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A Study on Emotional Information System Using User Color Information

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Abstract

The appropriate use of color and light can increase psychological stress or feelings of mental stability. As such, many people currently use color therapy, which provides relaxation and stability through color stimulation. Many people currently use color therapy, which provides relaxation and stability through color stimulation. The smartphone-based psychological color therapy system that is to be developed through the study is a method for relieving stress. This study examines a method of using smartphones to understand user's emotional information such as types of stress and to provide color therapy information regarding these emotions. The goal of this study is to use the user's smart phone to provide color therapy that employs the user's emotional information. The intelligent emotion system, which uses platforms such as mobile devices and the PC, was designed considering the user's context, and it provides the user with various data formats such as images, video, text, audio, to send results to the user. The system was developed in the form of a service-based mobile application. The study designed an emotional color therapy system that uses a smartphone to measure the user's stress and provides appropriate color therapy.

Keywords: *Emotional information system, User color information, Stress, Color therapy, Mobile application, Color Therapy*

1. Introduction

Human experience stress in various situations during their lives. They mainly experience stress due to stimulation, and unlike what many people think, it is not just strong simulation that leads to stress. Humans experience stress even when there is no stimulation, and the reasons for this are thought to include a decrease in problem-solving ability and the loss of a sense of space and time. When stimulation is strong, humans become anxious, and there are innumerable reasons for becoming anxious during our daily lives. A few of these include conflicts and changes in life. In moments when we deviate from what is familiar or make the decision to do so, humans become anxious, and this leads to stress [1, 2]. In addition, people become stimulated and experience stress during work due to personal relationships, the nature of the work, tiredness, etc. In modern society, stress occurs due to work because work hours have expanded and work has become more systematized [3, 4].

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Methods for obtaining a peaceful mind include sufficient rest, meditation, exercise, and vacations. Doing these things is not easy for busy modern people who lack even time to sleep due to the need for a certain environment and conditions. In such times, colors can help resolve stress just by being nearby. Because our bodies and minds are stimulated by the energy produced by colors, they can have an unexpectedly large effect when properly utilized in our daily lives. The appropriate use of color and light increases not only psychological stress but feelings of mental stability. As such, many people currently use color therapy, which provides relaxation and stability through color stimulation. In color therapy, there has been a recent increase in attempts to use colors and naturopathy to treat stress, which is a root cause for all diseases [3]. Each color has a unique wavelength and frequency, and colors have an effect on the muscles and psych neural activities of plants and animals, including humans. Color therapy is the study of the effects of color on health and the use of color in the treatment of disease or stress.

The goal of this study is to examine psychological color therapy as a method for relieving stress in adolescents with smartphones, which adolescents use for long periods of time. An operating principle and an organizational system were developed for this method. To accomplish this goal, the study aimed to understand the causes and degree of adolescent stress through questionnaires and a literature review on the causes, measurements, and methods for resolving stress that have been studied up to now. To relieve the adolescent stress that was found in the questionnaire, the goals of this study will be implemented in a convenient and proactive way using mobile devices, which are familiar to adolescents.

The rest of the paper is organized as follows. Section 2 surveys related work. It also describes the existing methods to relieve stress. Section 3 presents the design method of emotional information system. It presents stress measurement methods and results, and describes the design and operation of emotional information systems, and we conclude in Section 4.

2. Related works

In modern society, stress is a factor that everybody experiences due to complicated work tasks, school life, and personal relationships. In the 19th century, the term was used academically in the field of physics, but in the 20th century, continued research confirmed the close relationship between humans and stress, and stress emerged as the cause of various diseases. As such, it became an object of focus in the medical field [2-4]. Even today, stress is being studied in various fields by many researchers in regards to its physiological and mental effects. If stress is not effectively relieved, it can lead to a variety of physical diseases and bodily symptoms such as headaches, irritable bowel syndrome, ulcerative colitis, neurodermatitis, high blood pressure, diabetes, digestive disorders, and heart disease. In addition, it can bring about psychological disorders such as depression and anxiety, as well as changes in behavior such as alcohol, tobacco, and drug use that are caused by these disorders. These behavior changes may in turn influence the occurrence of physical pathologies. Emotional and spiritual symptoms can lead to a sense of alienation or a lack of intimacy in personal relationships [5]. In this way, stress is a factor that anybody can experience in their daily lives. However, if our methods of coping with stress are poor and the stress in our lives continues, it may have consequences for us. Therefore, we need to prevent and react to stress with quick and precise countermeasures [6].

Stress relief methods include art therapy, anti-stress techniques that use aromatic oils, and mentoring programs. Art is an effective activity for expressing emotions and resolving the emotions that are in our minds. Art has been used in stress therapies because participants can understand their inner sides and

alleviate their emotions through artistic activities. Because artistic activities can reveal unconscious emotions within people, art has been used in a variety of psychological therapies. In addition, art therapy has shown effectiveness as a preventative treatment, and therefore it is used as an early preventative measure for adolescents. Art therapy combines art and therapy, and it can be thought of as a method that uses the visual effect of art to help with psychological treatment [7, 8]. In art therapy, participants can express their emotions and inner selves, and they can obtain self-esteem and self-satisfaction through the expression provided by artistic activities. Art therapy plays an important role in discovering and recovering from repressed inner emotions or distorted psychological issues, as well as developing potential and growing as a person. Furthermore, when art's creative and expressive characteristics are demonstrated through artistic activities, participants can express or even resolve their inner conflicts and emotions, and they can improve themselves by thinking about their own issues [8]. These benefits are widely used not just for individual psychological therapy but also for group art therapy to prevent the occurrence of potential issues and improve individual self-regulation and positive sociality. Art's creative process and creative work have value as activities for adolescent self-growth [7]. The goals include stress relief, self-esteem improvement, and sociality improvement.

Art therapy provides an opportunity to resolve the intense stress of adolescents through art education during class activities. It helps students develop into healthy adolescents. Aromatherapy uses aromatic essential oils (which are pure natural substances carefully extracted from natural aromatic plants) to treat neurological and stress-related disorders in a variety of ways. Aromatherapy uses essential oils extracted from various plants, and a wide variety of modern aromatherapy methods have been developed using aromatic scents and nebulizers. Of the various aromatic oils, aromatherapy uses those which can calm the central nervous system and keep it in a stable, balanced state. Mentoring is a program which establishes continuing relationships between adults and adolescents so that adults can provide guidance to adolescents who are going through difficult times. Mentoring entails a helpful and humane relationship between the mentor and the mentee that includes specialized development, growth, and various kinds of support. To promote the development of mentees, relationships are created with people that have somewhat more experience [9, 10].

3. Emotional information system using user color information

The study examines a method of using smartphones to understand users' emotional information such as types of stress and to provide color therapy information regarding these emotions.

3.1 Stress measurement and improvement plan

3.1.1 Stress measurement method

Study results have shown that the biggest cause of stress in adolescents is school problems and anxiety about the future. Therefore, this study measured adolescent stress and analyzed its causes through an adolescent-targeted survey on stress caused by school problems and anxiety about the future, which are the biggest causes of stress.

Table 1. Survey items

Q1	(Grade) I worry because my grades do not improve even though I try hard.
Q2	(Test preparation) I feel very nervous and anxious each time I take a test.
Q3	(Learning attitude) I am upset because I cannot concentrate when I study.
Q4	(Career path) I worry about my career path and future.
Q5	(Extracurricular activities) I have difficulties because I attend many tutoring schools and have many extracurricular activities.

As a method of measuring stress, survey items from 'A Study on Adolescent Stress and School Adaptation (2004)' [3][14] were used. The five questions about school work and career paths were selected, as shown in Table 1. The stress measurement survey was given to 16 students in their 3rd year of middle school in July 2019. The students could answer each question with 'That is not true at all' (1 point), 'That is not particularly true' (2 points), 'That is sometimes true' (3 points), and 'That is very true' (4 points). A higher number of points indicates a higher level of stress.

3.1.2 Stress measurement results analysis

Table 2 shows the results of the 3rd-year middle school students' stress measurements. Overall, more students responded that they experienced stress (58.8%) than didn't experience stress (41.2%). Generally, it can be known that students continuously experience stress. In particular, almost all students felt stress in regards to their career paths (Q4).

Table 2. Adolescent stress survey results

Category	1: That is not true at all	2: That is not particularly true	3: That is sometimes true	4: That is very true
Q1	25.0%	43.8%	12.5%	18.8%
Q2	12.5%	25.0%	31.3%	31.3%
Q3	12.5%	12.5%	56.3%	18.8%
Q4	6.2%	-	**43.8%**	**50.0%**
Q5	31.3%	37.5%	25.0%	6.3%
계	17.5%	23.8%	33.8%	25.0%
	41.2%		**58.8%**	

As shown in Table 1 and Table 2, the levels of stress that were felt by Korean adolescents regarding school work were found to be similar. To analyze the survey results numerically, the answers to each question were placed on a Likert scale [12] from 'That is not true at all' (1 point) to 'That is very true' (4 points) as shown in Figure 1.

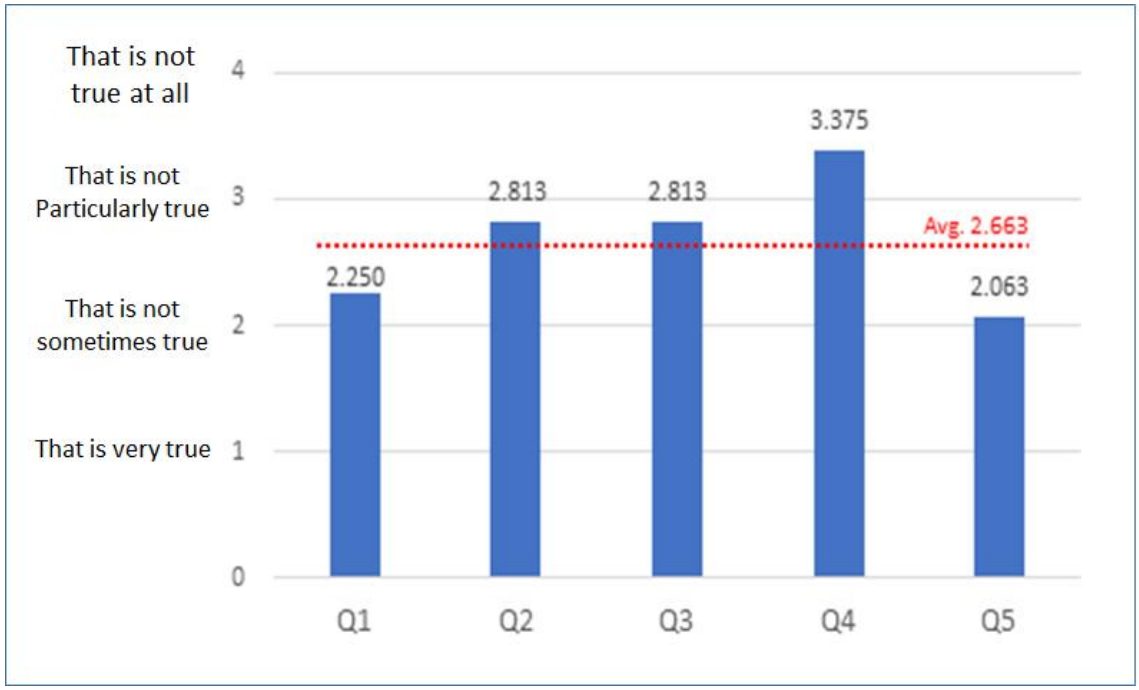


Figure 1. Stress measurement results

The mean of the analysis results was fairly high at 2.663. The highest stress value (3.375) occurred in regards to career paths (Q4), and the questions regarding test preparation (Q2) and learning attitude (Q3) were also above the mean at 2.813. The item that had the lowest stress value was in regards to extracurricular activities (Q5), and it had a stress index of 2.063.

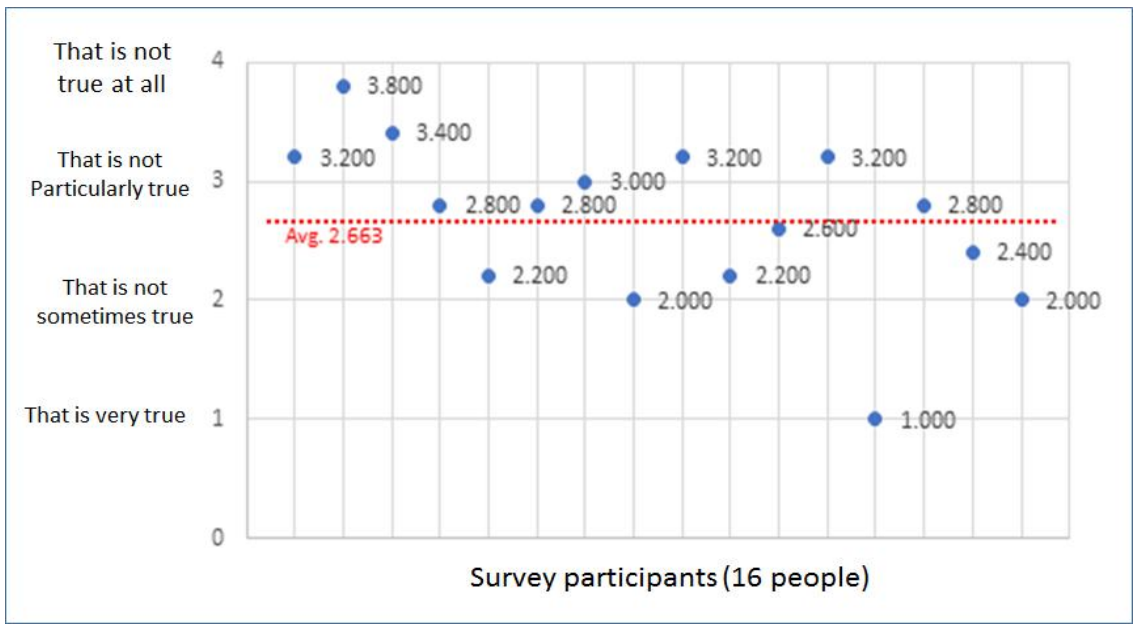


Figure 2. Stress level by survey participants

Figure 2 shows an analysis of the survey participants' stress levels by individual. The 9 students had stress levels that were above average (2.663), and 7 students had stress levels that were below average. The standard deviation was 0.684, which means that the stress levels were distributed relatively widely.
When stress was analyzed by item, stress regarding career paths (Q4) was the most severe. Overall, 93.8% of students responded that they were very worried (50%) or sometimes worried (43.8%). The 3rd-year middle school students, who are about to enter high school, showed very severe stress levels. If these highs stress levels do not improve, there is a high possibility of physical and mental effects leading to various ailments such as headaches and digestive disorders. As such, urgent efforts to relieve stress are considered necessary.

The analysis of 3rd-year middle school students' stress levels regarding school work and career paths produced relatively high results (a mean of 2.663), and the highest stress levels were found in regards to career paths (3.375). Due to these results, it is believed that it will be necessary to create a stress relief plan that can be used within a limited space for a short amount of time to improve the stress levels of the 3rd-year middle school students, who are preparing to enter high school.

3.2 Emotional color therapy using smart phone

The goal of this study is to use smartphones to provide color therapy through intelligent emotions.

3.2.1 Concept and effects of color

After Isaac Newton discovered that sunlight is divided into seven colors as it passes through a prism, the theory that defines color as light which has a certain wavelength has come to be accepted up to the present day. Colors have different wavelengths from red to violet, and the differences in the wavelengths of subtly different colors can have various effects on human perception. They can act as a stimulus or make people calm. They can cause excitement or relaxation, and they can convey a cold feeling or a warm feeling, as well as sadness or pleasure. Utilizing the physical and psychological effects of color wavelengths is the basis of color therapy [8][9].

3.2.2 Stress and color therapy

Using color or light to create a relaxing living environment relieves psychological stress and increases feelings of mental stability. Color therapy is a term that combines color and therapy, and it refers to a psychological therapy that obtains relaxation and calmness through color stimulation. It is widely used as an anti-stress therapy because it can provide psychological stability, vitality, and relaxation. That is, simply being around colors can help to relieve stress. The colors that bring about stability of the mind are blue and green. Being close to these two colors can prevent the accumulation of stress, and can help to lower the degree of stress or resolve stress when it is experienced. This is because blue plays a role in balancing the metabolism and resolving anxiety and stress, and green creates a peaceful state of physical and mental balance [9].

Modern color researchers and physiologists have performed a variety of studies that have demonstrated the effects of blue. Since the mid-20th century, these studies have focused on scientific aspects. In 1958, Robert Gerard measured physical reactions such as blood pressure, palm sweat, respiratory cycle, pulse rate, muscle activity, heart rate cycle, brain waves, and eye blinking in regards to 3 colors: red, white, and blue.

Table 3. Therapeutic effects according to color [10]

Color	Effect
Pink or Orange	- Psychologically inspires hope and courage - Reduces brain stimulation inflammation and stimulates the arteries when vitality or courage are needed - Provides energy to the kidneys and increases body's vibrations
Orange Yellow or Lemon	- Used for poor digestion and muscle contraction - Normalizes the body's functions as a color with a lot of calcium - A good color for memory decline - Contains iodine, iron, and silver sulfuric acid to cleanse the blood
Blue Blue-green	- Beneficial when eyes hurt or blood pressure is high - Blue acts on the sympathetic nervous system, and green has excellent detoxification effects - When blue-green light, which is a combination of blue and green, is shined on the soles of the feet or legs, mental stability can be obtained peacefully
Purple	- Relieves compulsive symptoms

Study results have proven that red light raises blood pressure and increases respiratory rate and muscle tension, while blue light reduces the degree of central nervous system arousal, respiratory rate, eye blinking frequency, and blood pressure, which leads to happiness, peace, and pleasurable thoughts [10]. Table 3 shows the therapeutic effects of each color. Looking at Table 3, it appears that blue and blue-green can help with adolescents' stress. Color therapy is not only used in psychological and emotional treatments, but it is also actively used for modern medical treatments.

3.2.3 Emotional Information system

The intelligent emotion system, which uses platforms such as mobile devices and the PC, was designed considering the user's context, and it provides the user with various data formats such as images, video, text, audio, etc. to send results to the user [15, 16]. Therefore, the analysis stage for developing a color sense information design that considers user stress was organized as follows. Figure 3 shows an organizational chart of the intelligent emotion color therapy system that uses the user's smartphone.

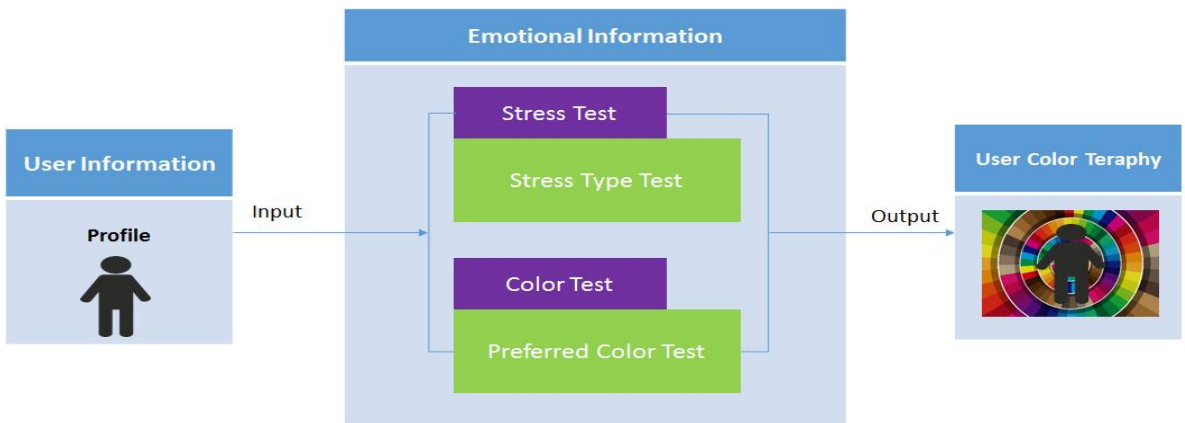


Figure 3. Organizational chart of emotion color therapy system

The emotion system first accepts the user's individual profile as input data and performs a user stress type examination and a color test via a stress test in the emotion information processor. The emotion information that has been analyzed based on this data is sent to the user in an appropriate color via the smart phone output.

Emotion Information Analysis Process

Color information is analyzed by the color information analysis process shown in Figure 4. After color information is found through the correlation between user stress and color test information, the appropriate color is provided through a color wheel.

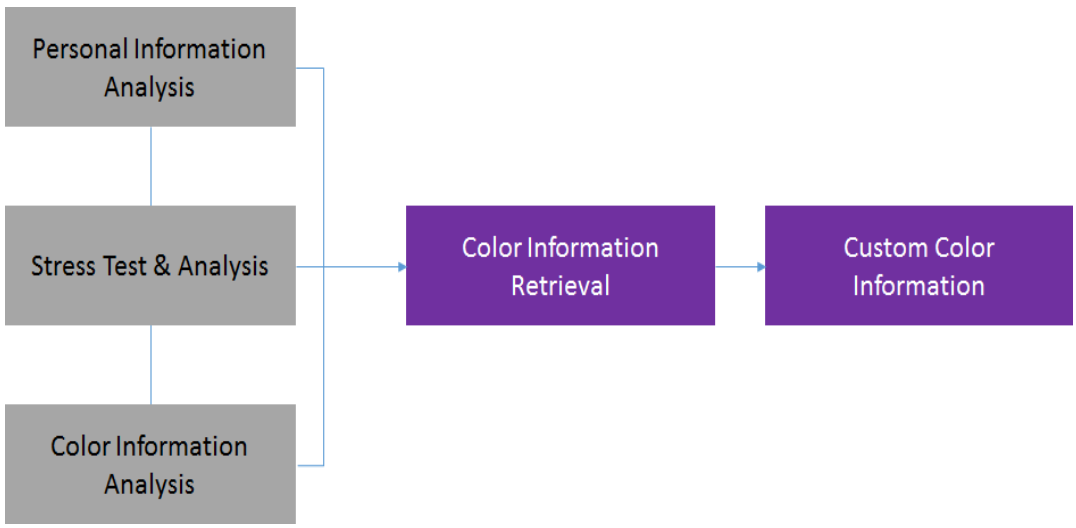


Figure 4. Color information analysis process

Color Image Design

The five colors that form the basis of the color information used in this study are defined as fundamental colors using the primary colors (red, blue, yellow) of the 12-color wheel based on the 5 traditional colors and the seven colors of Newton (red, orange, yellow, green, blue, indigo, violet) [13]. Figure 5 shows the 12-color wheel.

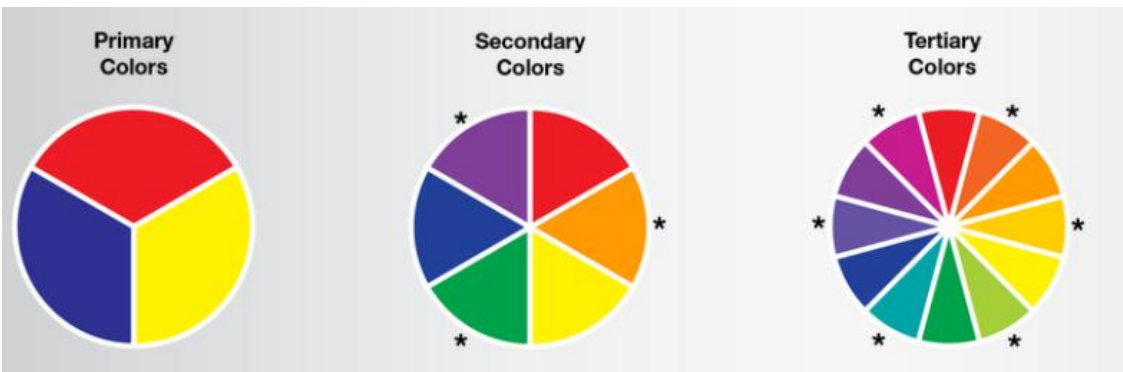


Figure 5. 12-color wheel (http://blog.guilfordofmaine.com/the-color-wheel/)

Secondary colors (green, orange, purple) are combined with primary colors to create tertiary colors (yellow-orange, red-orange, red-purple, blue-purple, blue-green, yellow-green). The colors that will be provided to the user can be created through color information analysis and stress testing.

Emotional information system algorithm

User color information uses color information extracted from personal information analysis as input information using personal information analysis and stress test. The algorithm of the color information system is shown in Figure 6.

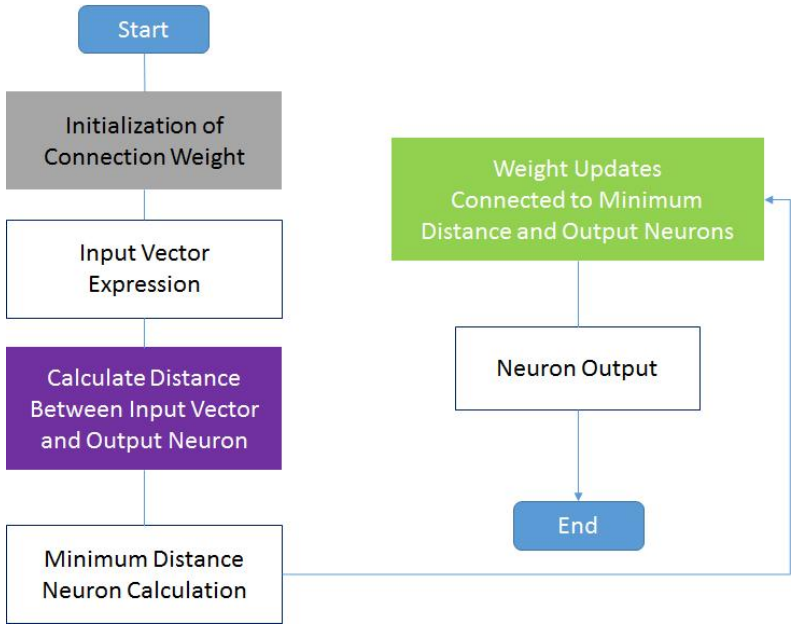
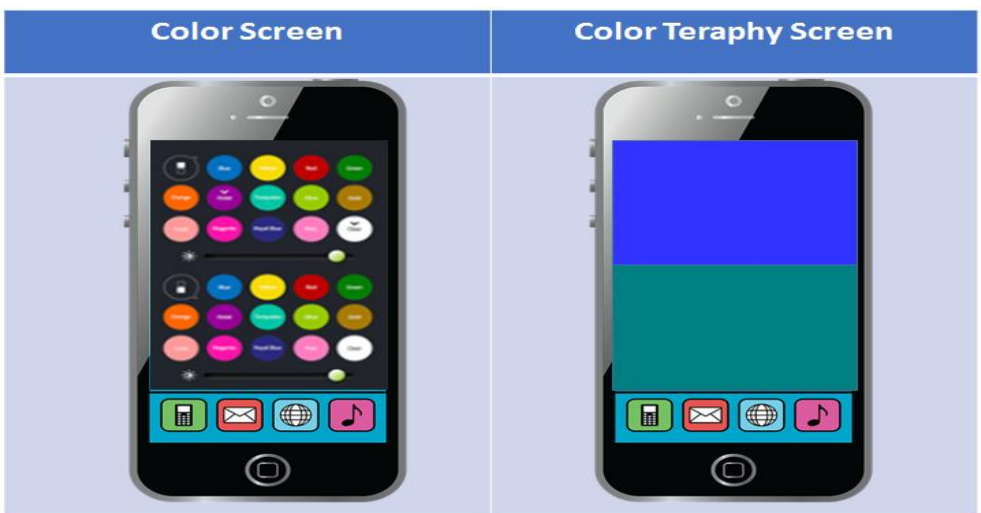


Figure 6. Flowchart of color information algorithm

In the normalization step, the distance between the input strength vector and the connection strength vector between eac vertor is calculated, and the nearsert neuron is determined as the minimum distance neuron. The minimum distance neuron becomes a neuron capable of sending an output signal, and only neurons adjacent to the neuron can use the presented input vector.



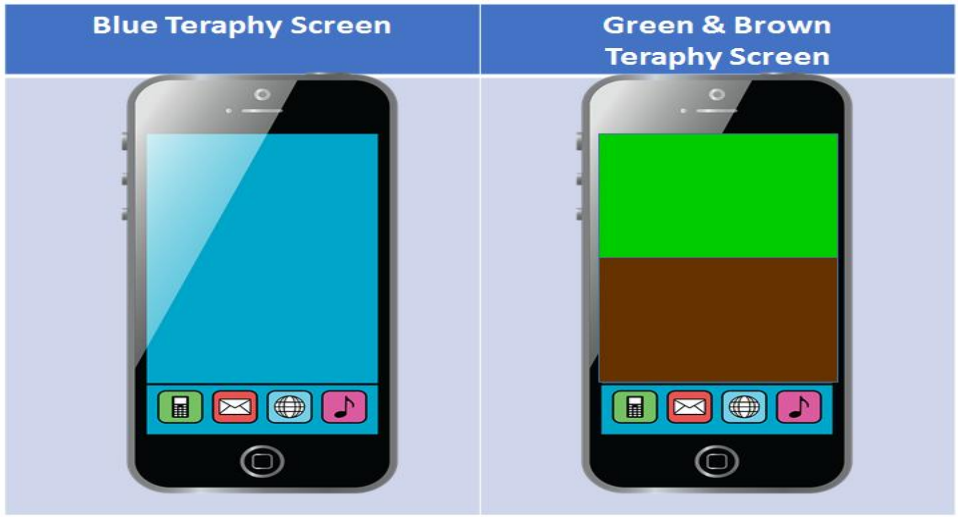


Figure 7. Smart phone output screen

User smart phone output screen

Figure 7 shows the smartphone output screen for the user color sense information. Blue is a color that makes a person's mind calm. It causes the release of neurotransmitters that can stabilize the brain, which make the pulse stable and breathing deeper. In addition, it has the effect of lowering body temperature and suppressing the appetite. Therefore, using blue color therapy can help with adolescent stress.

The color green helps to increase the ratio of histamines in the blood and expand the blood vessels to supply large amounts of blood. It is beneficial for healing wounds when the skin is damaged. Brown is effective in improving chronic fatigue because it aids in the synthesis of serotonin, which improves the mood, and it works well to improve adolescents' chronic fatigue.

4. Conclusion

This study was performed to examine the causes and extent of stress and to develop a plan for relieving stress using colors in smartphones, which are used for long periods of time. This study designed an emotional color therapy system that uses a smartphone to measure user stress and provides appropriate color therapy. The developed system was designed in the form of a service-based mobile application, and it was designed to be easy to use from the user's perspective.

In future studies, it will be necessary to increase the usefulness of the developed emotion color therapy system by analyzing the degree of stress improvement that results from using the system and increasing system efficiency. It will also be necessary to study intelligent emotion systems that use various IoT devices other than smart phone.

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