

การรับรู้สีสันของภาพวาดศิลปะโดยใช้เสียงสำหรับคนตาบอดสนิท
**COLOR PERCEPTION OF VISUAL ART PAINTING UTILIZING
SOUND FOR THE TOTALLY BLIND**

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Abstract

Art can be perceived by the five senses such as the seeing color by eyes, to taste with the tongue, the smell by the nose, hearing by ears, and touching to the physical environment. The shape and color vision is the first to recognize the work of art, even if the 2 dimensions works such as visual art painting, the 3 dimensions works such as the sculpture and the last perception is the brain. The interpretation of sensory perception to affect the physical environment. And touch the minds of the artwork itself. This effect may be identical or different knowledge, understanding and experience. The look and see that it is a very important first step in the perception of art but there is a work of art that one can not recognize a work of art by looking and seeing, that is blind. The art can not communicate to the people at all.

Blind people can learn the art of the science that is vital to humanity but learned about color, which requires the recognition of the eye as it is difficult and challenging. Blind, Loss of visual perception, color perception, but can be used to offset part of it. The study found that Can be used instead of the color tone, this system recognizes hearing instead of vision. The color and sound to the frequency. And features. Similar to each other attribute values for the example, the value of color is represented by the sound quality, colors can be mixed with the audio mix. Researchers selected through a computer touch screen devices have been developed for blind people to use drawing and painting. The methodology of the interview. And a questionnaire about their understanding and experience to recognize colors with hear the instructor of art, artist and designer. The answer has been given to design and develop programs and tools for the blind as a standard in color, using voice recognition.

This research has volunteered as a completely blind since born because they do not have the experience to be seen. The results obtained from the study were recorded at the close of

the work of the blind since born are particularly interesting. The results of this research. Completely blind since birth can learn the art as well as the normal eye, after completely blind since birth have been using the tools developed in this research, can learn to understand and use the correct color based on the principles and their own imagination, the painting of a blind man who is a volunteer in this work to the exhibition. We can show that both men seemed to look normal and the blind to touch the cool, colorful paintings. The tool has been designed and developed from this research can be applied to other cases by the blind.

Key words : *color / sound / perception / art / blind / design / computer*

1. Introduction

Art is the process or product of deliberately arranging elements in a way that appeals to the senses or emotions. It encompasses a diverse range of human activities, creations, and modes of expression, including music and literature. The meaning of art is explored in a branch of philosophy known as Aesthetics. (Wikipedia, the free encyclopedia) Arts can be portrayed by the artists to people through 5 senses of human. The 5 senses are as follow: 1) Figure – by looking and seeing through the eyes (shapes, forms, and colors), 2) Taste – the perception of tastes through the tongue, 3) Smell – the air perception through the nose, 4) Sound – the perception of hearing through the ears, and 5) Touch – the environmental physically feeling. Looking and seeing the figure are the first steps to appreciate all kinds of arts. To begin with the 2 dimensions art such as visual art painting, secondly is the 3 dimensions art such as sculpture and lastly is the 4 dimensions art such as animation works, all of these can be initially perceived through seeing. Consequently, the brain, the last perception, will transfer perception from the nerve to both physical and mental of people who appreciating the arts. However, the differences and similarities may occurred depending on the knowledge, cognitive and experiences of people. Therefore, seeing is the most important and first step in perceiving the arts. Nevertheless, there is one group of people who have no opportunities to appreciate the arts by seeing; they are the Visually Impaired or the Blind.

There were attempts to broaden the opportunities for the blind people to touch and feel the arts by hands, this can show that art is beyond frontier. Physically challenges should not be regarded as an obstacle for people to appreciate the art which is important for human being. From the studies found that the blind people have the imagination from touching the arts, they can feel the figure and form of the sculptures. The blinds can understand the elements and art proportion of sculptures. Moreover, they can create the image by forming

the shapes and figures controlling by the Cerebrum – Frontal Lobe in the Forebrain. The Cerebrum controls thought, intelligence, feeling, emotion and imagination. The blind however cannot perceive 2 dimensions art because they can only feel the texture of it. There were the attempts to use the technique modifying artworks to be bas – relief in order for the blind to feel and perceive the art figures. However, there is still no technique to portray the colors of art for the blind. Since feeling arts by hand can only give form and shape to the blind, how can they perceive the Abstract Expressionism Arts? Moreover, touching the artworks can accidentally damage it. From the previous studies found that blind people. Therefore, this study is attempt to find the way to portray the colors of 2 dimensions art utilizing sound through hearing nerve system for the blind people. As a result, they will have the abilities to perceive the values, characters, elements of pictures and the aesthetics from colors. The instruments used in this research are Touch – Screen Monitor Technology and computer program developing for the mean of communication.

Computer can store the date of colors and sounds in the digital form, then decoding the color value to human through the eyes by color monitor and sound through the headphone or loud speakers. These two variables have some value in common, for example; in Psychology: both colors and sounds can convey the feeling and emotion, in Physics: colors and sounds can be explained in form of wave, in Mathematic: colors and sounds can be defined and stored in the digital forms, and for Medical aspect explained that some people can communicate through Synesthesia Phenomenon where as the Buddhist religions regarded as an audible object.

This purpose of the research is not for the blind to have the ability to see the colors but for them to have the perception of pictures and emotion of pictures through the hearing system instead of seeing system that they have limited accessing. The researcher hope the opportunities to appreciate the aesthetics of visual arts to be able to perceive the beauties of artworks. Since art is the origin of imagination, creation and development of all human being, this study is aimed to break this barrier for the blind to have the capability in perceiving the color differences like ordinary people. As a result, the art will become truly Universal Design because the blind can also appreciated the 2 dimensions visual arts though Computer – Aided in Art Design. Moreover, the researcher expected that this computer software will be the pilot study for the blind to further their knowledge in creating the visual arts based on their imagination and creation. And finally, the world will have the opportunity to see new visual artworks composed by the blind people.

2. Purpose and objective of the research

1. To identify the relationship between color and sound that can convey the feeling, emotion, and aesthetics from each other.
2. Develop the computer software to interpret the numerical value of colors and sound through Touch – Screen Monitor Technology for the blind to be able to perceive the beauty of visual arts.
3. To develop the computer software in order to help the blind to have the abilities to create the visual arts based on their knowledge and imagine.

3. Hypothesis of the research

The blind can physically feel by their fingers. They can move their fingers along the Touch – Screen Monitor utilizing developed computer software from this research to perceive different positions of visual art. Each position being touch, the sound will occur in accordance with different colors. As a result blind people will be able to perceive the colors from the different sounds that they heard. This computer software will convert the color value which is in the form of light to be the sound wave, consequently sound can be used to convey the color perception for the blind. Moreover, the computer software will be used as a teaching aid for the blind to learn the theory of colors and be able to create the visual artworks from the knowledge they have gained effectively. Thus, blind then will be able to show their abilities in creating artworks to others.

4. Scope of the research

1. Focusing on the group of people who were born totally blind. Due to the reason that another groups of people who are blind later tend to experienced the perception of colors that may cause the conflict to the purpose of this research.
2. This research is intended to convey the beauty of colors in visual arts for the blind to feel the aesthetics through sound variable. However, the researcher does not have an attempt to involve medical aspect for the blind to have the ability in seeing colors.
3. The researcher attempted to find the most appropriate Touch – Screen Monitor Technology to be used for research instrument and further developed to be the computer software.

5. Expected outcomes

1. Have the computer software which can communicate color of visual art by utilizing touch- screen monitor for the blind.
2. Have the computer software that can help the blind to have the ability in drawing visual arts in accordance with their own imagination.
3. To bridge the gap in appreciating visual arts for all human being and to create the genuine Universal Design.

6. Research Methodology

This research is the qualitative research combine to Sciences and Arts for studies. To study in theory and practice for truly information. This research claim the theory of Scientific and develop the tools of Artistic and claim to literature review and background of knowledge from researcher studying in Scientific and Artistic. The researcher related the both knowledge to create the tools for the blinds and they are able to learn and develop the creativity of Arts. There is aims to the perception and creation of visual arts painting and using the truly of color from the imagination of the blinds.

6.1 Area Criteria of the Research

This research is design and develop of tools for the totally blind to appreciate in aesthetic and color in visual arts painting. The volunteers are the totally blind since born. The researcher select Thailand to area of the research and do not relate cultural and traditional. This research is study to behavior of the blind only. Therefore, the result of research is able to apply for the other, such as, volunteer of foreigner or other areas. This research defined the target groups or volunteers and area of the research as follows:

6.1.1 The target groups or volunteers

The volunteers are the totally blind since born or earlier two years because they have not the experience of vision. Everything of performance from them is the pure imagination of the color painting. The result of analysis is the new knowledge. And they are 15 years old or study in more than grade 10 and learned in Arts before.

6.1.2 The area of the research

As a result of research that can lead to blind anyone and the target group or volunteer representative of all cases. Therefore, the researchers chose to study was a place that is easily accessible and to cooperate in research. The designated place as follows:

- 1) Center of the Blind Education in Khon Kaen. Address 214 Moo. 10, Soi Pracharak, Baanped, Mueng, Khon Kaen, 40000, Thailand.

- 2) School of the Blind in Bangkok and Foundation for the Blind in Thailand. Address 420 Rachvithi Rd., Payathai, Rachtavi, Bangkok, 10400, Thailand.
- 3) Center of Technology for the Blind Education. Address 78/2 Tivanon, Banglad, Pakkred, Nontburi, 11120, Thailand.

The visual Arts painting of the volunteers will obtain for exhibition where is as follows;

- 1) Art and Design Gallery, Faculty of Decorative Arts, Silpakorn University.
- 2) Semi – Public Area of Hall and Plaza of Department Store.

6.2 Hypothesis of the Research

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6.3 Question of the Research

- 1) How replace to perception of color by using sound ?
- 2) Is it possible that the totally blinds learn and understand truly for the theory of color ?
- 3) Is it possible that the totally blinds will perceive the color visual art painting from this tool?
- 4) Is it possible that the totally blinds will paint the color visual art from this tool ?
- 5) It is possible if the totally blinds appreciate the painting of visual arts ?
- 6) Can this tool use to other type of blinds ?
- 7) Can this tool use to other age of blinds ?
- 8) Is it possible that the totally blinds learn in design ? (upgrade themselves)

6.4 Questionnaire Design

The questionnaire is distributed 2 part as follow:

- 1) The questionnaire of the blinds which is question for the knowledge of the theory of color to compare with before and after using tools.
- 2) The questionnaire of the people who is the Artists and general and to bring the result of feeling to compare color and sound.

6.5 Subsequent Survey

The survey is distributed 2 times as follow:

- 1) The survey of data.
- 2) The survey of testing tools.

6.6 Observation and Interview

The researcher provided the questions for interviewing that is concisely. The interviewing is formal and informal and interview to the teachers of arts for the blinds.

6.7 Analysis of the Results

The result of the questionnaire that is about the feeling of compare with translation of color to sound, the researcher defined by Statistic.

6.8 Design and Development Software

From all information will design and develop software and using the touch – screen monitor. The properties of device is as follow:

1) Device of computer

To define the specification of standard and easy to find in market and there is the less of specification such as, CPU 1.33 GHz, Memory of RAM 1 GB, Storage 160 GB, Display Card 256 MB, Stereo of Sound Card, Keyboard and Mouse Pointer. Both of Personal Computer and Mobile.

2) Tools of development

Using BASIC language to programming that is standard and stable and flexible of installation in the operating systems.

3) Touch – screen monitor

Support for multi – touch and size of screen is 40 inch that like a size of drawing paper is A1. To design and develop is distributed 2 part as follow: to develop programming and design interface.

6.9 Testing and Improvement

After software and tools are finished, the researcher will test the volunteers who is the totally blind since born to using and practice in curriculum of Arts. To test in drawing and perception of color and learning in element and principle of Arts for full skill of volunteers.

During demonstrate software and tools, the researcher will observe and interview thoroughly and note the advantages and disadvantages for improvement.

7. Design and Development Software

Review of the literature on the subject of color theory and music theory. Researchers analyzed and synthesized into design principles. And development of computer programs, to change the color signal into an audio signal based on the principles of music theory. In order to get a tool that will be used in research. This can be explained as follows.

7.1 Select the tool to use in the design and application development

The researcher has chosen the touch is a tool used to coordinate between users and applications. By touching with the finger paint and the computer system is processing a change of color to the specified volume.

Computer operating system you use Microsoft Windows. Since it is widely popular and easy to use. Compatible with a touch screen. And computer programs.

The property and the ability to implement development programs. Methods of display and processing by selecting a tool for program design by using Microsoft Visual Basic 6.0. As a tool for application development. Because it can be used to display the results and processed according to the rules and other features. Which can be attributed to the formation and development capabilities of the program. Consider the following details.

- 7.1.1 Support the development of graphics applications that require contact (Graphic User Interface : GUI) and graphical development tools such as API and components each.
- 7.1.2 To be a program that displays graphics (Graphic Interface) The user interface works great.
- 7.1.3 To be used for application development. (Application) that can run on Microsoft Windows operating system, the operating system as standard. The most commonly used.
- 7.1.4 To be a program that can develop continuously. This is because the Microsoft Visual Basic is a program that is based on the BASIC language, It is easy to understand language for application development in general.
- 7.1.5 To be a program that is convenient. And flexibility in application development. With the ability to work quickly. (Rapid Application Development: RAD)

From the above, therefore, select Programs, Microsoft Visual Basic 6.0 is a tool for the design and application development. Microsoft Windows operating systems and touch screens and computers. A set of tools to be used in research.



The touch screen display that is used as a research tool.

7.2 Analysis of processing of the application

Analysis of how the program will explain the process of concept development. And show how to calculate the core functionality of the program is the following step.

7.2.1 The preliminary data

Technical information used in computing the research is divided into two parts.

1) The standard audio system information

The sound system is a standard type of computer system called MIDI (MIDI - Musical Instrument Digital Interface) is a musical instrument digital interface standards. A voice synthesizer on the computer. The meaning of music. And the control of the sounds.

2) Input and output data

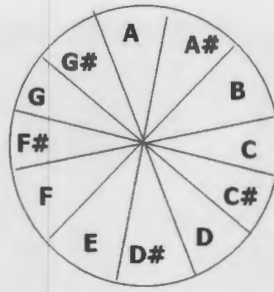
The program was developed as two parts of the read noise of the image. And the drawing.

7.2.2 Analysis approach to music theory

Study of literature about music theory. These principles stipulate that the agreement to the communication of voice and music with a sound regulatory system and the scheme is divided into four such systems.

- | | |
|---------------------|--|
| 1) Diatonic Scale | DoRaMeFaSoLaTi(7notes) |
| 2) Pentatonic scale | DoRaMeSoLa(5notes) |
| 3) Chromatic scale | CC#DD#EFF#GG#AA#B(12notes) |
| 4) Mode scale | Ra-Ra' Me-Me' Fa-Fa' So-So' La-La' Do-Do' Ti-Ti' (7 notes) |

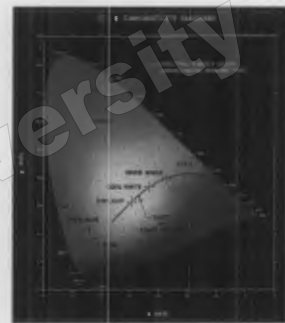
The sound system is the most complete sound systems, chromatin fiber, which is half the total volume by 12 votes in a State's Antioch was to create a square circle is shown.



A chromatographic system did not have to square the circle

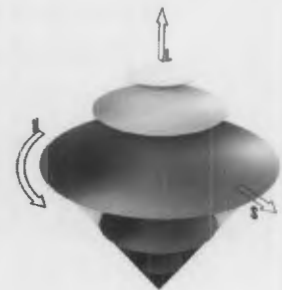
7.2.3 Analysis approach to color theory

The study reviewed the literature on color theory. The principles of color that is visible to the eye. It covers the rules and how to use color in art and design, psychology, science and history. The human eye sees color is limited. The other creatures are visible range of colors are not equal. Depends on the ability of the eye and brain organs.



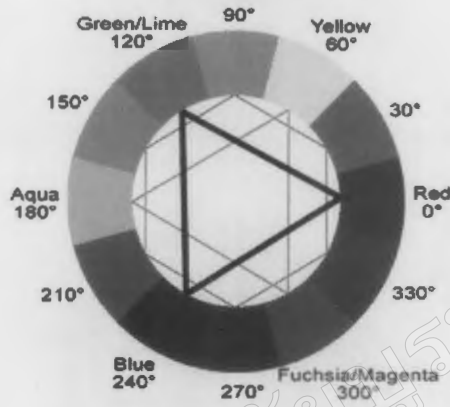
The colors the human eye sees(L), The CIE color display that shows the range of colors the human eye can see(R)

Color theory is explained with charts and models. To grasp the extent and direction of a sequence of colors to clear up a HSL color system, colors are arranged in a circular layer. The circular will contain all the colors the human eye sees them neatly arranged in a circle. There is a freshness of color gradient acting on an object is the reduction of the saturation. And the axis perpendicular to the plane of the circle to the intensity gradient of the gray and white.



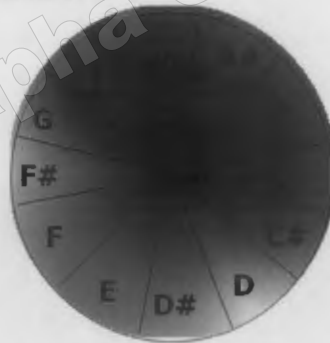
HSL Model color

When the plane of the circle is divided into 12 channels equal to 12 colors in the range of each channel are similar. The theory used to describe a color that is a step 3.



7.2.4 Processing methods and comparing the color with the music

The study and analysis above, we see that the color and sound have been divided into 12 intervals on the plane of the circle as well, when the overlap is a range of colors and sounds 12 years just to replace the color with sound. the first color is red. The dose corresponding to the sound or noise C



The overlay shows the chromatin fiber of the circle system with a circle of 12 blue color range.

The plane circled and put a floor below which the following is a sound one sound is represented by a color based on the position to be divided into 12 intervals because human memory is limited. In this study, the researcher has determined the scope of a 6-color paint to use easily recognizable and can be used easier. The time axis of the intensity of gray and white color combination, as all nine colors and three 9 votes.



The gray-white color on the axis perpendicular to the plane of the circle



A circle divided into 12 intervals in the range of 360 degrees

Then apply the above principles to represent in writing to the program. Using a set of commands to control the sound system MIDI (MIDI), which are all 128 tones can be divided into 11 on the State's (Octave) research group sound on the state's No. 4 is the volume of six voices. the colors 6 colors.

Octave #	Note Numbers											
	C	C#	D	D#	E	F	F#	G	G#	A	A#	B
-1	0	1	2	3	4	5	6	7	8	9	10	11
0	12	13	14	15	16	17	18	19	20	21	22	23
1	24	25	26	27	28	29	30	31	32	33	34	35
2	36	37	38	39	40	41	42	43	44	45	46	47
3	48	49	50	51	52	53	54	55	56	57	58	59
4	60	61	62	63	64	65	66	67	68	69	70	71
5	72	73	74	75	76	77	78	79	80	81	82	83
6	84	85	86	87	88	89	90	91	92	93	94	95
7	96	97	98	99	100	101	102	103	104	105	106	107
8	108	109	110	111	112	113	114	115	116	117	118	119
9	120	121	122	123	124	125	126	127				

Figure 128 tones in MIDI.

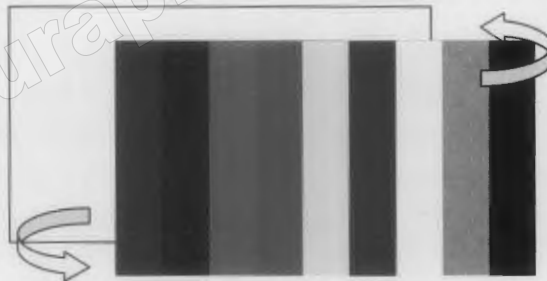
In Audio MIDI (MIDI) is a synthesis of the instrument all 128 Products by research, a sound long-haul Violin (Audio 21), as the main program instead of the six tones of white, gray black. instead of white with a C at Octave 6 (High) instead of black with a C in Ocho State Cup 2 (Low) instead of neutral gray with a C in Ocho State's No. 4 is scheduled for speech synthesis. 86 is an audio tone to be able to distinguish between the six colors with three colors, white, gray, black, easily. The properties of the sound is different, so the scope of this paper is used by all nine tones.



12 colors in a color display system chromatin fiber. Gray, black and white

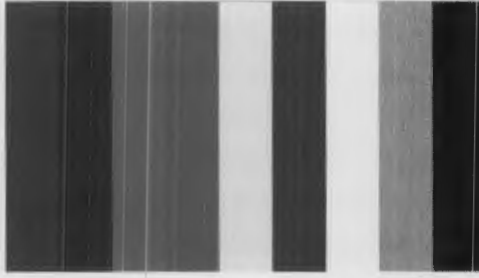
7.3 User interface design

The main target users are blind. Therefore, design the user interface program is a straightforward. Simplify deployment. By design, the drawing area. And palette. Stacked alternately on and off by pressing the space bar on the keyboard.



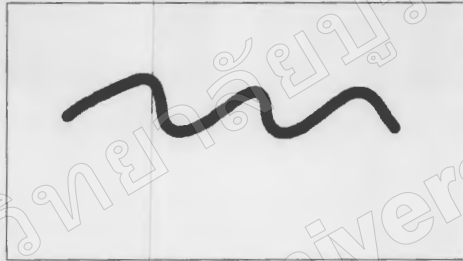
The overlap of the drawing area with the color palette

Users will select a color from the palette by dragging a finger on a touch screen. The sound is loud with the fingers pointing at the sound of that color, like red, C, E and green tones.



Color palette area

Then press the space bar on the keyboard to switch the color palette to be closed. Appear in the drawing area. Color from the palette that was last selected will be displayed in color on the drawing area.



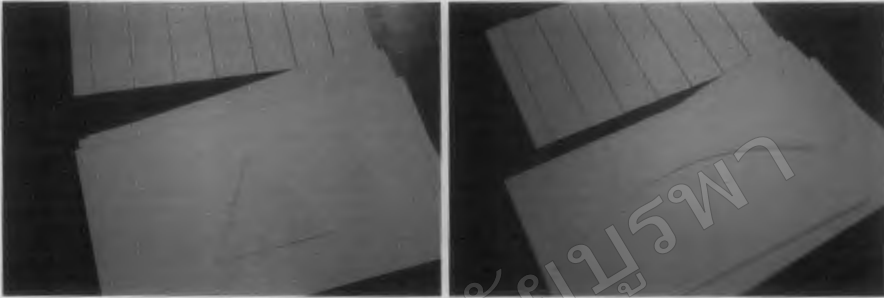
The red color is selected from the palette to paint or draw on the drawing area

8. Result of the research

The samples of this study are 4 voluntary totally blind students. The instruments are computer program, touch screen computer, low-relief picture, voice recorder, camera and video camera. The research instruments are questionnaires and lesson plans. There were eight lesson plans but due to the limited amount of time which is after school time of the samples, the researcher decided to modify the lessons to the 1 hour actual use of computer program.



The study starts with the sample shading the 12 colors on the computer touch screen from reddish pink, pink, purple, blue, indigo blue, light blue, greenish blue, green, yellowish green, yellow, orange and red respectively. Half voice notes represent each colors are C C# D D# E F F# G G# A A# and B accordingly in order for the sample to recognize the sounds base on the colors chart. Then the line understanding is performed by introducing the low-relief picture.



The sample then feel the direct line on the screen where the line is in red and the background is in white. Red is represented by B sound at octave 4 and white is represented by C sound at octave 6. It is show that the sample can indicate the pictures correctly which are horizontal and vertical direct line pictures. After that the sample has to feel the low-relief pictures and it shows that they can identify the figure correctly which are squares and triangles. However, the sample cannot identify the circle and freeform figures because they have curves which are difficult to identify.

After that the simplified pictures were used for the sample to feel and hear. It is found that the sample know the area of colors on the screen from the sounds heard, moreover they can identify the colors from the sounds. The sample knows the area whether it is wide, narrow, or long from the color area on the screen. Later, the sample has to recognize the picture from the sounds with some assistance from the researcher in guiding his hand through parts of picture. Once the sample is ready, the painting program is used by the sample choosing colors and area from the picture he has felt earlier. The modified Starry Night picture is used for this study. The sample begins with yellow painting the moon, then black moving around for the background and triangle shape for the Sipres tree. He then chooses blue and light blue painting around for the sky background of the Starry Night. Once the sample finish, it is found that his picture is similar to the original picture although he is totally blind from birth.

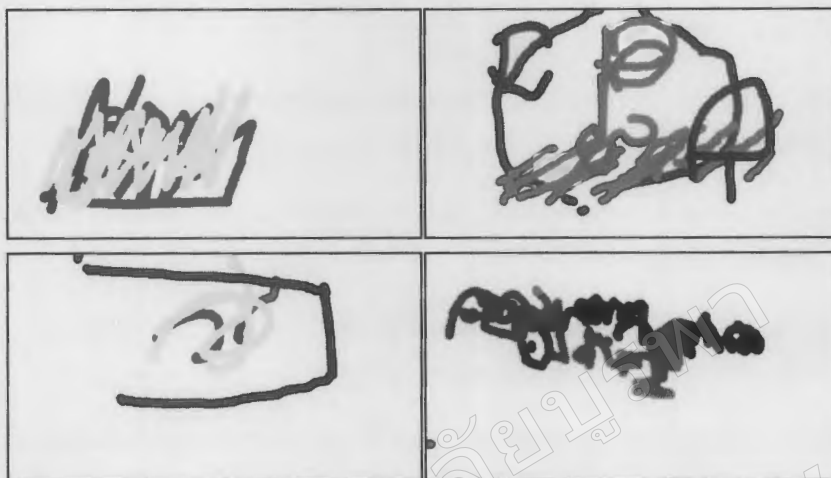


The researcher then asks the sample to draw the picture on his own and from his imagine. The sample wants to draw the beach and the sea from his prior experience. Then he choose orange for the beach color, blue and purple for shading the sea by distance, green for the island in the sea and light blue for the sky. The sample's picture comes out very well with two-dimensions and sequence of objects.



The researcher tries the same way with other 5 samples but with the limited amount of time which is after school, the samples are already exhausted. So the researcher only has them draw pictures from their imagines without through explanation like the first sample. The pictures came out unclear which are difficult to identify. In the mean time,

the samples cannot explain their pictures either. From this limitation of the study, the researcher will try to equally explain and guide all samples in order to gain the accurate result.



However, the result has prove the prior assumption which is the blind can use their feeling through their fingers to perceive the positions of visual art by moving their hands on the touch screen with specially developed computer program for this study. Each touching position, there will be sounds from the touched colors. The blind then can perceive the colors from hearing and understand the visual arts. This study lead to the visual art perception through hearing by converting color value which is light wave to sound wave, sounds then can lead to the color perception without seeing. Moreover, the computer program can be used as a tool for the blind to learn the color theory correctly. They can draw visual art and communicate their arts to others.

9. Conclusion

The specially developed computer program is well used as equipment for the totally blind from birth to perceive and convey art through colors on the touch screen computer. It is a safe and easy way to learn the theory for the blind. The finding from this study will be further analyzed and the outcome pictures from the blind will be displayed in the exhibition.

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