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Optimizing Visually Impaired Ability To Read Tactile Pictogram Through Texture Design

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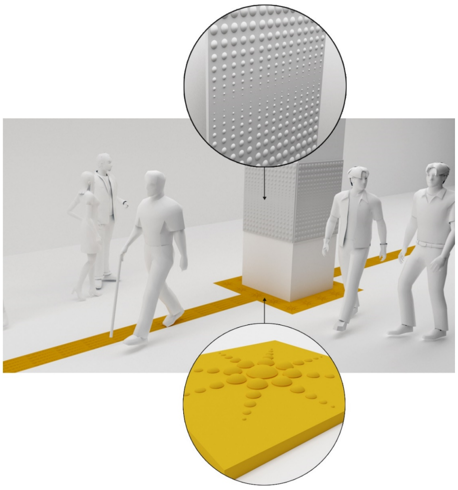

ABSTRACT. This experiment aims to optimize the visually impaired ability when reading tactile pictograms through texture design. Experiment was motivated by two previous studies results by authors show that the visually impaired need a tool to make the reading process more efficient. Overall, the visual semiotic was used to adapt the Space-Time-Curve (STC), Tabrani's visual language theory, as a texture media design system. The design result produces media textures with size composition differences. The media was tested on 20 visually impaired people directly with quantitative analysis technique. The results show that the design system for media textures is not able to optimize visually impaired reading. In general, it concluded that the visually impaired do not perceive a system without memory regarding its variable mechanism as a whole.

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INTRODUCTION

To date, the verbal approach is still the most frequently used way of conveying messages to the visually impaired. In line with the need for linguistic concepts, this is effective. It proves by braille that it is still used by the visually impaired as an international letter system. However, this approach is less efficient in improving the pragmatic spatial ability of the visually impaired. Because the verbal is static. That is limited to being responded to when the visually impaired perform motion. Meanwhile, the condition of public space demands that anyone can do orientation and mobility to the maximum.

This study is a further experiment from previous studies by the author. The topic regards the design of tactile pictograms for the visually impaired in public spaces. The author aims to make the design of tactile pictograms accessible according to the ability and habits of the visually impaired to read tactile graphics. More specifically, the tactile pictogram design is expected to be identified, described, and understood in context accurately and quickly.

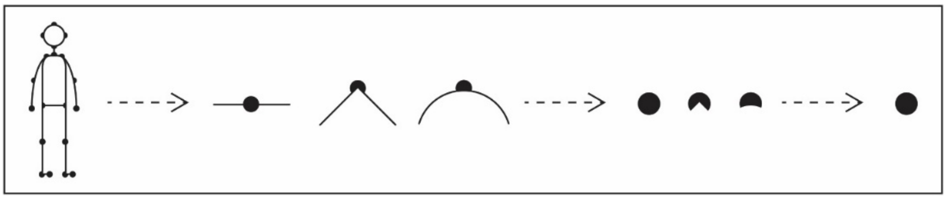

Figure 1. Dots Technology

The approach used in previous experiments used visual semiotics on Tabrani's (2012) 2D visual language or Space-Time-Plane (STP). The author adapted theory from the way to read the story in the picture into a system for designing tactile pictogram shapes. The design system is the way to draw shapes and contextual motion of objects. The first experiment aims to test whether the adapted theory could be perceived correctly by the visually impaired. The first author's experiment results in the proceedings entitled "Building General Perception for Blind People as Orientation System in The Bandung City Train Station through The Pictogram Design" (Fadhlillah, 2018) shows that the visually impaired can read objects symbolized with verbal assistance. Then, the second experiment was conducted to reveal a technological design that could increase the readability value of tactile pictograms. The second author's experiment results in the journal entitled "Seminal Breakthrough in Tactile Pictogram Design for Visually Impaired in Train Station" (Fadhlillah, 2020) initiated the technology of drawing shapes with three dots. Each dot has a function to draw straight lines, curved corners, and acute angles. The experiment result shows that the dots were still not able to shorten the reading duration. Referring to those results, the author considers that an experiment to optimize the ability of the visually impaired to read tactile pictograms is essential.

Considering that is part of the graphic element, the author proposes an optimization process through textures. The textured design plays a role as a rehabilitation media. The intervention is carried out without verbal assistance and doesn’t require a common understanding. The intervention process occurs when the visually impaired interact with the texture composition. Considering the success potential in using the adaptation of the previous theory, the foundation in designing texture reuse Tabrani’s visual language. However, the author adapted 3D theory with its three components, namely Space-Time-Curve (STC). The author hoped that the intervention mechanism can increase the touch sensitivity of the visually impaired so they can recognize dots technology in tactile pictogram designs both through active touch and passive touch procedures. So, the logic is that the faster the dots are recognized, the more efficient the reading process will be.

Determining texture as the strategy for touch rehabilitation is supported by several scientific references. First, the reference comes from journals entitled “Texture Perception in Insighted and blind observers” (Heler, 1989) and “Tactile Picture Recognition by Early Blind Children: The Effect of Illustration Technique” (Theurel, Witt, Claudet, Hatwell, Gentaz, 2013) revealed that textures can accelerate the stimulus to the brain when the visually impaired read tactile media. Second, referring to the results of the theoretical analysis presented in the book "Rehabilitating Blind and Visually Impaired People" (1993) and "Foundations of Orientation and Mobility" (2010) revealed that texture-based rehabilitation procedures can optimize the ability of the visually impaired sense of touch to identify tactile graphics-based media.

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METHODS

Media design and data analysis used different methods. The designing process uses qualitative methods and the analyzing data process uses mixed methods. The method selection aims to optimize the quality of the outcomes.

The design process uses a qualitative method with a visual semiotic approach. This method aims to adapt Tabrani's 3D theory from the way to read the story of the object in the picture to be the way to draw textures. Overall, the adaptation process is the same as in the two previous studies. However, there is a specific adaptation stage related to reinterpret space definition understood by the visually impaired. The design process generates systems. Those are the texture shape, the way to draw textures and place texture media in the spaces.

The mix-method consists of two sequential stages. Those are quantitative analysis and qualitative analysis. It aims to reveal two things. First, to find whether the designed texture can optimize the visually impaired ability to read the tactile pictogram and its causal factors. Second, preferred design system by the visually impaired for technology in optimizing the ability to read tactile pictogram by touch. Data was collected through interviews after the trial process. The trials were conducted on 20 visually impaired people who were respondents in the last experiment. The respondents have two minutes to interact with the prototype. In the first minute, the visually impaired are welcome to access the texture media. In the second minute, the visually impaired are welcome to read the tactile pictogram design. Quantitative data are presented both in a graphic format with a description. Referring to ISO for graphic symbol testing, data validation achieves when the sound reaches above 60%. Then, data verification carries on by repeating the study scheme. Furthermore, the qualitative analysis uses two types of data. Those are namely primary data and secondary data. Primary data is the quantification process results. Secondary data is the conclusions from the previous experiments. The author conducted a qualitative analysis to evaluate the design system of texture. Technically, the analysis process used a comparative technique. It focused on observing the optimal design criteria, the design conditions that need to be optimized, and the design specifications to avoid. The final result is used as input for further studies.

THEORY

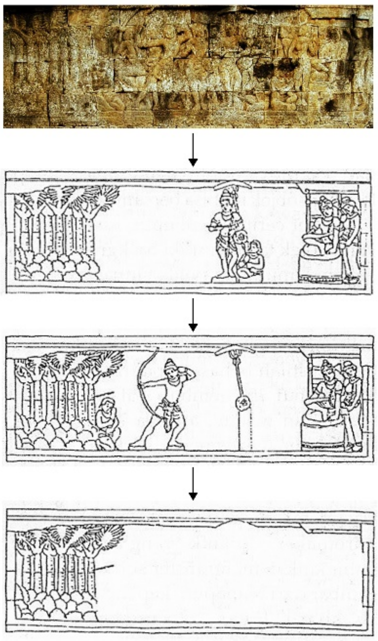

Figure 2. Lalitavistara in Borobudur Temple

Tabrani's ancient visual language is a theory to read the story in the picture through its movement by the multiple images drawn. He said this drawing system has proximity to Albert Einstein's relativity theory. It is space that cannot be separated from time. The drawing system is called Space-Time-Plane (STP) and Space-Time-Curve (STC) whose characteristics are described in various directions, various distances, and various times. The object is drawn in close-up, there is no sequence of reading direction standards, the story is told with gestures, and the characters are depicted by the attributes used. There are three components to draw with this drawing system. These components are image way, inner grammar, and outer grammar. Image way is the way in which objects are drawn. How to arrange various images way in a scene so that you can tell a story is called inner grammar. Whereas the method of distinguishing image way and the arrangement of expressions between the panel and one another until the sequence of the panel are able to tell a story is called outer grammar. STP system is more applicable to 2D drawing and STC is more applicable to 3D. In particular, reading 3D objects with the STC system means that the image has a depth of field.

The reason of author choose Tabrani's theory is because it has two strengths. First, the multiple-image drawn shows the concrete movement of the object. Second, Second, the drawn object must be in close-up. Those reading systems were hoped can work effectively as orientation and mobility systems in the spaces through the adaptation process into design system through the adaptation process. So that the design can answer the needs of the visually impaired to build spatial abilities pragmatically in the field. This mechanism is applied in adapting the STC theory in this experiment.

After studying theory, the author found two ideas to reinterpret space and to develop texture design systems. First, determining universal space components that can be conceived by both visually impaired and sighted people. It is essential because the concept of space discussed in Tabrani's theory is visual and physical. Consequently, space will only be translated as a verbal concept because to teach the visually impaired ideally is by demonstration. Thus, space definition departs from Newton's theory that the components of space consist of length, width, and height is challenging to be understood practically by people who do not have the opportunity to access spatial simultaneously. Subsequently, the three components should be translated into more perceptible meaning for them in concrete and phenomenological. Referring to the study topic is about sign the writer tries to achieve that value by translating the definition of space from physical language into sign language. More specifically, it is a sign when someone is in space. Therefore, the three spatial components of length-width height translated into repetition-navigation-direction. The author applied the translated components as texture media placement systems in the field. Second, the texture design system is discussed in the next section.

RESULT

1. Texture Communication

The design objective aims to build the after visually impaired interaction with texture and tactile pictogram media. Simply, it refers to semantic concepts. It is applied to motivate them to interact with texture media curiously. The texture communication emphasizes the sensations felt by mechanoreceptors that can stimulate tactile imagery. Schematically, there are two things hoped. First, at the beginning consider texture to have no meaning.

The last, then at the end, the texture can be recognized as a part of the tactile pictogram design system. Ideally, the more visually impaired people are attractd to interacting with the texture design, the faster the texture is understood.

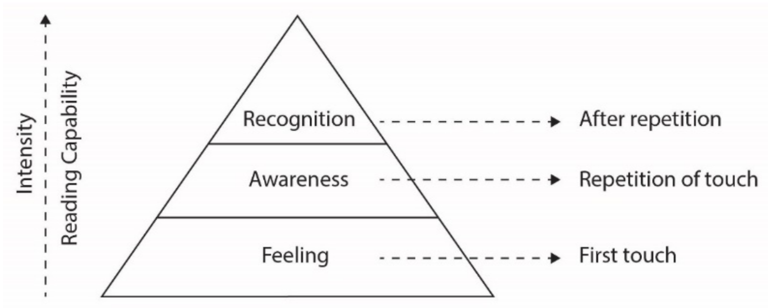

Figure 3. Texture Communication

In more detail, the rehabilitation process consists of three levels. First, visually impaired feel texture arising. Second, they find a hidden message. Third, texture optimizes their sense of touch sensitivity. The texture media is functioned to find the location of the tactile pictogram.

2. Texture Elements

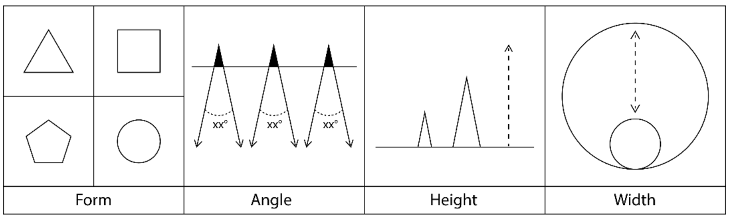

Figure 3. Texture Elements

The texture media has four elements. Those are form, angle, height, and area. The form is a basic geometric arrangement. Angle relates to the texture surface sharpness. Height relates to the texture depth. Width and height relate to the size of the media. The four texture elements are to be interpreted as a story.

3. Texture Drawing System

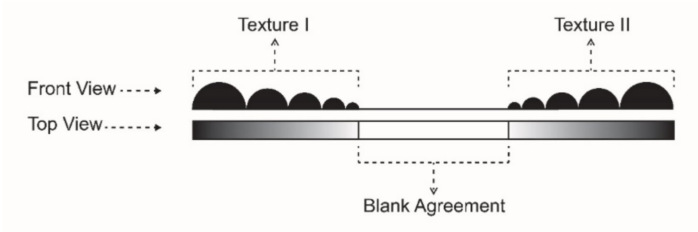

Figure 4. Texture Drawing System

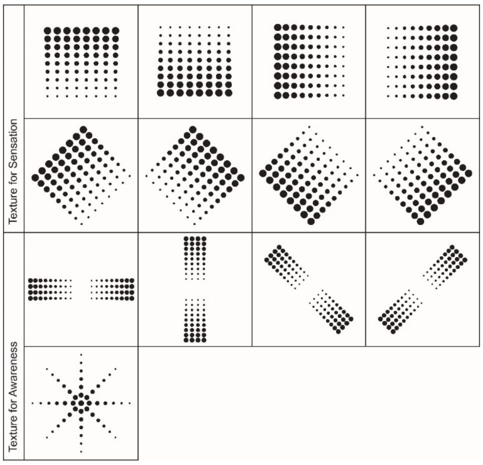

Figure 5. Texture Alternatives

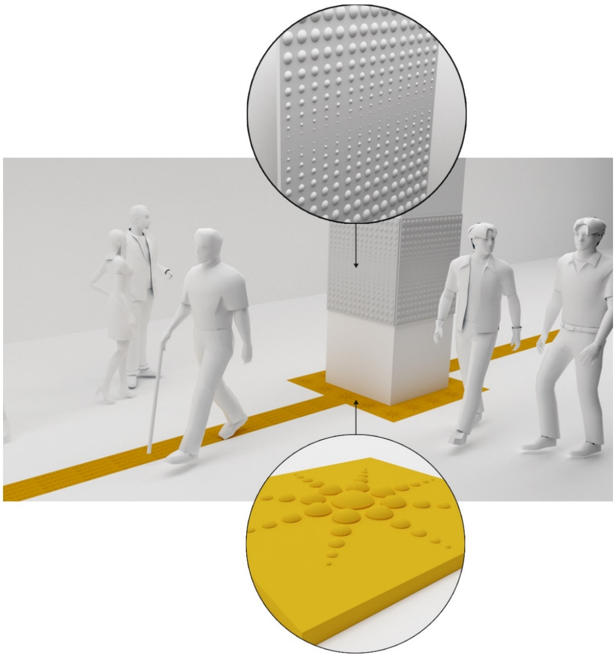

Figure 6. Digital Simulation

The author created a base to adapt the STC system. This base is called the "Blank Agreement". The blank agreement is a condition that the visually impaired cannot read any information on tactile media because they touch no texture or can also be referred to as a surface without height. The author used this to optimize the legibility of texture and its story. The trick was taking advantage of blank space as a sign of a change in tactile height through motion. This agreement design departs from the previous finding, it shows that the condition of tactile media that does not have texture builds general perceptions of nothing. Simply put, this is the same as the reaction when the eyes see a blank platform.

RESULT

1. Prototype Production

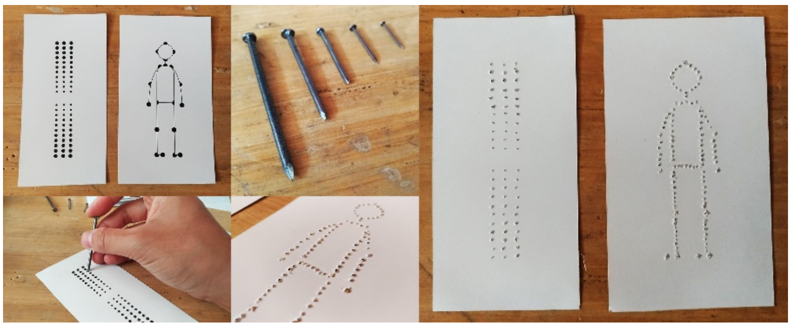

Figure 7. Prototyping Process

The prototyping process chose the most efficient tools, materials, and techniques. Tools and materials selected Art Paper 260gr paper and nails with five sizes. The prototyping process was initially carried out by printing each tactile pictogram and texture form on different paper of the same size. The chosen tactile pictogram symbol is human. The reason is this symbol has complex anatomical details but the visual perception of the visually impaired is familiar with it. Then, the selected texture form is an awareness texture. The reason is to make the testing process more efficient. The next step was making tactile height in the groove of the shape by piercing it with nails. The size of the prototype produced is 65mm x 130mm.

2. Trials

Figure 8. Trials Process

The trial consisted of 2 sessions. The first is the media reading session. The second is the interview session. In the first session, respondents received the prototype in turn. In this session, respondents got the information that they would get two media and only had one minute each to read each media. During the reading session, there are no additional verbal descriptions and instructions. Then, in the second session, all respondents were given three questions:

- What is the built perception when you access texture media?
- Did texture media optimize your ability to read tactile pictograms?
- What kind of design system for optimizing the ability to read tactile pictograms do you prefer the most?

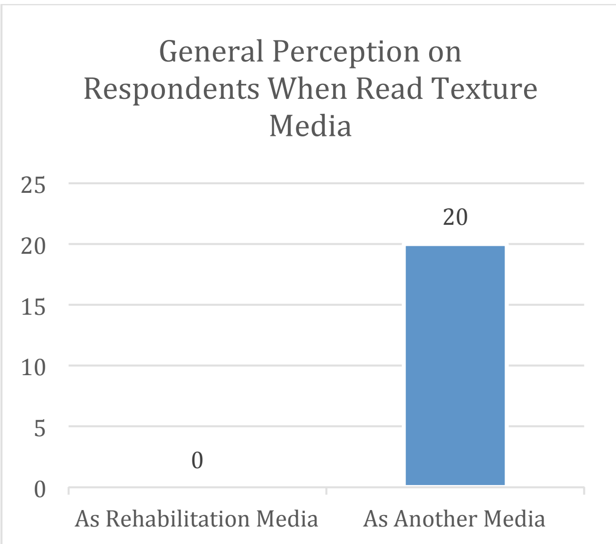

Table 1. General Perception on Respondents When Read Texture Media

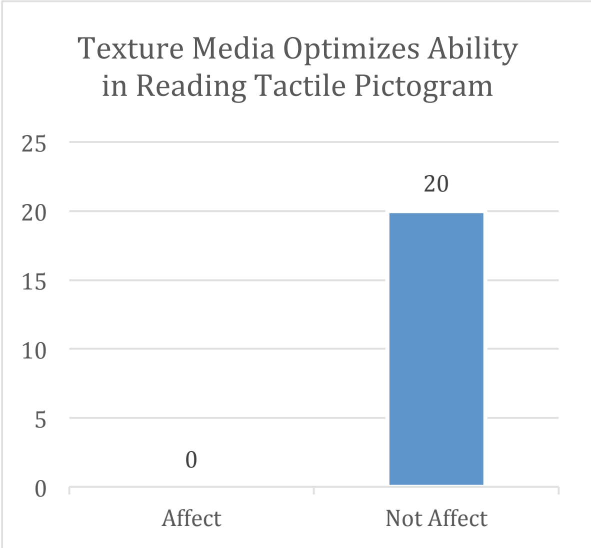

Table 2. Texture Media Optimizes Ability in Reading Tactile Pictogram

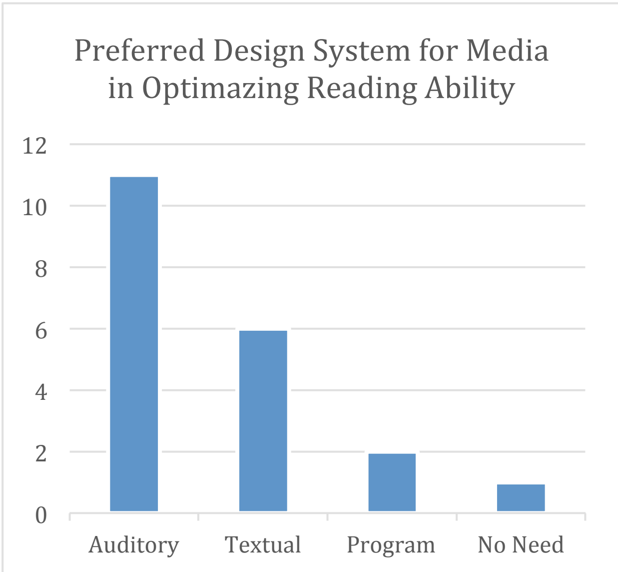

Table 3. Preferred Design System for Media in Optimizing Reading Ability

The trial reveals highly comparative data. Overall, it concludes that textured media does not optimize the ability of the visually impaired when reading tactile pictograms pragmatically. Texture media are perceived separately as unrelated media. The perceptual process shows that the visually impaired first perceive based on the number, not systematic. The general perceptions are categorized into five types namely sharpness, materials, objects, scenery, and feeling. Furthermore, the most preferred design system is the media with declarative knowledge. More specifically, media that bind verbal contexts such as audio sensor and textual, including braille. In addition to another system, several respondents suggested that optimization should be emphasized in the rehabilitation program. The respondents stated that there is no problem with a new design if they are trained regularly until they are proficient. Finally, respondents who do not need media for optimizing reading ability stated that too many tools further weaken the value of graphics-based designs. In addition, several respondents rated the time above one minute to access media in public spaces as inefficient.

The author evaluates four probabilities cause the texture media design not to work. First, it is not effective to design assistive devices for the visually impaired using a semiotic approach. The author considers that determining the parameters of their abilities and habits as the design basis is more appropriate than assuming the mechanism. Second, the dominance of visually impaired cognitive skills in memory. Accompanied by analysis of the results of previous experiments, it is considered that the visually impaired will face limitations if they perceive a new design system without semantic support. Third, the author made a mistake in compiling the experimental methodology. Theoretically, human abilities are more influenced by bottom-up processes so that the duration and experience variables are consequences. Thereafter, the variables and structure of the experiment are opposite. Fourth, the execution of the prototype design is still not good.

The author found a general assessment for good rehabilitative design criteria through qualitative analysis. First, the design reaches the optimal value if the visually impaired perceive its function correctly in less than 60 seconds. Second, determining the semantic parameters to achieve optimal value is potential. Third, media specifications are designed based on the quantification of their required functions. Pragmatically, there are two alternatives in designing rehabilitation media. Those are design starts from familiar things for the visually impaired or the design is supported by a familiarization program.

CONCLUSION

The designed rehabilitation with declarative principles to increase the readability of the tactile pictogram is overwhelming. It means the studies to reveal the most appropriate tactile pictogram design system for the visually impaired still need to be done. As the core of the conclusion and provision for further studies, the author considers that applying the performance of the System Working Memory (SWM) on the visually impaired in developing a tactile graphic-based design is fundamental. It should ideally link the visually impaired perceptual process to memory and simplify semantic learning.

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