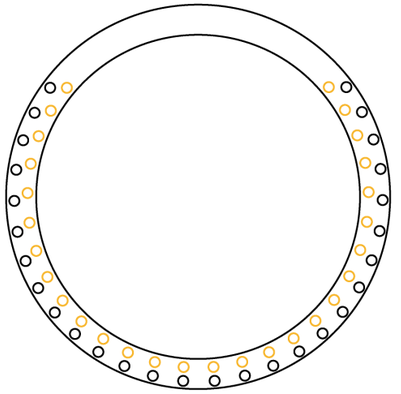
Effect Drawing



Front Panel

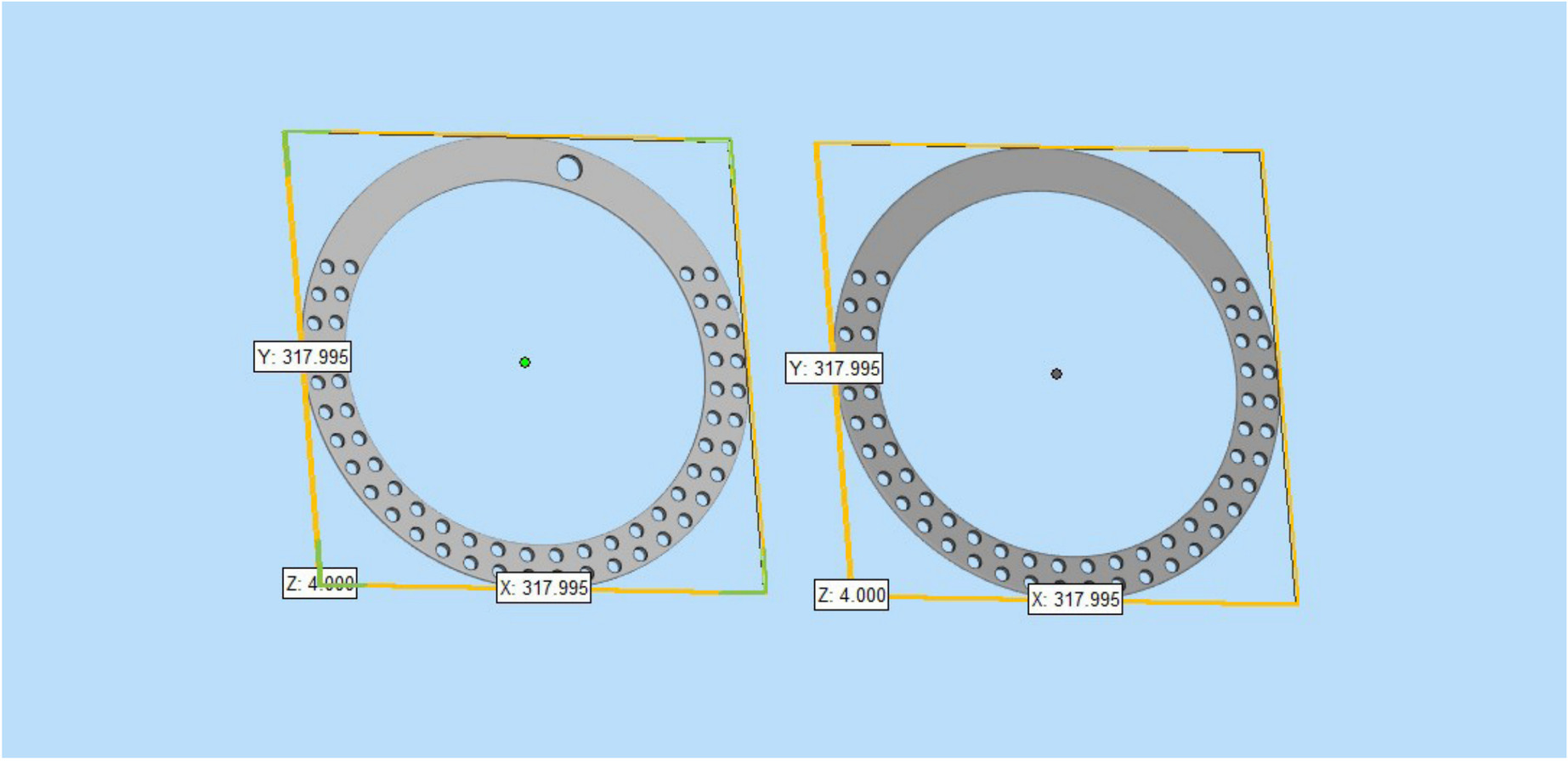


Back Panel

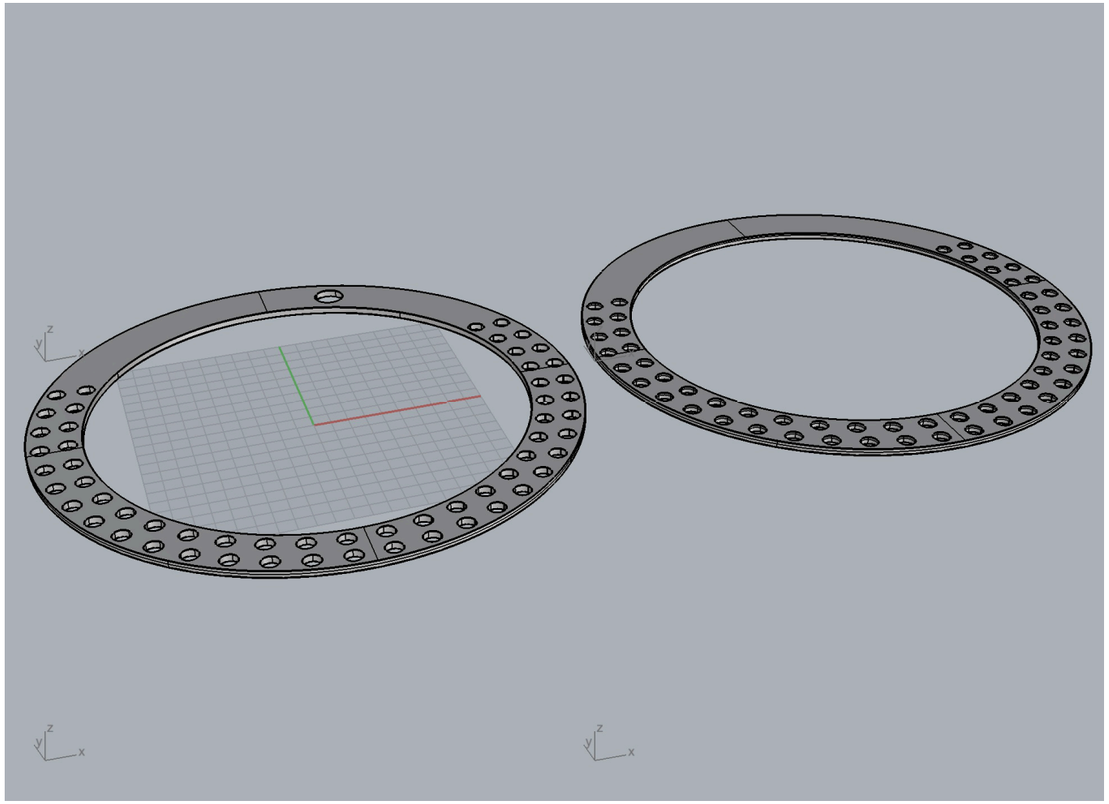


Modeling

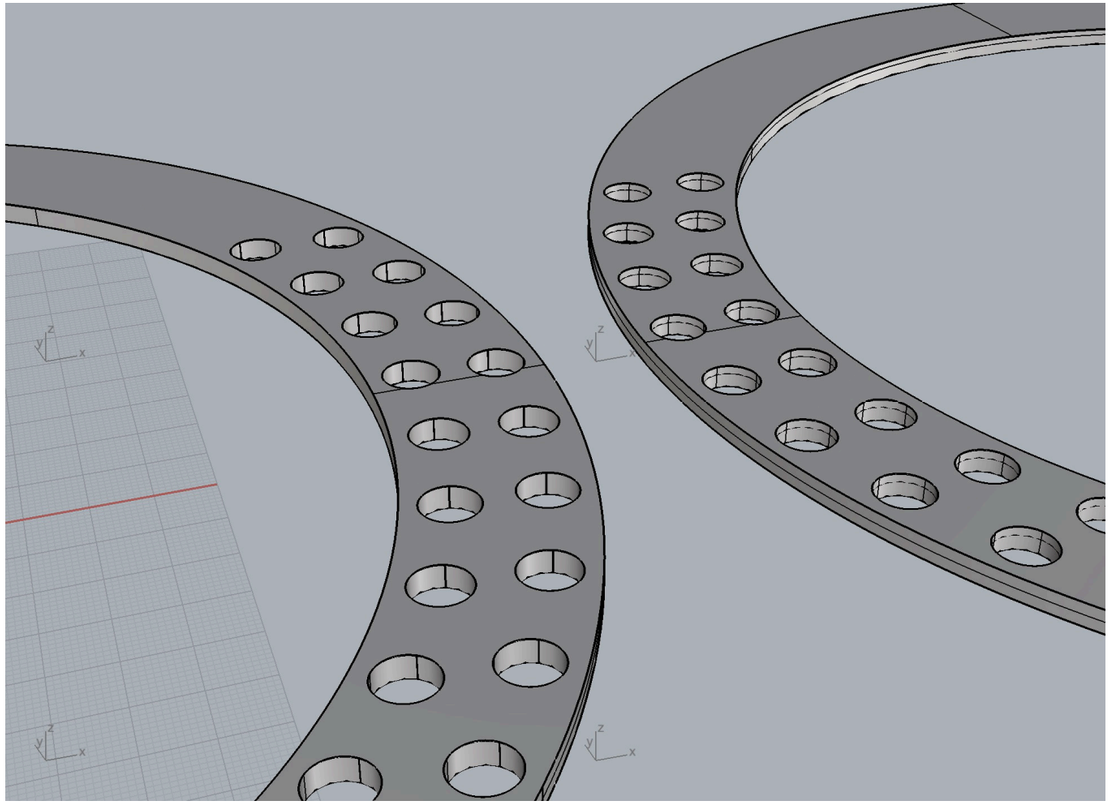
Use **RhinoWIP** software to model the package board. The specific dimensions and details are shown in the figure. Unit: mm



Modeling

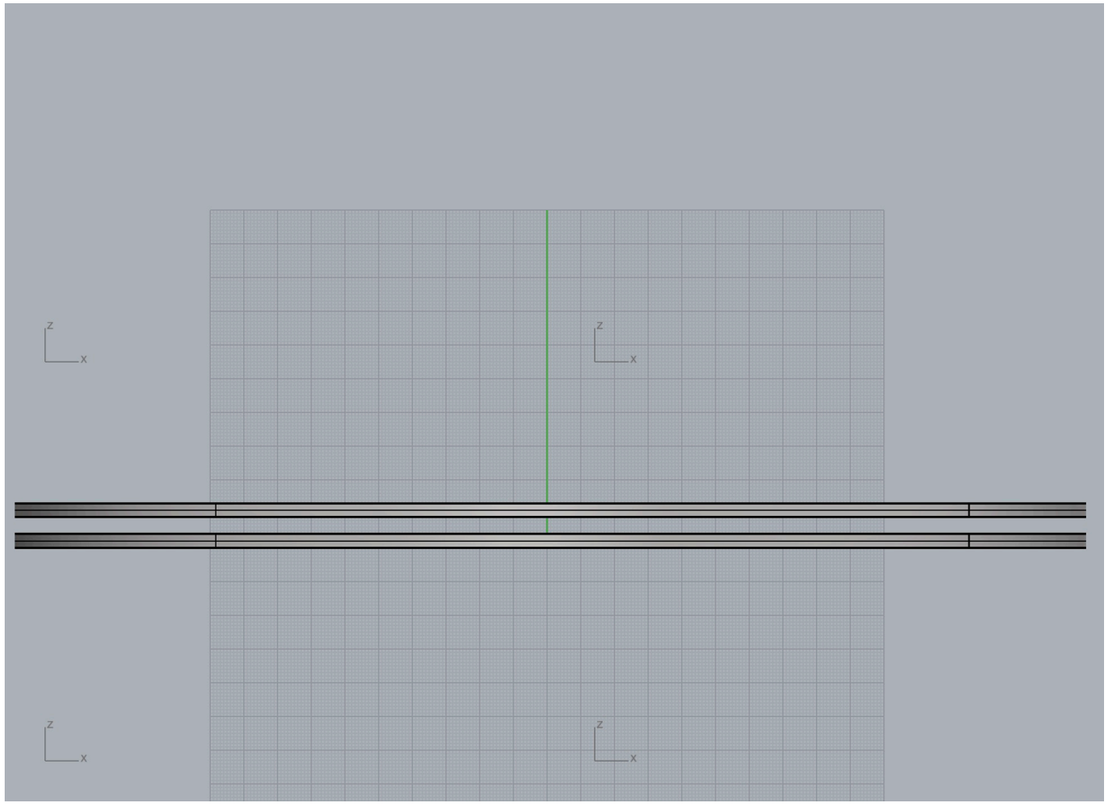


Preview

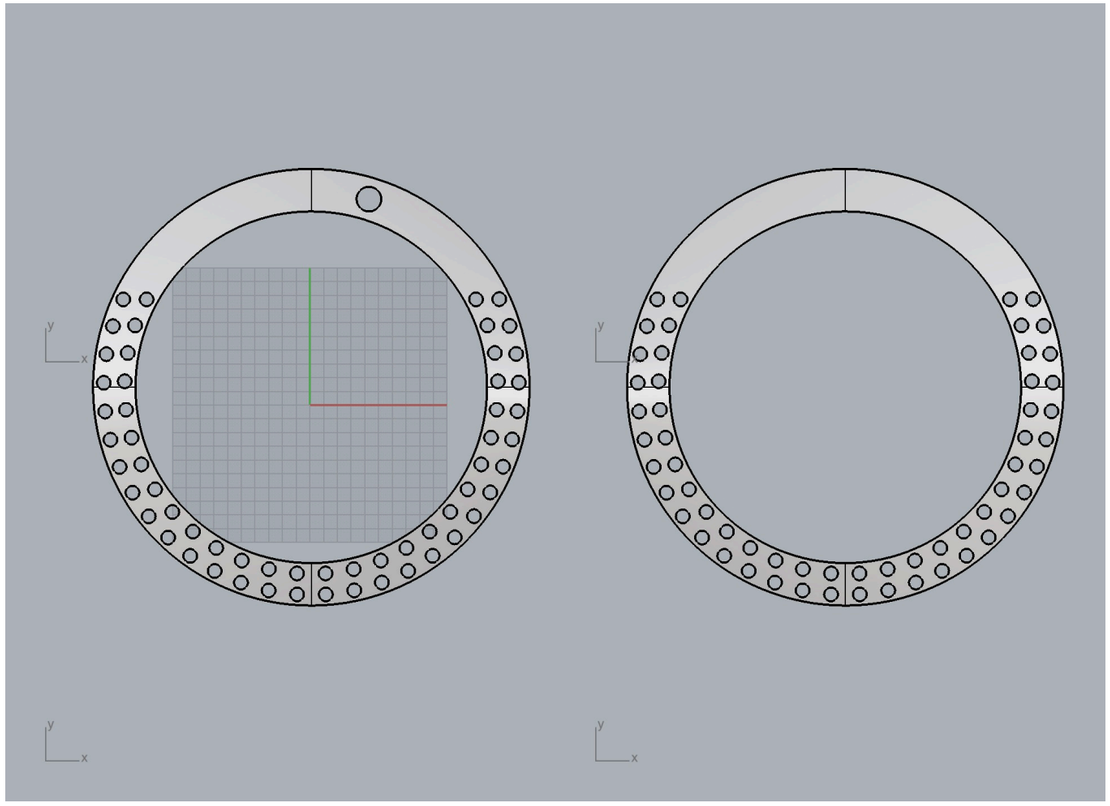


Details

Modeling



Front View



Top View

Coding

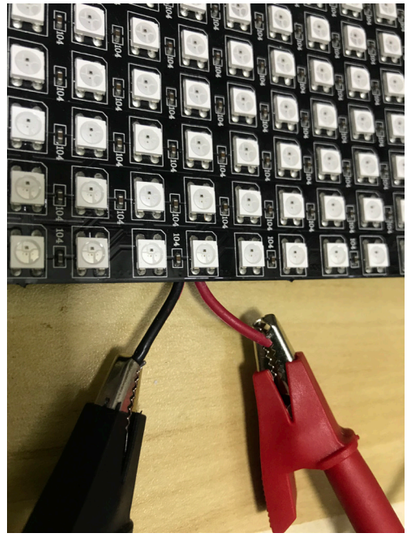
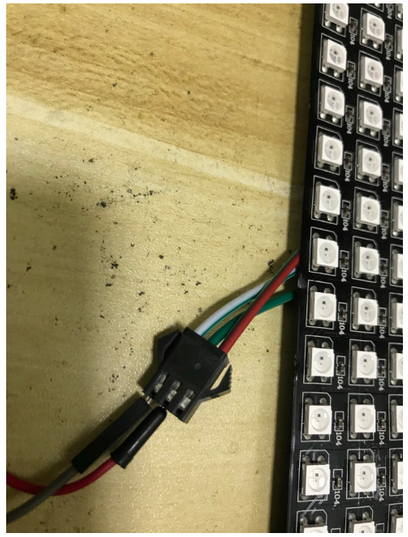
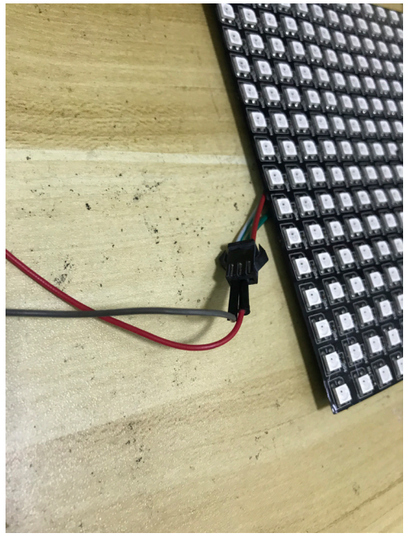
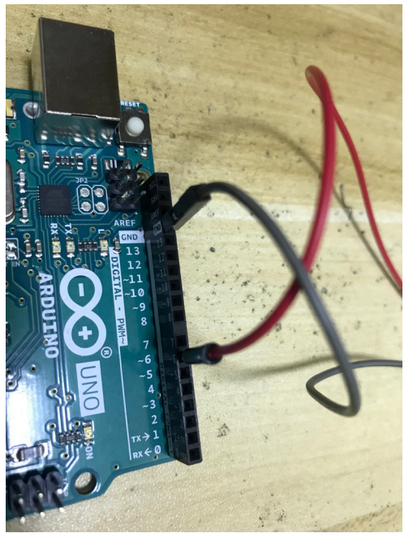
Light up lights of different colors by detecting different heart rates

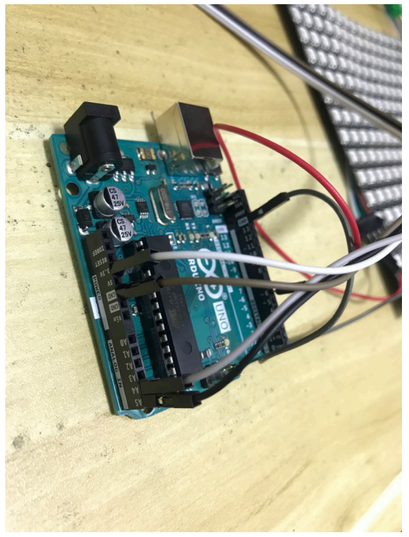
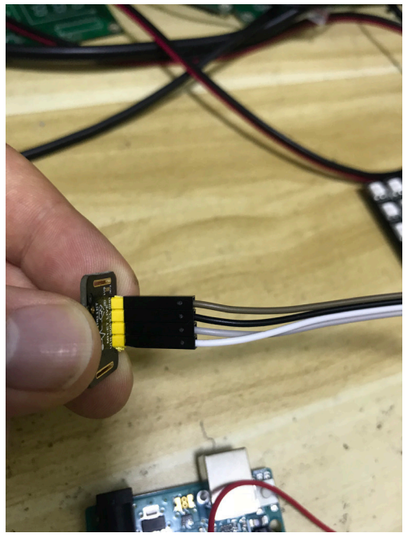
```
if (irValue < 50000)
  {
    Serial.print(" No finger?");
    colorR = 0;colorG = 0;colorB = 0;  (Changing the value here
can change the color of the light)
  }else
      { if(beatAvg<80) {
          colorR = 100 ;colorG = 100;colorB = 100;
        }else if(beatAvg>=80&&beatAvg<=100)
             {
               colorR = 240;colorG = 255;colorB = 200;
             }else if(beatAvg>=100)
                  {
                    colorR = 205;colorG = 200;colorB = 177;
                  }
```


The code here can control the interval of the breathing light

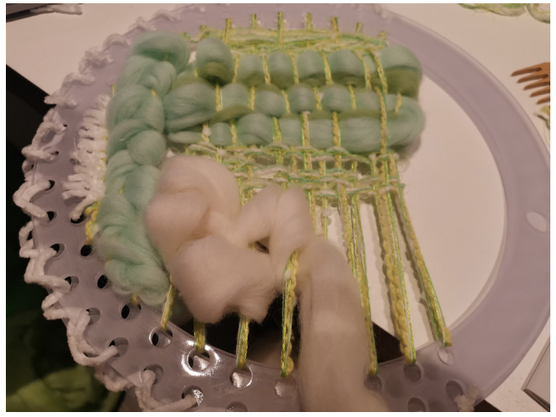
```
      if(colorR>0)
      colorR–;
      if(colorG>0)
      colorG–;
      if(colorB>0)
      colorB–;
      if(colorR==0&&colorB==0&&colorG==0)
      break;
      for(int i=0; i<strip.numPixels(); i++) { //For each pixel in
strip...
        strip.setPixelColor(i, strip.Color(colorR,colorG,colorB));
//Set pixel's color (in RAM)
      }
      delay(10);  (Changing the value here can change the
interval of the breathing light)
      strip.show();
```

Process-Arduino

Process-Weaving



“healing”

“healing”

“healing”

“healing”

Appendix

Bibliography

1. Harlow, H. F. (1958). The nature of love. American psychologist.
2. Kandinsky, W. (1977). Concerning the Spiritual in Art. Courier Corporation.
3. Csikszentmihalyi, M., & Csikzentmihaly, M. (1990). Flow: The psychology of optimal experience (Vol. 1990). New York: Harper & Row.
4. Yan, K., Zhang, W., Zhang, Y., & Feng, W. (2006). The Application of Heart Rate Variability to Study Psychosomatic Disease and Emotion Disorder. Advances in Psychological Science, 14(02), 261.
5. Sztajzel, J. (2004). Heart rate variability: a noninvasive electrocardiographic method to measure the autonomic nervous system. Swiss medical weekly, 134(35-36), 514-522.
6.Stemmler, G., Heldmann, M., Pauls, C. A., & Scherer, T. (2001). Constraints for emotion specificity in fear and anger: The context counts. Psychophysiology, 38(2), 275-291.
7. Wang, S., Li, Z., Yang, H., Bai, X., Zhang, X. (2015) Research on the quantitative test method and realization technology of individual emotion Abstracts of the 18th National Conference on Psychology-Psychology and Social Developmen.
8.Sternberg, R. J., & Grajek, S. (1984). The nature of love. Journal of Personality and Social psychology, 47(2), 312.
9. Henry, M. (2009). Seeing the invisible: on Kandinsky. A&C Black.
10. Hahl-Koch, J. (1993). Kandinsky (pp. 143-151). London: Thames and Hudson.
11. Kandinsky, W., & Rebay, H. (1979). Point and line to plane. Courier Corporation.
12. Csikszentmihalyi, M., & LeFevre, J. (1989). Optimal experience in work and leisure. Journal of personality and social psychology, 56(5), 815.
13. Seligman, M. E., & Csikszentmihalyi, M. (2014). Positive psychology: An introduction. In Flow and the foundations of positive psychology (pp. 279-298). Springer, Dordrecht.
14. Malik, M., & Camm, A. J. (1990). Heart rate variability. Clinical cardiology, 13(8), 570-576.

Figures

1.& 2. "Turn signal biking jacket,"© by Leah Buechley
3.& 4. Living Wall
5.& 6.& 7.& 8. NeuroKnitting
9.& 10. Interactive Cushion: When feel the changes in touch, the pillow will be lighted.
11. GRE Mood Sweater
12. Heart Rate Monitoring Shirt
13. Rhesus Monkeys Experiment
14. Wassily Kandinsky. Colour study with concentric circles. 1913.
15. Wassily Kandinsky. Yellow-Red-Blue. 1925
16. Sarah Neubert working at one of her looms. Photo by Caleb Young.
17. Different types of Arduino boards
18. Pulse Sensor Kit
19. MAX30100/MAX30102 Sensor
20. WS2812B 16*16: Colorful display, flexible material, programmable led display.
21. 3D Printers: with the manufacturer-provided plastic covers and doors installed, which are examples of engineering controls
22. 3D Printing General Principles: Modeling printing & finishing schematic diagram.
23. Main 3D Printing Types: From top to bottom are FDM, SLA and SLS
24. Finished products made with UV-Curing Resins: Can quickly complete various complex surfaces
Pic 25. Tapestry Loom
Pic 26. Cross-stitch
Pic 27. Two Samples of Morandi Color

Thanks

Special thanks to my mentor for supporting me. After a long time of hard work, I finally achieved my set goals. But there are some regrets left. This project can be done better. If anyone wants to work on the same topic in the future, I can provide all the information of the paper free, thanks again.