TACTILE CAMPUS MAPS FOR VISUALLY HANDICAPPED STUDENTS

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Abstract

At the Dresden University of Technology a project designated "University Access for Handicapped Students" is in preparation. Within this project, cartographical research is relevant for designing tactile maps and producing them with use of a modern technology. To this end, empirical studies are to be compiled jointly by cartographers and psychologists.

In the meantime, first experiences and practical results have come in at the Institute for Cartography. A detailed map on a scale of 1:3000 of the central university area have already been elaborated. The maps have been designed and drawn per computer.

The computer-supported production of the maps has been advantageous in many ways. For example, it makes it easy to change the form, size, pattern, arrangement, etc. of maps. The maps were printed with a Laser printer on swell-paper and the finishing was done using the relief copying method. The finished map 1:3000 were successively used for first psychological tests at the Institute for Psychology. These tests resulted in indications for further studies.

The final goal is a functional, user-orientated series of maps in different scales.

1 Scope of Research and Aims

At the Dresden University of Technology, a research project designated "University Access for Handicapped Students" has been being followed through since 1993. The structure of this project is very complex. Architects, traffic engineers, computer scientists, psychologists, as well as cartographers are cooperating in this project.

Object of analysis is the general situation of handicapped people at the University, the ergonomics of working spaces and the access of handicapped people to electronically stored data (amongst others, the work of visually handicapped people with computers). The project part "Path System Planning and Production of Maps for the Blind and Visually Handicapped" is central to the project. It aims at creating orientation aids for blind and visually handicapped students and staff on the campus area and the nearer surroundings.

The research on design, production, and use of tactile maps is being implemented at the Institute for Cartography (Chair for Theoretical Cartography and Map Design), in close cooperation with the Institute for Work- and Organizational Psychology as well as the Institute for Information Systems. Furthermore, there are contacts to the Saxon Association of the Blind and Visually Handicapped as well as to other similar institutions.

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The research results collected to date are accessible in two dissertations (Liebmann, 1993; Kinzel, 1995). The present goal is to develop and test exemplary sample maps (test maps). The final goal is a series of functional and user-orientated maps in different scales.
In connection with this, the question of the role of tactile maps within a more general information system of orientation should later find its due attention. For such an information system, Möller (1991) has suggested the combination of spoken information, textual information (large type or Braille), visual information (with strong contrasts for the visually handicapped) and tactile information (for the blind).

2 Development and State-of-the-Art of Tactile Cartography

A remarkable development has taken place over the last two decades within the area of the production of cartographic representations for the blind and otherwise visually handicapped people. This is due in great part to the activities of national schools for the blind and the work of international organizations. For several years, the Commission on Tactile Mapping and Low-Vision Mapping of the ICA has been supporting the systematic theoretical and structural exploration of the general process of tactile communication from a cartographic point of view. We here refer e.g. to the report of Wiedel and Tatham (1994).

The many publications of cartographers, psychologists, sociologists, pedagogues for the blind, etc. show that intensive work is being done on the still unsolved problems of design, technical production, and effective application of tactile maps - including thematic and statistical maps (Kadmon, 1991).

This work however is difficult, since the problem of perceiving geo-spatial information is much more complex in blind people than in people who can see.
Vasconcellos (1993) is correct in asserting that tactile cartography must find its own way to be able to satisfy the demands it faces: "Tactile Cartography should be based in different concepts, following other rules and using distinct techniques both in map design and production" (p. 995). However, the scheme of the "Tactual Graphic Communication Process", developed by the same author, as well as her special interpretation and adaptation of Bertin's visual graphic variables in "tactile graphic variables" (pp. 996 and 998) show that tactile cartography should not entirely reject the fundamental theories and experiences of visual cartography. Instead, it should adapt this knowledge, these rules. It is exactly in this task that the cartographers' responsibility for this special area of worldwide importance lies.
Furthermore, newer developments show that a cooperation with visually handicapped users is already necessary in the early stages of conceptual cartographic work. Here, methods of empirical cartography are only applicable in connection with the theoretical and practical experience of psychologists.

3 Design and Production of Sample Maps

In accordance with the practical requirements, studies concentrated on the depiction of three typical areas of the University campus. The depictions were executed in the respective adequate scales:

- Administration section of the University with the rector's offices, library and canteen (plan map 1:1000);
- Main area (central campus area) of the University (detail map 1:3000);
- Total area of the University, but without campus-external objects (overview map 1:5000).

The relief copying method was applied for the technical production of the maps. Swellpaper was used as material for the maps. This is a low-cost material. It can easily be printed on. A sufficiently palpable relief is created in the fuser. This technology, however, puts certain restrictions on the design of the maps. For example, certain map symbols requiring a relief depiction on more than two levels cannot be used.

3.1 Plan Map 1:1000

A cadaster map of Dresden's City Administration in the scale of 1:1000 served as the basis for this tactile map, which has a size of 30 x 52 cm and is foldable to DIN A4 size. The "grid build-up method" was used for the execution of the tactile symbols of the map. The background is depressed while the topographical information as well as the Braille inscriptions are raised.

Figure 1 shows a section of the map (reduction of the original) and Figure 2 the key.
The streets are represented as raised areas (actually, as raised strips). Within the elevated area of the streets, the Braille writing was inserted in depressed areas. The differentiation between buildings was realized by means of labeling alone, since blind people have difficulties recognizing different kinds of hatching.

The question of the choice of point symbols revealed that those of the "First European Symposium of Relief City Maps for the Blind" (Brussels 1983) are insufficient for this special map. Therefore, a series of new symbols was introduced. Non-essential information was omitted to avoid overloading the map with information. Other information was summarized to single symbols. Often, it was difficult to keep to the minimum palpable distances between signs. Great attention was paid to keeping these distances at least at 2 mm.

The map was designed and drawn per computer. The program used was ALDUS FREEHAND 3.1. At first, it was attempted to elaborate the key using the same program.
This procedure, however, was in many ways disadvantageous. For this reason, finally the program COREL DRAW 3.0 was used. COREL DRAW 3.0 allows an accurate reproduction of Braille writing.

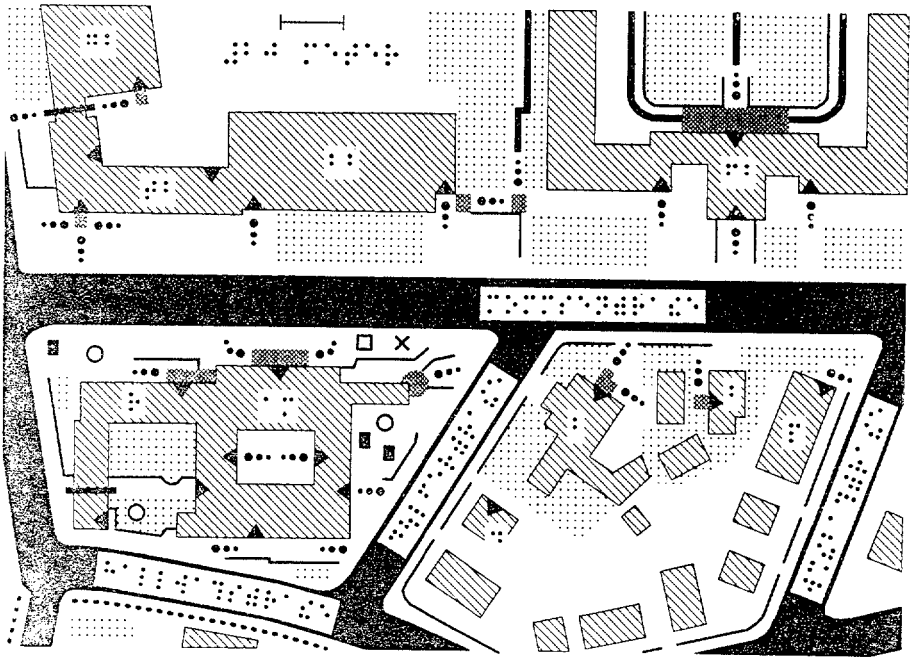

Figure 1: Plan Map, scale of the original 1:1000, here very strong reduced

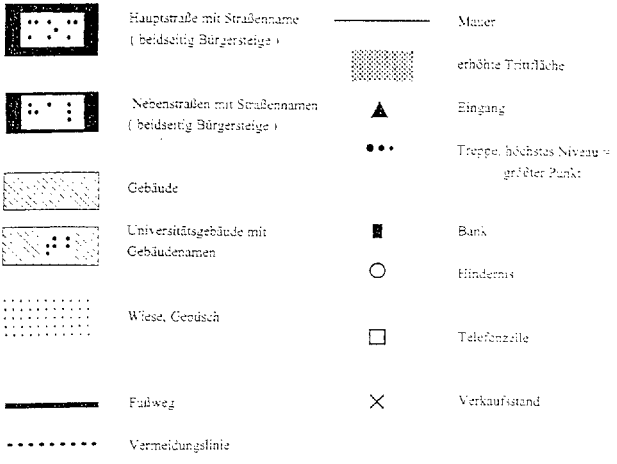

Figure 2: Key of the Plan Map

3.2 *Detail Map 1:3000*

The basis of this map was an enlarged cadaster map in a scale of 1:5000.
For technical reasons the map is depicted on two DIN A4 pages, which are put together to form the A3 format.
The total size of the map is 50 x 55 cm. This map is also foldable. The "grid build-up method" was used for the greater part of the map contents. In respect to the streets, it was attempted to combine the "grid build-up method" with the "block build-up method". Figure 3 shows the map (without key) in a very reduced form. The map symbols used are partially normed (cf. Brussels 1983), and partially newly designed point, line and area symbols (Figure 4). For example, for the depiction of stairs a new symbol was used, since the normed symbol is only executable on multi-layered maps. As already mentioned, this multi-layering is not possible when using swellpaper technology.

Only University buildings are depicted as single buildings. They are filled with a hatching that allows a satisfactory tactile differentiation from all other area symbols. The normed type of area filling for buildings was not adequate, since it can easily be mistaken for a rough dot grid. The outline of the buildings probably has been depicted in too much detail. Each building is named with a letter, which is respectively inserted in an oval figure to avoid mistaking it for a map symbol. In this way, a clear assignment to the respective building additionally is ensured.

Keeping to the minimum palpable distances here again represented a major problem.

The map was later tested by blind users (cf. section 4). These tests revealed weaknesses in depiction which must be taken into account in future work.

For the technical production COREL DRAW 3.0 alone was used.

3.3 *Attempts at an Overview Map 1:5000*

For the sake of a general overview, a map of the total university area is imperative.
Since the Faculty for Informatics, the Faculty for Medicine, and the Faculty of Arts are situated in campus-external positions, one main map and three supplementary maps would be necessary. On this subject no closer examinations have been carried through yet.
Kinzel (1995) has worked on an overview map of the more or less closed University area and the surroundings between the rector's offices, the central train station, and the former military academy. The scale of this map is 1:5000.

The degree of generalization is relatively high and two versions were elaborated. These are characterized by the following features: depiction of the single University buildings and undifferentiated depiction of other buildings (built-up areas within the street and path net).
The draft of the key for this depiction was prepared in collaboration with blind map users. An empirical verification (test), similar to that of the 1.3000 scaled map, could not yet be carried through.

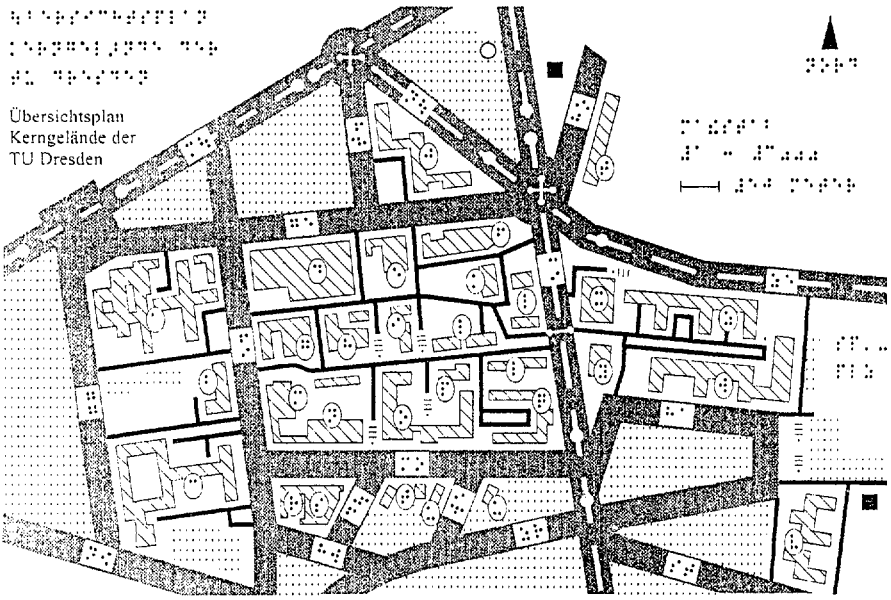

Figure 3: Detail Map, scale of the original 1:3000, here very strong reduced

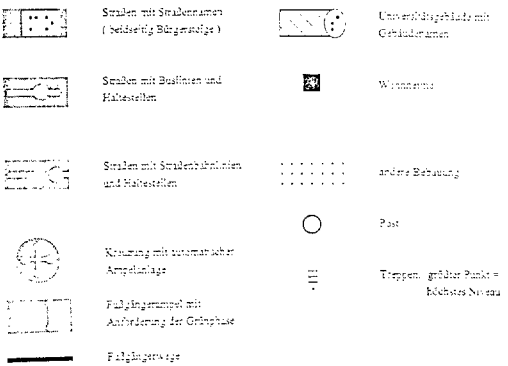

Figure 4: Key of the Detail Map

4 Results of an Empirical Verification of the Detail Map 1:3000

Mohr (1993) has tested various tactile maps, including the detail map 1:3000 of the main area of the Technische Universität, in an empirical examination.

The long-term memory ability (reproduction ability) of blind grown-ups formed the methodological basis for this survey. It was assumed that this ability is dependent upon the way the maps are designed, and that further dependencies upon co-variables, such as age, point in time, at which sight was lost, level of qualification, previous knowledge, and gender, exist.
The test persons also assessed the map and its basic single elements.

17 blind and 2 visually very handicapped grown-ups (average age 45,5 years) could be found to participate in the testing. With only one exception the test persons were not blind from birth. With respect to the co-variables, they represented a relatively heterogeneous group. Mohr therefore correctly underlines that the results cannot be unqualifiedly generalized, since they are only valid for the persons tested. Nonetheless, the results do reveal an undeniable trend.

The test persons assessed the tactile perceptibility of the map on a scale from 1 (very good) to 5 (very bad). Mohr used this assessment scale, as it has proven its worth in other assessments of tactile patterns and Braille writing. A description of further details of the relatively complicated system of examination is not possible in this context, as it would go beyond the scope of the present paper.

The evaluation of the assessment of the detail map 1:3000 produced diverse results in respect to the map's design. Different map elements, or objects, were perceived in very differing ways. The corresponding reproductive ability oscillated accordingly. The verbal assessments ranged from "very good" (dormitories, post office, streets with labels, built-up areas) to "average" (university buildings, traffic lights, tram route with stops, bus route with stops) to "bad" (stairs). The density of information was assessed by the test persons as too high. This critical evaluation must be taken into account in various changes of the graphic design of this sample map. At the same time, however, one should not overestimate these results, since motivation and previous knowledge, as well as the degree of familiarity with the university campus additionally influenced the assessments of the test persons.

5 Outlook

The partial results achieved to date show that it is possible to produce tactile maps for the Dresden campus with relatively simple means (PC, swellpaper, and fuser). The university public's interest in the project also gives reason for optimism (Bäumel 1995).
The examinations however also showed that map design for tactile perception raises partially difficult and unexpected problems. Some of these problems have not yet been solved.
A partially modified map design must improve the prerequisites for tactile information acquisition by blind users. Probably it will also be necessary to reduce the density of information contained in the map.

Finally, experiments are to be made with the breaking down of the complex cartographic depiction into single layers, as encouraged by Vogler (1985) and tested by Mohr (1993).

In the further future, the combination of media and audio-tactile information systems should receive their due attention.

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