Tactile Maps - Safety and Usability

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Abstract. Maps are regularly used in planning a trip or a route, e.g. when going on a holiday abroad or driving to a meeting in a place one has not visited before. Sighted people can get hold to a map quite easily as they are available both in paper copies and furthermore virtual maps are more and more widely available too.

When one is visiting a city abroad one uses maybe more than one map at a time - city map as well as a route map of the public transport. These can be carried quite easily, as well as referred to on a regular basis. There are also maps of bigger venues like seating plans of auditoriums or concert venues. For the visually impaired tactile maps are also a safety issue [1].

Keywords: Tactile maps · Visual impairment · Mobility · Safety

1 Introduction

Maps are used to learn about an area and planning routes within it [2]. Maps are also used in education to teach about the awareness of the world in general as well as in more detail. The visual maps are easily reproduced and hand-held while tactile maps are more expensive and not as easily referred to. A map is a physical array of symbols to represent and depict the spatial relations of objects in a physical environment [3]. It is a two-dimensional representation of the environment showing specific features of the terrain in terms of their relative size and position [4]. The design of tactile maps generally follows the same guidelines as those used in visual maps, but the basic image must be edited for tactile exploring [5–7]. A tactile map cannot be a mere translation of visual information into tactual form. A tactile map, in other words, is a raised, specially-adapted tactile representation of the specific cartographical location in question. Both visual and tactile maps are concrete thus they are different from verbal maps and description.

How the map feels is more important in a tactile map than how it looks [5, 8, 9]. The important aspects to be considered when preparing tactile maps are according to [8]: 'the ability to discriminate lines, textures, size, labelling, and use of colour'. Tactile maps can give a greater spatial understanding than either a direct experience of moving

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through the environment [10] or a direct experience supplemented with verbal explanation [11]. The relevant information is presented clearly in a map with relative simultaneity, and without other difficulties associated with travel in the real environment.

It would be essential to create coherent guidelines for tactile map design. The guidelines should take into account the differences in age, vision and other abilities of the potential users. The design should include the map size and format, the choice of symbols and the scale [12]. If this were achieved, it would be possible to have globally standardised maps.

Haptic exploration in reading tactile maps uses the combination of information from hands, movement and sense of touch. When a person touches an object it is at a certain orientation to him/her. It is a relation in space between a person and the object being touched. Haptic exploration includes information about the orientation, tactile, movement though tendons and muscles in the hand. It is a combination of these bits of information [13] among others. You have to have a physical contact to the object in order to gather information by haptic exploration. On a map hands recognise the temperature of it on first contact, but on exploring by movement one gathers information of the shape, size, height and material as well as the alterations on the map [14]. With haptic exploration one processes the details, differences and relations in the map. The process involves also the combination of these information patterns into a mental map, the connections between map and real world environment and decipher the details for safe movement within a surrounding.

According to [15] the muscle and proprioception senses are more important in movement and receive the environment as visual pathways are not available. The differences in materials and surfaces are felt through the muscles and proprioception in fine detail. The basic orientation system helps with the mental maps too.

In this paper we present examples of tactile maps manufactured using different types of materials and on some of them we have user perspectives on their usability. The maps in the article are currently used in O&M consulting with both blind and low vision people. Gathering end user comments on usability and importance of maps is, we think, the preferable way in trying to develop international standards for tactile map manufacturers. There are differences between the opinions of blind and low vision end users of tactile maps and we present both views when obtainable.

2 Reading Maps

The conventional method of direct familiarisation with an area by travelling through it can be time-consuming. When a child who is blind explores an unfamiliar environment he or she can study a tactile map before entering the area. It allows the child to explore the area independently, thus avoiding the situation of having all the information coming through another person. Even a brief exposure to the map is an effective and adaptable means for introducing the spatial structure of a novel area [16].

In 1970s [17] compared the performances of good and poor map readers, who were school-age Braille readers, in order to distinguish the necessary elements for effective map exploring procedures. Continuous movement in line tracing, the ability to search for shapes, recognition of shapes, comparison and differentiation of shapes, and locating distinctive features on the maps were the important factors influencing good performance, as well as the recognition and tracing of shapes which were juxtaposed to other shapes.

Good map readers searched the map completely by using one finger instead of the flat of the hand or several fingers. They also picked out a point of origin and traced around the shape in a continuous motion and returned to the point of origin; they did not search the area between the lines or contours. [18] found that children who were good tactile map readers had strategies of the same kind as sighted children.

One research group [19] videotaped the performance of 16 adults with visual impairment as they explored tactile maps. The subjects used their hands singly or together, and they could be fixed or move across the map. Sometimes, the hands were held flat, and the palm was used to gain an overview. The fingertips were clearly the most important in tactile map reading. Often one finger was used for fine discrimination of raised details and four fingers for general exploration. Subjects used their fingers constantly to move over the surface of the map; at other times the fingers repetitively traced back and forth along a symbol, or they traced a line. Good readers employed a mix of single finger, multiple fingers and whole hand-based techniques. Usually the map is first scanned with both hands. It is done from top to bottom to get the size of the map. The studying of the map legend symbols and Braille on the map is done with fingertips as the fingertips are most sensitive in details [20].

3 Factors Affecting Readability of Maps

The factors affecting readability of maps differ in visual and tactile maps. Visual map readability is affected by choice of colours, scale and abundance of information in the map. Also overall size matters—whether the map is easily folded and easy to track a certain path in a map that stretches several pages. The colours can be given a specific meaning that needs to be explained in a map legend.

In tactile maps readability is affected in two different scopes: tactile and low-vision readability. Often tactile maps are designed for low vision users as well. Here strong visual contrasts are important as well as the orientation of the map concerning lighting conditions. Tactile readability is affected by abundance of information—too much information results in low readability. Orientation of the map affects readability as well. While visual maps can be easily used outside as well as inside in tactile maps weather conditions affect readability of them. This is more poignant in the north where snow and cold weather can hinder readability of the map drastically.

In tactile maps the orientation of the map in the surrounding can greatly affect its readability in terms of physiological restrictions in using one's hands. That is a map that is upright on the wall can be less readable because of the restrictions in flexing muscles of the wrists. In maps on the wall one's height affects the maps readability as one cannot reach but to a certain height on the map. This is more important and has to be more widely studied and noted when erecting tactile maps. Reading a map on the wall is not the best for ergonomy. On the other hand, if a map is erected horizontally there is a possibility people start using it as a table surface thus using it for coffee cups, etc. That means maps should be erected inclined to prevent its use as a table surface.

Desirable characteristics of tactile maps are durability, sharpness of border lines, surface texture, recognisable symbols, and availability. Maps can be located and available in various places, and they should withstand abrasive use, chemical exposure, and adverse weather conditions. At the same time they should be pleasant to touch, consistent in symbol representation and they should have distinguishable lines to trace.

4 Examples of Tactile Maps

In this section we present examples of tactile maps with discussion or end-user opinions where available. There are four different solutions of tactile maps, both inside and outside. These maps in question are unique and unusual as the materials in them are not traditional but the choice of materials has been influenced by their location and the vision of the architect. That is to say these maps are not mass produced but rather individually designed into their place.

Wherever in the world there is a tactile map, the processing and reading of the map serves exactly the same purpose: to orientate oneself in the surroundings and to find out the routes within, to familiarise oneself with the environment. The context is always the same, to process the information from the map and map it into the environment. When a person with a visual impairment reads a map, the reading process starts with the map legend, the compass rose if available, then the general framework before starting to explore the details in the map. Studying the map is quicker when studying it with an O&M instructor or a sighted guide. Braille is used in tactile maps all over the world.

Paris metro tactile map is placed near a wall on waist height. It is erected inclined. There is no guiding to the map with guiding tactile strips, but the route needs to be memorised. The material is metal, it is dark and with no colour alterations. It is difficult to use with low vision because of lack of colour contrasts. It has a good tactile feel, but the metal is slightly cold to touch. The map illustrates different platform areas and exits (Fig. 1).

The tactile map of an institute for the visually impaired in Finland (Keskuspuisto Vocational College) is erected outside of the building, in a taxi waiting area (Fig. 2). The map includes the premises of the institute as well as routes in the immediate vicinity of the institute. There are the connections to public transport nearby (buses and train stations). The map has colours but they are low in contrast. It might be partly due to wear and tear as the map is outside and the fact that it is subjected to adverse weather too, especially in the wintertime.

Kamppi bus terminal map (Fig. 3) is ceramic so has good tactile contrasts as well as a good contrast in colours, which increases low vision readability. Each of the floors in the centre is presented in a separate map, which also adds both low vision and tactile readability. It displays bus terminal functions and exits, so it promotes route planning and presents a general overview of the layout of the centre.

The tactile map of Iiris, the service and activity centre for the visually impaired in Finland (Fig. 4), has original choice of materials including wood, which makes it beautiful both visual and tactile sense, it is smooth to touch. It however makes the

Fig. 1. Paris metro tactile map

Fig. 2. Keskuspuisto Vocational College tactile map

Fig. 3. Kamppi bus terminal tactile map

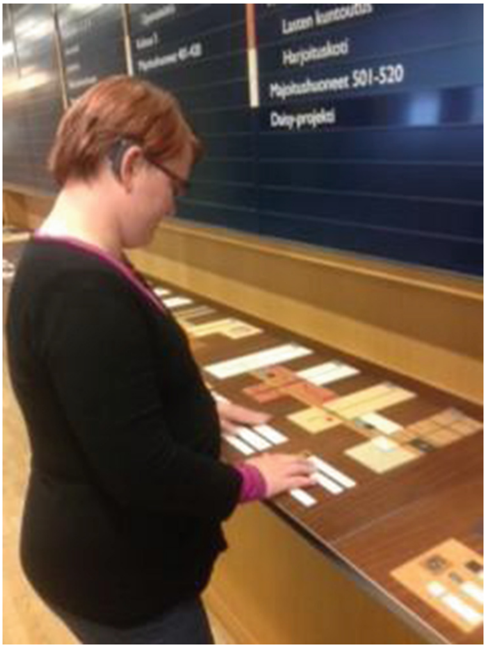

Fig. 4. Iiris centre tactile map about here

updating a challenge. The map has general overview of all the floors of the centre with the functions as well as the guiding tactile strips depicted. However, due to challenging updating procedure the map is not in active use as it refers to functions that are no longer present.

5 Conclusions and Future Vistas

There is no systematic convention about the place of the map legend on a tactile map but it depends on the manufacturer of the map. For example in Finland there are maps which have map legend information scattered to different places on the map. This decreases map's readability. Another issue is that there are no conventions on the symbols on the map, in other words the symbols differ from one map to another. There is a distinct need for a standardised, international set of symbols to be used in tactile maps world wide. It is also utterly important that the map is placed in such a way that it can be found easily and the place is calm enough for a person to stay there to study it.

Often in construction phase the architect wants a certain scheme to the building and that also includes the visual design of the tactile map. However, this is not the optimal solution for a tactile map as there are certain features that differ from visual to the tactile perception. Tactile maps should not be judged by visual standards but according to the characteristics of the sense of touch and how does the map feel instead of how it looks like. For example the map in Iiris (Fig. 4) was designed as a work of art but it resulted in updating being a challenge. To have a map correctly updated is also a safety feature [1].

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