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Reflecting Pictorial Language Design for Tactile Pictogram (Tactogram)

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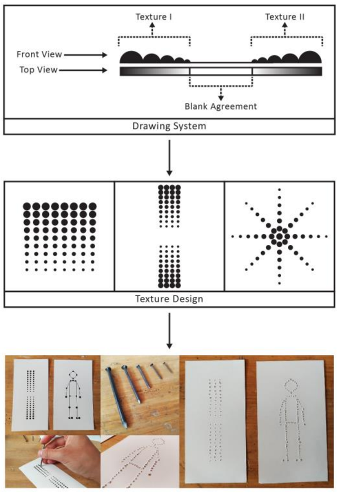

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ABSTRACT This paper was intended to reflect on an appropriate pictorial language design for the tactogram. The research method used document study analysis based on the three previous studies. The data included the results of designing pictorial language using Tabrani's 'ancient visual language' theories. Tabrani revealed how to read stories in pictures through translating the drawn multiple images in a panel as object motion descriptions. This research assumed the descriptive image system as a suitable pictorial language concept in designing tactogram for the visually impaired as orientation and mobility system in train stations. In general, if the visually impaired still cannot understand the meaning of the tactogram symbols simultaneously with their sequential reading principle, then the pictorial language is not optimal yet. It indicated some errors in designing methods because it did not meet the visually impaired ability and habits to read tactile graphic-based information.

Keywords: pictorial language, tactogram, visually impaired, orientation and mobility system, tactile graphic-based information

INTRODUCTION

Most people access visual information by vision. Visual information includes three things are spatial dimension, color, and motion (Bennett, Bex, Bauer, and Merabet, 2019). Accessing orientation and mobility systems through pictogram design in public space for people who don't have functional limitations on their vision doesn't make it difficult. Normal vision benefits someone when understanding the image representation has meaning as a tool in determining a destination, carrying out contextual motion, and carrying out instruction simultaneously (Gracia, Dorronsoro, Sanchez-Gonzalez, Sawides, and Marcos, 2013). Of course, this is different with the visually impaired accessing a lot of information with the sequential concept. The tactogram design tends to be applicable for them in highly dynamic spaces. Thus, the selected tactogram pictorial language must be appropriate for easy understanding and use for the visually impaired. It should get based on both reading habits and capabilities (Bhowmick, Hazarika, 2017).

Figure 1. Borobudur Relief Using STP System

Source:

Tabrani's Journal (https://journals.itb.ac.id/index.php/wimba/article/view/10914)

The designed pictorial language before referred to the two drawing systems of Tabrani's theory (Figure 1), namely the Space-Time-Plane (STP) system for 2D and the Space-Time-Curve (STC) system for 3D (2012). This research developed a tactogram as an orientation and mobility system three times. In the first study, the pictorial language was designed by applying Tabrani's visual language drawing system to be a tactile form. The designing tactogram process was the same as representing the concrete form into a simplified form then raised the touch area. In the second study, the research adapted the STP system becomes dots technology to draw the tactogram symbols. The dots consist of dots to make a straight line, curved line, and angular. The dots proposed to be read sequentially so they can read the form precisely and understand its meaning. In the third study, the research adapted the STC system to be the concept of spatial dimension based on sign language. It translated Newton's theory from length-width-height becomes repetition-navigation-direction. The generated spatial conceptual got implemented in a texture that plays as a tool for optimizing reading ability of the visually impaired by touch.

In this paper, this research focused on two things. Firstly, evaluating the three previous findings to reveal whether designed pictorial language through adapting Tabrani's visual language into a drawing system for pictogram meets the design objective. Secondly, combining the analysis to generate new heuristic perspectives on designing pictorial language should be based on the data potential. The urgency of this research was motivated by references to the fundamental designing of informative media in tactile form for people with limited visual function are still lacking in availability and are not yet common to be used as a strategy for designing large-scale public spaces. Meanwhile, tactile graphic-based information design for inclusive public spaces must have a foundation based on parameter, systematic, and scientific data (Preiser, 2008).

Building a new design foundation is not significant if it only refers to one theoretical reference. The limited sources urge to find alternatives for updating tactogram pictorial language. This research expects these challenges can be bridged by the findings so that the scheme of determining design approach and improving practical design studies becomes structurally. It hopes that this paper, apart from being a personal asset, can also be a reference for other designers to enrich tactile-based science.

LITREATURE REVIEWS

First Study

The full material had been published on proceeding titled Building General Perception for Blind People as Orientation System in The Bandung City Train Station through the Pictogram Design (Fadhlillah, 2018). The result (Figure 2) showed that the designed tactogram was not understood effectively and efficiently by the respondents. The respondents could perceive the symbols but couldn’t all understand its meaning correctly without the guidance from sighted people and verbal aids. Motion description identified as blurry object. The respondents' input for the improvement was to complete the pictorial language with the braille system. Overall, this study concluded that the visually impaired people can perceive any tactile media and its pictorial language but there were internal and external factors that affected the accuracy and optimization process of using these abilities. Internal factors included the experience of accessing tangible objects variety and the condition sensor systems. The experience was related to memory capacity and visual queries. Furthermore, external factors included tactile settings and rehabilitation programs. Tactile setting consisted of appearance, dimension, texture, and material. Then, the rehabilitation program concerned the material taught both in the academic and pragmatic scope. In this study, it was assumed that other factors caused the visually impaired people to be unable to read pictorial language. That is the stigma of society that thinks tactile graphic-based information is not important for the visually impaired due to their limited vision so that media with this form is considered unnecessary.

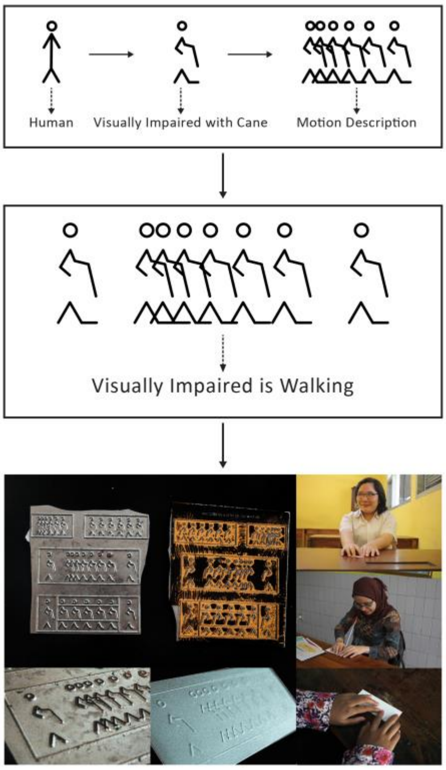

Figure 2. First Trials Documentation

Source: Self Courtesy

Second Study

The full material had been published on journal titled Seminal Breakthrough in Tactile Pictogram design for Visually Impaired in Train Station (Fadhlillah, 2020). The result (Figure 3) showed that the dot technology proposed didn't affect the visually impaired performance in understanding the symbolized form. They needed a verbal clue to mix-match the meaning into graphic symbols. The research considered that the visually impaired didn't need additional embedded graphic elements on the tactogram. On the other hand, representing meaning in a symbolic form was not preferred to the visually impaired. There were two fundamental reasons connected with this phenomenon. Firstly, efficiency in time consumption. The more complex and abstract the form, the longer it will take for the visually impaired to read and understand. Second, the semiotic process is in mind. Each visually impaired has an absolute interpretation of every accessed object without guaranteeing an agreement between them. Perceiving symbols without any verbal guidance had the consequence meaning process randomly. The respondents' input for the improvement was to complete the pictorial language with the braille system. Overall, this study concluded two things. First, balancing the effectiveness and efficiency reading process was needed. At this stage, it was assumed that the pictorial language should ideally simplify semantic learning. These alternatives selection must get based on scientific parameters. Second, tactile graphic-based technologies for the visually impaired are ideally made to enhance their capabilities, not create.

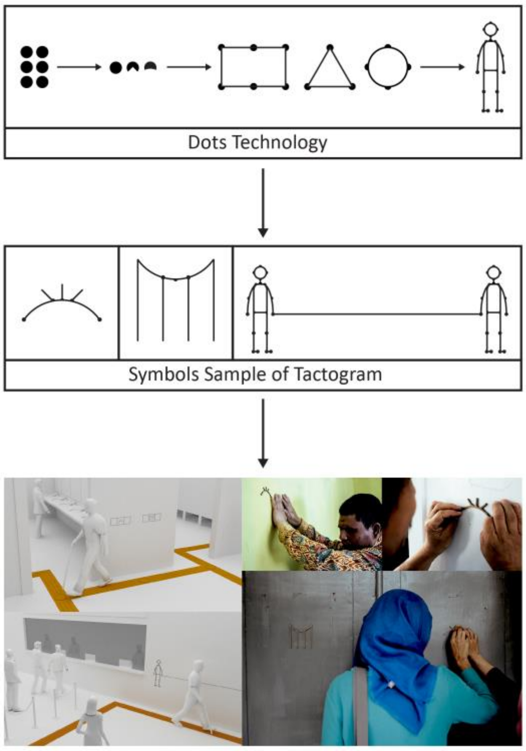

Figure 3. Second Trials Documentation

Source: Self Courtesy

Third Study

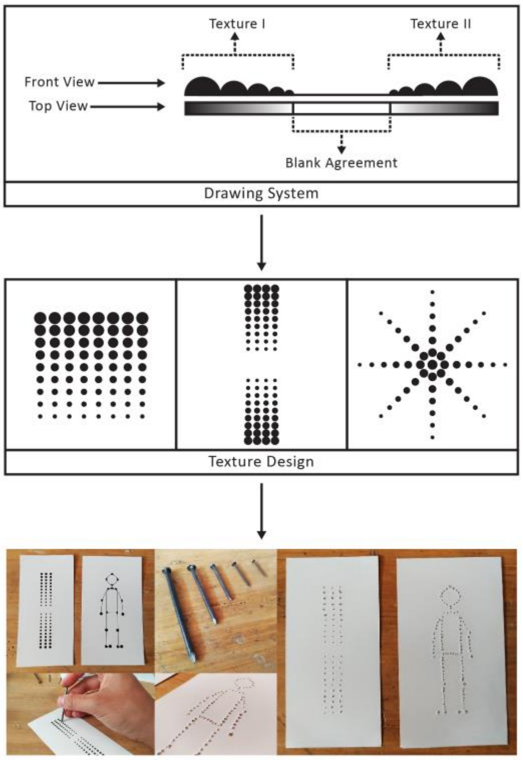

Figure 4. Third Trials Documentation

Source: Self Courtesy

The full material had been published on journal Optimizing Visually Impaired Ability to Read Tactile Pictogram through Texture Design (Fadhlillah, 2021). The result (Figure 4) showed that the new spatial concept application in designing texture can't optimize the visually impaired reading impaired ability. It was found the respondents perceived each media separately without verbal aids. Through the verbalism when they interacted with texture media, the research observed that they associated the appearance of the texture with various objects. Objects included both singular and plural. The texture was chosen as a rehabilitation media because it is the closest alternative form of communication to the reading concept by touch. It confirmed the previous finding that the tactogram design system didn't need to be supported by similar communication concepts and graphic tools. According to the tendency of the visually impaired to focus their mind on only one object declaratively, the texture design decreased the efficiency value. Of course, multilingual media with this concept didn't benefit their mobility in public spaces. Each access to the object builded its thinking algorithm. Without memory related to how texture media works correctly beforehand, the respondents would not understand the systematics. Such systematics must be understood both as one and as a unit. This final study concluded that the design of the pictorial language should consist of a mono-system. Then it was increasingly understood by interaction repetition. The respondents' input for the improvement was to complete the pictorial language with the braille system.

Johannesson & Perjos (2014) divides six types of knowledge. Those are definition, descriptive, explanatory, predictive, explanatory & predictive, and prescriptive. Writing structure follows this theory to make the analysis more solid and systematic.

METHODOLOGY

The method used was document study. The type of document is academic publications. It included three previous publications mentioned in the literature review section. Analysis data used mix-methods then was carried out using comparative and descriptive techniques.

Comparative analysis was carried out through quantification studies to reveal the similarity documents data significance, that focuses on conclusions and their reason. Then in the descriptive analysis phase, the research aimed to find the imagery of stepping stone in designing the pictorial language in further study. The imagery got formed from a qualitative assessment process on three variables. Those were a blindness concept from the point of view of graphic aids, a design approach based on existing applied science, and concrete mapping regarding how to update the pictorial language.

RESULT AND DISCUSSION

Previous Researches Evaluation

The incompatibility of adaptation with Tabrani's 'visual language' generated another perspective. It showed that pictorial language should avoid 'visually simultaneous' concepts as the basis for building an orientation and mobility system for the visually impaired in public spaces. The research documented those concepts are shape simplification, visual semiotics, and adding tactile features. Shape simplification referred to selecting the most representative detail of a graphic element from an object. Visual semiotics referred to assuming the meaning from a personal point of view. Then, the addition of tactile features referred to adding texture as a practical solution. The essential weakness of these three concepts was the complexity consequence of the resulting graph, which was not touch-ergonomically reading. The knowledge lacking related to spatial and object information due to this phenomenon should get understood by designers. If the pictorial language used in public spaces, its effectiveness and efficiency were weak. The language would be unbeneficial to be read by the visually impaired. On the other side, adding media is costly. The designing pictorial languages based on the general perception and graphic cells should be explored.

Defining Blindness Concept

As a benchmark for the problem statement, the research considered understanding the blindness concept besides a clinical and social perspective was essential in designing a tactogram. After combining the data, the research analyzed blindness in the visually impaired from the perspective of graphic aids, which had the same concept as the function of the number zero in algebra. Below described the analysis by type.

1. **Blindness as Set**

   This section talks about two concepts. First, blindness is an empty set. The first concept talks about quantity rather than order. It describes if someone does not have melons, then zero melons. The principle in this concept is in the same context as the Lateral Geniculate Nucleus (LGN) condition in the visually impaired. LGN is a multilayered structure in the human brain that can process graphics-based information through vision and touch (Derrington, 2001). Outwardly, visual areas connectivity in humans for both the sighted and the visually impaired has the same ability, but the habit of using senses influences as they grow and develop (Zihl, Dutton, 2015). Second, blindness is the lowest number. The second concept talks about the arrangement. It can be analogous to the number of zeros being smaller than the number of ones and more. The principle in this concept is in the same context as the visually impaired ability to read graphic information simultaneously that it is affected by their clinical eyes damage and certainly will not be as good as the sighted (Mohammed, Omar, 2011). The blindness concept as the set is closely related to societal stigma. It is visually impaired does not have graphics processing capabilities, so graphics-based media is not required and will not work for them (Śmiechowska-Petrovskij, 2017).

2. **Blindness as Propositional Logic**

   This concept talks about zero as the truth value false. The principle in this concept is in the same context as the definitional output analysis for the visually impaired when understanding the meaning of graphic objects. It will not be precise but can be optimized. This phenomenon gets found in the visually impaired reading habit of a particular shape of an object (Millar, 2004). They can read media correctly because the design system improves their orientation ability (Heller, 1989). Generally, sighted people determine the condition as a weakness (Fraser, Beeman, Southall, Wittich, 2019). However, to achieve a more inclusive environment in the future, the research offers the perspective that is being reversed. That is limitation comes from technological constraints.

3. **Blindness as Abstract Algebra**

   This concept talks about zero as a neutral element. The principle in this concept is in the same context as the intervention concept in a rehabilitation program to build the visually impaired contextual abilities. Three keywords that influence the rehabilitation program are habituation, assessment, and repetition (Dodds, 1993). It concluded that the velocity and improvement to read tactile graphic-based information are directly interconnectedly to their quality training scheme.

4. **Blindness as Lattice**

   This concept talks about zero as the bottom element. The principle in this concept is in the same context as the human brain development stages. Theoretically, it mentioned that the older a person gets, the more mature their brain growth and development is if there is no brain damage. This phenomenon gets found in the results data from another researcher. It stated that visually impaired adults are better at processing tactile graphic-based spatial information than the younger visually impaired (Millar, 2004).

5. **Blindness as Category**

   This concept talks about the number zero as a property for composition. It describes a calculation concept. For example, if zero plus one equals one and zero plus ten equals ten. The principle in this concept is in the same context as the level of accessibility and suitability of tactile graphic-based technology for the visually impaired. This phenomenon gets found from the effective comparison of moon type, night writing, and braille for the visually impaired. They will prefer used media to meet their ergonomic value (Naraine, Fels, Whitfield, 2018). On the other hand, the better impact influences their independence (Beyer, Meek, Klisby, Perry, 2008).

6. **Blindness as Recursion**

This concept talks about zero as a model for computing is often regarded as decision problems. The principle in this concept is in the same context as the urgency level of graphics aid for the visually impaired. This level gets influenced by two factors, namely the type and function. This phenomenon gets found from the need for tactile symbols. For instance, the visually impaired preferred the braille sign over symbolic shapes as an orientation and mobility system in the public (Fadhlillah, 2018, 2020, 2021).

Exploring Design Approach

The pictorial language for tactogram intended to don't need a verbal aids support system. For improvement study, semiotics didn't get used further. The research tried to improve the newly generated five fundamentals. Those are tactile settings, general perception, graphic cells, hierarchical-based information, and semantics. First, number units include the standard for tangible objects setting that meets the minimum accessibility value. Second, the general perception is visual queries on the visually impaired and can get understood by them. Third, the graphic cell is the natural human ability to read forms. Fourth, hierarchical-based information refers to the most needed information for the visually impaired to be represented. Fifth, semantics includes reading and understanding graphics techniques that involve memory ability. The fundamentals were integrated into the blindness concept to project a hypothesis for the most appropriate design approach. This integration should be a pragmatic reflection.

Algorithm 1:	$x + y = 1$
Algorithm 2:	$x - y = 0$
Algorithm 3:	$y - x = \infty$

Figure 5. Basic Blindness Concept
Source: Self Courtesy

At the beginning integration process, the research found two clauses. Those were 'able to read graphics' and 'not able to read graphics'. The ability in the first clause means the information components on graphic tactile-based information media can be accessed by the visually impaired optimally. The components are spatial information and temporal information. They were translated consecutively as 'x' and 'y' (Figure 5). The relationship between the two types of information was translated into an algorithmic language to get mapped more simply. The first algorithm explained that the visually impaired will do able to access spatial data if there is an informative-tangible object. The second algorithm explained that the space without an informative-tangible object will not allow the visually impaired to use, build, and optimize reading graphic skills. The third algorithm explained that the presence of tangible objects in the absence of space makes visually impaired people never end guessing the meaning. Space included physical or phenomenology definition.

Question 1	Where do the visually impaired face limitations?
Question 2	What does limit the visually impaired?
Question 3	What is the solution?
Question 4	Where should the solution be applied?

Figure 6. Graphic Aids Assessment
Source: Self Courtesy

As a cognition map, the research found the role of spatial and temporal discussed in neuroscience. Those factors are working systems from the dorsal stream and ventral stream. Theoretically, the dorsal or 'where' stream is responsible for guiding actions and recognizing object location, then the ventral or 'what' stream is associated with object recognition and form representation (Pandya, Petrides, Seltzer, Cipolloni, 2015). A neuroscientific-based design approach has strong potential to be developed as a foundation for pictorial language. That's because the two-streams examined theory about the connection of behavior and cognitive functions in humans when accessing spatial and temporal information with brain conditions. As the first step, the two-stream work concept got used to building a pragmatic graphic aids assessment model. The assessment model consists of problem-solving questions namely 'double what' and 'double where' (Figure 6).

Generating Design Map

Conducting assessments and projecting data as the foundation of technology were two-different interconnectedly activities. Designing graphic aids for the visually impaired based on their limitations is essential. The research analyzed the reading tactile graphics-based limitation divided into two terms. First, disability is a limitation caused by a lack of knowledge and experience interacting with tactile graphics-based media. It gets influenced by the intervention length. So, this term is connected with a temporal factor. Second, inability is the factual condition of not being able to do. Inability is the result of the unavailability of accessible space. So, the visually impaired are unable to build any capabilities. Thus, the spatial factor becomes a consequence of their orientation process.

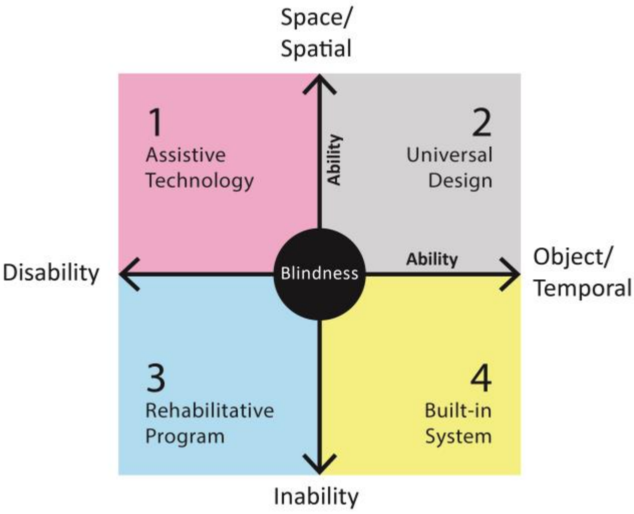

Figure 7. Intentional Design Mapping

Source: Self Courtesy

The resultant integration of five variables consisting of blindness, spatial, temporal, disability, and inability resulted in an intentional design mapping for the visually impaired (Figure 7). First, the first quadrant intends the design to adopt personal use principles. It gets recommended to maintain the functional ability of the visually impaired in a space. Second, the second quadrant intends the design to achieve universal value. This approach is associated with a vision to build inclusive spaces more massive and technologies for all. Third, quadrant three intends the design supported by the pedagogy principles. This approach gets recommended to cope with the inaccessible environment. Fourth, quadrant four intends the design to be an integral and permanent part of a construction. This approach gets recommended to build systematic learning.

CONCLUSION

Visual semiotics is not suitable to be chosen as the foundation for designing a pictorial language for tactile pictograms. These things include how to symbolize and read representations of shapes. A risky approach to producing designs with low readability values and the parameter to measure them is whether the symbols and their meaning can be read simultaneously correctly or not. Further studies should discuss the character of tactile graphics-based that can be read faster than the previous design with the support of findings from this paper.

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