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Tactile map evaluation using Technology Acceptance Model

Albina Mościcka [a,*], Anna Wilbik [b]

[a] *Military University of Technology, Warsaw, Poland, albina.moscicka@wat.edu.pl*
[b] *Maastricht University, Maastricht, The Netherlands, a.wilbik@maastrichtuniversity.nl*

* Corresponding author

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Abstract:

The development of low-cost relief printing techniques (e.g. 3D printing) is changing the situation in tactile mapping. More and more new tactile maps are appearing, including tactile thematic maps. With this comes one of the main difficulties - the lack of ability to quickly assess whether the solutions proposed by the cartographer are legible and understandable to the recipient. Especially as there are no standards or specific guidelines on how such maps should be produced. To ensure that the maps are of high quality, it would be advisable for them to be tested by a group of PVI users. Unfortunately, no generally accepted methods for such verification have yet been developed.

To address the above challenges, the aim of our research was to use the Technology Acceptance Model (TAM) (Davis, 1985) to assess the legibility and informativeness of the tactile maps. TAM is a method used in IT to test whether newly developed applications will be accepted by users (Davis et al., 1989; Venkatesh and Davis, 2000). It focuses on two theoretical constructs: *perceived usefulness* and *perceived ease of use*, which are fundamental determinants of the use of information systems. Adapting these terms to tactile mapping, *perceived usefulness* can be defined as "*the degree to which a person believes that using a particular tactile map will bring them some benefit*" - for example, obtaining new information that is not available from other sources or in other ways. The basic type of information that can be gained from exploring a new area using a map is the spatial relationships between objects on the map. *Perceived ease of use* refers to "*the degree to which a person believes that using a particular map would be effortless*" and can be defined in the same way for both systems and maps - how easy they are to use. In the case of maps, it is strongly related to the legibility and comfort (also safety) of the map. Sometimes an additional determinant is taken into account, called *intention to use*, defined as "*the degree to which a person intends to use a particular tactile map*" and assessed by a simple choice between "*I intend to use the map*" or "*I do not intend to use the map*".

In practice, the appropriate composition of the research test achieves the implementation of the TAM (Davis, 1989). From the definitions of *perceived usefulness* and *perceived ease of use*, initial items are generated - statements that match the content of our determinants. As many of these statements as possible should be collected. On the basis of the collected items, a preliminary test is carried out. It consists of two tasks: ranking and clustering. Ranking means arranging the items from the most important to the least important, while clustering aims to collect items in groups of items with similar meaning. Both tasks aim to reduce the number of final items in each construct to a maximum of 10 in each category. The final items are then scored by PVI using a 5-point Likert scale (Likert, 1932). The credibility of the resulting test was estimated by calculating Cronbach's alpha coefficient (Cronbach, 1951), which indicates whether all items in the test measure the same concept. The level of difficulty of the test was estimated by calculating the p-value. Both parameters were calculated separately for each determinant.

The above methodology was tested on a set of 13 tactile maps of historic gardens in Poland, designed in 5 different garden styles: Renaissance, Baroque, Romantic, English and Japanese (Fig. 1). The number of maps is the result of a wider project to learn PVI about garden styles using maps. The maps represent a new type of thematic tactile maps - not intended for navigation, but for learning about garden design styles, whose content was previously unknown to PVI (Zwirowicz-Rutkowska et al.). The tactile and graphic signs used on them were methodically tested on PVI (Mościcka et al. 2024; Wabiński and Śmiechowska-Petrovskij, 2024). The maps were printed using low-cost printing technology (UV printing), which has never before been used to print maps for PVI (Wabiński, 2024).

A set of 13 tactile maps was evaluated by 20 PVIs in April 2024. The testers were selected from a group of almost 90 people who agreed to take part in the research. The final group of testers was diverse in terms of age, gender, level of education, type of visual impairment and experience of working with tactile maps. They rated items such as: “The maps allow me to gain a level of knowledge about the gardens that I would not be able to get from any other source” (*perceived usefulness*) or “I have no difficulty in finding symbols on the map that have a specific meaning” (*perceived ease of use*).

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Figure 1. A blind user tests the map of the English Garden in Krasiczyn (Poland)

The test results show that all aspects of *perceived usefulness* and *ease of use* were rated very highly. Virtually every question received a 'strongly agree' or 'agree' rating of over 80%. *Intention to use* was rated even better, with 90% of users choosing the 'strongly agree' or 'agree' option. In other words, users are interested in exploring gardens with the help of this new type of tactile map. Coefficient alpha and p-value were above 0.8 for both determinants, meaning that the whole test was reliable and not difficult for users. The test results confirmed the testers' positive opinions of the maps.

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