Guideline for Tactile Figures and Maps

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ABSTRACT
The purpose of this research is to propose a guideline for tactile maps and figures. At present, there are no unitary standard for manufacturing tactile figures and maps in Japan. In this research, first of all, I proposed the guidelines for tactile figures and maps based on the characteristics of the tactile perception. Secondly, I proposed how the Tactile-Mapping- Practice should be conducted. Finally, two experiments were conducted to evaluate the usefulness of the Guidelines and the tactile-mapping-practices. From these usability test-results, I was convinced of the usefulness of the Guideline and the Tactile-Mapping-Practices.

Categories and Subject Descriptors
H.5.2 [**User Interfaces**]: Ergonomics, Standardization

General Terms
Experimentation, Human Factors, Standardization

Keywords
Tactile Maps, Tactile Figures, Guideline, Haptic Characteristics, Tactile-Mapping-Practice

1. INTRODUCTION
When the blind goes out solely, “buildings, stores, fence, and wall”, “listening to someone else”, “textured paving blocks”, “sounds of daily life”, “public guiding sounds”, “audio spoken assists”, and “Braille assists” are all useful for providing needed information for the blind [1]. In Japan, only very small numbers of the blind get out solely, because of the concern that most of them believe that getting out solely has a high-risk of being injured. One of the reasons for such beliefs is the blind are difficult to obtain enough information for walking around solely.

There are three types of presenting information by Tactile/Haptic information during walking; 1) Prior Information (someone gives needed information beforehand), 2) Real-time Information (someone gets information during walking), 3) Learned Information (someone receives information after walking).

Tactile map is the map which is embossed or written in Braille, thus user can get necessary information of the map tactually. There are three types of notation systems for common map; 1) Overall viewing map (presenting a broad overview of commodious premises), 2) Fragmentary viewing map (presenting a part of the commodious premises, like floor maps), 3) Detailed viewing map (presenting a piece of the commodious premises, like a guest room or a toilet). There are same types of notation systems in tactile maps.

In this paper, I proposed Guideline for Tactile Figures and Maps and the Tactile-Mapping-Practice based on the guideline. Usability tests were conducted to compare the existing styles of tactile maps and the new style of tactile maps based on the Tactile Mapping Practice. As the results, we validated availability of the Guideline and the Tactile Mapping Practice.

2. PRESENT STATE OF TACTILE MAPS
2.1 Tactile Map
Tactile Maps are the map for the blind person. On the tactile map, streets, landmarks and figures for buildings are printed with a slight protuberance to present information tactically. User touches the tactile map to read the information of the maps. There are two kinds of slight protuberance ways; 1) Printing lines by Braille dots, and 2) Embossing all figures. Braille dots could be printed on paper which then could be sent by mail. In contrast, the embossing technique is usually used on with metals and figulines, thus the map size will be larger.

2.2 Tactile Map Classification
There are no standard for presenting tactile maps. I classified tactile maps in the following categories: 1) Visual Dominance Embossed Effect Map, 2) Visual dominance Braille Effect Map, 3) Landmark Dominance Effect Map, and 4) Arrangement in Space Dominance Effect Map [2].

2.2.1 Visual Dominance Embossed Effect Map
Visual Dominance Embossed Effect Map (VDEEM) (see Figure 1) depends on the visual map, and is created with the embossing techniques. When the sighted use VDEEM visually, they can understand their meanings. However, when the blind persons use the VDEEM, configured with many tactile figures, they cannot understand their meanings.

Figure 1. A sample of VDEEM.

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Visual Dominance Braille Effect Map (VDBEM) (see Figure 2) depends on the visual map, and is created with Braille dots. Parts of Landmarks and roads are enclosed by Braille dots. When the sighted use VDBEM visually, they can understand their meanings. However, when the blind persons use the VDBEM, which are configured with many dots, they cannot understand its meanings.

Figure 2. A sample of VDBEM.

2.2.3 Landmark Dominance Effect Map

Landmark Dominance Effect Map (LDEM) (see Figure 3) places emphasis on Landmarks with deformation. These LDEM are given emphasis to be used for entertainment and therefore usually used in amusement spots. LDEM are configured with many tactile figures, thus the blind person cannot understand their meanings.

Figure 3. A sample of LDEM.

2.2.4 Arrangement in Space Dominance Effect Map

Arrangement in Space Dominance Effect Map (ASDEM) (see Figure 4) places emphasis on space dominance, and is created with embossing techniques. These ASDEM consider the space is the most dominant factor and eliminate other elements such as distance information, landmark information, etc. These ASDEM give emphasis to major locations such as station premises, administrative institutions, etc. ASDEM are configured with too many tactile figures that the blind person cannot understand their meanings.

Figure 4. A sample of ASDEM.

3. Guidelines for Tactile Figures and Maps

3.1 Outline of the Guideline

These Guidelines for Tactile Figures and Maps explain the basic philosophies, the general principles, and the implementation structures of helping human walking by tactile figures and maps. It is necessary that all users can use tactile figures or maps easily to understand their meanings. This guideline was summarized for produce more easily comprehensible and useful information more correctly. When producers produce the tactile figures or maps, they have to take into account the characteristics of the handicapped, and should use this guideline to appropriate presentation of information by tactual figures effectively. Furthermore, if the users can use the tactile figures and maps well, the handicapped people will be free to take individual action more freely and safety.

3.2 How the Guidelines are Organized

This document includes fifteen guidelines, or general principles of accessible designs. Each guideline includes:

- The guideline number.
- The statement of the guideline.
- The rationale behind the guideline and the opinions of some groups of users who have benefited from it.

3.3 Guideline for Tactile Figures and Maps

3.3.1 Use Easily Comprehensible Tactile Figures

Produce tactile figures or maps with figure's size thickness and size standards. [PRIORITIES 1]

The tactile figures or maps have to be produced with constant thickness. Using different thickness figures will complicate the tactile figures or maps. It is preferable that use the standard size to express as landmarks [PRIORITIES 2]. However, when

producing the tactile figures or maps, producers are free to use different size of figures if expressing as actual location or destination.

3.3.2 Use Tactile Figures' Shapes as Needed

Use separate figure shapes to express as actual location, destination, and landmarks [PRIORITIES 2].

It is easy to recognize each figure's meaning that uses separate figure shape to express as actual location, destination, and landmarks. The pyramidal shape is the shape which is easiest to recognize; therefore, use pyramidal shape for expressing the actual location.

3.3.3 Use Minimum Amount of Information

Think about how many figures might be in the tactile figures or maps, and use minimum amount of figures to express as landmarks [PRIORITIES 1].

The number of information has to be limited to five for one touch [PRIORITIES 1].

It is difficult to create cognitive map that information which is complicated on tactile figures or maps. Therefore, producers must other than the landmarks, roads or streets, around the actual location, and destination. The haptic information capacity is five plus or minus one, so that producers have to create the tactile figures or maps with not more than five informations for each one touch [3].

3.3.4 Use Braille or Embossing Words with Written Words

Producing the tactile figures or maps includes Braille or embossing words and written words [PRIORITIES 1].

Remember only the minority of the blind can read Braille. The majority of the blind are people who have posteriori lost their sight. Therefore, some of the blinds read embossed words more easily than Braille. If necessary, the sighted read the blind to written information on the tactile figures or maps, therefore producer has to use either Braille or embossed or written words.

3.3.5 Use Power Exponent for Presenting distance information

Use power exponent for presenting distance information [PRIORITIES 2].

Use power exponent suitable for use with each situation [PRIORITIES 2].

The cognitive distances are differences between cognitive level and somatic cognitive level, therefore, tactile power exponent must be used on presenting "distance information". The power exponents are difference between each using situation, therefore, use different suitable power exponent for use with each situation; inside, outside, portable map, or installation map.

3.3.6 Standard Distance Mark of Scale Should be Printed in Lengthwise

Produce standard distance mark of scale vertically for reducing any distance error [PRIORITIES 3].

On the visual map, the standard distance mark of scale is located crosswise. On the tactile figures and maps, however, standard distance mark of scale is preferably located vertically for reducing distance error. If it is possible that producers use the distance between actual location and the first landmark for the standard scale distance mark for that particular area [PRIORITIES 3].

3.3.7 The Blind Should Select Landmarks

The blind should select landmarks [PRIORITIES 1].

The alternative for landmarks is the difference between the blind and the sighted during walking. The sighted depends on visual information for landmarks, while, the blind does not depend on visually information for landmarks. The blind usually depend on auditory information, olfactory information, and tactile information for landmarks. Therefore, the blind should select the landmarks to produce the tactile maps.

3.3.8 Landmarks Should Be Located Correct Placement of Each Actual Landmark

Landmarks should be located relative placement for real situation to keep users safe [PRIORITIES 1].

The blind often use the placement of landmark on the tactile map and their relative distances during walking. Consequently, the located relative placement and relative distance are most important to present information to the blind. The tactile maps put the blind in jeopardy because of the haphazard placement.

3.3.9 Use Color Effectively

Use colour effectively for the assistance of amblyopia [PRIORITIES 4].

The majority of the blind are amblyopia. They can get the visual information in some small measure. Usually tactile figures and maps are used with tactile sense, however, when the amblyopia uses tactile figures and maps, they use visual information effectively. When producer produces the tactile figures or maps, they must be noted that colours of contrast are of significant aid to the amblyopia.

3.3.10 Should not be Depended on Visual Map when Designing Tactile Figures or Maps

Producer must be recognized the difference of visual map characteristics and tactile maps characteristics [PRIORITIES 1].

It is difficult to understand their meanings that the tactile map was produced from visual map with written in embossing words and Braille manners. Producer must be recognized the difference of visual map characteristics and tactile maps characteristics. Producer must not cannibalize the visual figures or maps to tactile figures or maps.

3.3.11 Should not be Depended on Only Audio Assist when Designing Tactile Figures or Maps

The audio assist work on the presenting information, however, it does not work useful by location [PRIORITIES 2].

The audio assist works on the presenting information, however, it does not work useful by location; noisy cross-point, in front of a station, etc. The audio assist can take longer time to present

information. The audio assist is useful to present name of landmarks. The audio assist must be use for only assist to present tactile map.

3.3.12 Map size Should be Smaller than Range of Human Brachium Movement

Map size should be produced smaller than the range of human brachium movement [PRIORITIES 2].

If the map size is produced larger the regular than range of human brachium movement, the user of the map could not get enough information. Only the maps scale down, however, there are too many information on the tactile figures or maps, therefore, user could not understand their meanings. Producer must carefully consider the details of the information capacity and function of presenting areas (see 3.5.3). Producer, furthermore, must carefully consider the details of using several tactile figures or maps separately to present larger area.

3.3.13 Set Up High and Range Should be Adjustable

Producer should be carefully considered the details of set up high and range of tactile figures and maps adjustably [PRIORITIES 3].

Users' high and length of their arms are unequal. It is preferred that the tactile figures or maps could be height-adjustable and range-adjustable. If user could not adjust oneself, producer must produce the tactile figures or maps' high ranged between 5-95%ile of average height and ranged between 5-95%ile of average range of human brachium movement.

3.3.14 Set Up Tactile Map and Real Field Palewise

When set up tactile figures or maps, a main street which is on the tactile map should be perpendicular to the real field [PRIORITIES 3].

Producer must carefully consider the details that set up angle of tactile figures or maps work on building human cognitive maps. The actual location should be placed on the bottom-centre of the tactile figures or maps, and the destination should be placed on the top of the tactile figures or maps. When set up tactile figures or maps, a main street which is on the tactile map should be perpendicular to the real field, the actual location should be placed on the bottom-centre of the tactile figures or maps.

3.3.15 Should not be Depend on Only Textured Paving Block

On the derivation to the tactile figures or maps, producer should be not depend on only textured paving block, therefore, should be use the auditory information or olfactory information [PRIORITIES 5].

Usually use the textured paving blocks are used to direct the blind to the tactile figures and maps. However, on the some kinds of environmental status, the blind could not use the textured paving blocks. Producer should be carefully considering the details of using auditory information or olfactory information. Furthermore, Producer should be carefully considering the details of using colour effectively to be thoughtful of amblyopia

3.4 Priorities

Each checkpoint has a priority level assigned based on the checkpoint's impact on accessibility.

[PRIORITY 1] The producer of tactile figures or maps must satisfy this checkpoint.
[PRIORITY 2] The producer of tactile figures or maps should satisfy this checkpoint.
[PRIORITY 3] The producer of tactile figures or maps may satisfy this checkpoint.
[PRIORITY 4] The producers of tactile figures or maps might satisfy this checkpoint.
[PRIORITY 5] The producers of tactile figures or maps may wish to satisfy this checkpoint.

4. DISCUSSION

5. CONCLUSION

The Guidelines for Tactile Figures and Maps were proposed. Furthermore, the Tactile-Mapping-Practice based on the guidelines were proposed. Two usability-testings were conducted on the tactile maps which were produced based on the Tactile-Mapping-Practice.

First, usability-testings were conducted according to "the usability-flow-chart-evaluation" which was formulated by the Guidelines. As the results, the tactile maps which were produced based on the Tactile-Mapping-Practice scored "AAA". On the other hand, the tactile maps which were produced based on VDEEM were scored "A". The scores consist of five grades, namely, "AAA", "AA", "A", "B", and "C".

The second usability-testing was conducted by ten sighted subjects. The subjects touched each of the tactile maps which were produced on the basis of Tactile-Mapping-Practice and were produced basis on VDEEM, then subjects represented the maps on A3 sized paper by the Sketch-Mapping Method. The results showed on the correct answer rate of number of figures, shape of figures, relative position of figures, and relative distance of each figure, the tactile map which were produced based on the Tactile-Mapping-Practice received higher scores than the other tactile maps.

On these results, the tactile maps which were produced based on the tactile-Mapping-Practice were easier to understand than the tactile maps which were produced based on the VDEEM for the blind. Basically, the Guidelines and the Tactile-Mapping-Practice would be useful.

It would be important to continue to work on standardizing the Guidelines for tactile figures and maps.

6. ACKNOWLEDGMENTS

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