JVIB

April 2005 • Volume 99 • Number 4

# Practice Report

## Automatic Transcription of Tactile Maps

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Author's note: TTME, the software described in this article, is not freeware and is currently being used only for educational and research purposes with regard to the production of tactile maps. In the near future, it will be commercially available. More technical information about TTME is available from the author on request.

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Tactile maps are an important means for the education and mobility of people who are visually impaired (that is, are blind or have low vision). Because of the importance of tactile maps, it is essential that they are accessible to people who are visually impaired and correctly interpreted. There has been considerable research on the design of these maps in recent decades, providing answers to most of the questions that have arisen about their intelligibility (for example, the use of symbols) and the implementation of uniform standards

to make the maps generally accessible.

One issue is how people from other countries can read the place names of a country on a map. Another important issue involves the global design of tactile maps and their exchange among different countries: How can a visitor who is blind read and pronounce correctly the braille place names on the tactile map of a foreign country if that country uses a different braille code or print alphabet? Visually impaired visitors to Greece, for instance, would be unable to read the place names on Greek tactile maps, first, because they are printed in Greek braille and, second, because they use the letters of the Greek—not the Roman—alphabet. This article describes a solution to this problem, proposing a method that is based on software that was created for the Romanization of Greek tactile maps and their conversion into standard braille for the Roman alphabet (English braille).

The subject of Romanization is part of the field of linguistics, itself a taxonomic science, because writing systems are connected to linguistic structures. The structural levels of phonology and morphology in the analysis of language are especially pertinent. Romanization is a system for representing a language with the Roman alphabet when the language typically uses a writing system other than the Roman alphabet.

## The automatic production of tactile maps

A number of methods have been developed worldwide for producing tactile maps (Bentzen, 1997; Dahlberg, 1997; Edman, 1992; Eriksson & Strucel, 1995; Papadopoulos, 2000; Turner & Sherman, 1986), the most frequently used being stereocopying, thermoform, silk screen with foam ink, and the method that uses a milling machine (Papadopoulos, 2000). The introduction of new technologies, mainly in the past 10 years, has contributed to the design and production of tactile maps, following procedures that are appropriate to the special needs of tactile mapping with automatic cartography.

In the creation of a tactile map using a personal computer (PC), a basic stage is the construction of a digital map. However, it is well known, especially to those who are involved with cartography, that many digital maps are available as a result of the creation of conventional maps. On the basis of this legacy, one can more easily create tactile maps, avoiding the task of digitizing a map and concentrating on the generalization of graphic forms and the creation of braille labels. Taking this situation into consideration, the procedure for constructing digital maps includes the following stages (Papadopoulos, 2000): construction of the geometric content of the digital map; generalization of the graphic forms; choice, construction, and placement of tactile symbols; placement of labels in braille; and construction of a legend.

For the placement of braille labels, some braille fonts are used. These braille fonts are from the country in which the map is constructed. For the conversion of these braille labels into English braille code, the braille labels need to be transcribed.

## Transcription of tactile maps

Transcription, in this sense of the word, is a system of writing the sounds of a word in one language using the writing system of another language. Any reader of the latter language should be able to pronounce the transcribed word (almost) correctly. Since the word may contain sounds that are unknown in the latter language, this goal is not always completely reached. Transcription into a nonalphabetic language may also be used for the conversion of all writing systems. It is the only method that can be used for systems that are not entirely alphabetical or syllabic and for all ideophonographical systems of writing, such as Chinese (Hellenic Organisation for Standardization, 1997; United Nations, 1983).

In cartography, the transcription of original geographic names into Roman characters is often a main concern in editing maps, especially when the map users are not familiar with the language in which the original geographic names are expressed and written (Ebinger & Goulette, 1990; Yoeli, 1972). In producing tactile maps, another matter has to be taken into account: the differences among various countries' braille codes. The

Greek braille code is different in many respects from the braille codes that are used in other countries and from the English braille code (see Figure 1 for these differences). Furthermore, there is no complete correspondence on the PC keyboard between Greek and English braille. Thus, Greek braille cannot be automatically converted to English braille just by changing the name of the font. For example, the character "ξ" of Greek braille, is the same as the character "x" in the English braille code (see Figure 1), but on the PC keyboard, it is located on a different button (at button "j"). The diphthongs of Greek braille create an additional problem for this procedure.

The National Centre for Maps and Cartographic Heritage (Thessaloniki, Greece) developed the project and the relevant software in Visual Basic, under the name Transcription Tactile Map—ELOT (TTME)—in order to automate the process of tactile maps transcription. (ELOT is the Hellenic Organization for Standardization.) The two main steps that are followed for the conversion are these:

1. the dxf file (design exchange file) with the geographic names and features into TTME and export the TTME of a new dxf file in which the geographic names and features have been converted.

2. Change and use the fonts of the language in which the map is going to be transcribed or use English

braille fonts when the map is to be transcribed into English.

The dxf format (an ASCII-encoded vector graphic format) was chosen because it is a common format, especially in software, that can be used for the digital editing of tactile maps.

The philosophy of the TTME is based on the interaction of TTME with MS Word. MS Word opens dxf files even if the option is not listed as a normal choice (Papadopoulos, 2003). In addition, MS Word executes commands in Visual Basic using a macro.

During a conversion, the following transcriptions are made: (1) transcription of the braille into the conventional alphabet of the initial language (such as from Greek braille to the Greek alphabet) according to the rules that exist for the specific transcription, (2) transcription of the conventional alphabet (such as the Greek alphabet) into the Roman alphabet (according to the official rules of transcription for each country), and (3) transcription of the Roman alphabet into English braille.

The rules for transcribing the Greek alphabet into the Roman alphabet are complex, and attention and experience are required to avoid making mistakes. This procedure is not a simple one-to-one transcription of a character. For example, the letter "ψ" is converted as "ps" and "αυ," is converted as "av" when followed by

such characters as “β” and “γ” but as “af” when followed by such characters as “κ”and “π.” Moreover, there are different subcases of transcription, depending on the location of the characters in a word. (The complete list of symbols that shows the transcription of characters and combinations of Greek with Latin characters can be obtained from the author on request.)

The process of conversion follows a succession of replacements that concludes with these general steps: the conversion of Greek braille labels to the conventional Greek alphabet; the conversion of geographic features to the Roman alphabet; the conversion of combinations of Greek characters with diereses (there are some subcases); the conversion of a combination of Greek characters and the conversion of the following to the Roman alphabet: αυ, ευ, ιυ, and ηυ (there are some subcases), αυ′, ευ′, ιυ′, and ηυ′ (there are some subcases), simple characters with accent marks (such as α′ and ε′), a combination of Greek characters whose transcription influences their place in the word (the beginning, middle, or end), simple characters; and the conversion of Roman characters into English braille characters.

In addition to the transcription of geographic names, TTME provides the translation of the words for geographic features (for example, *vounó* into *mountain* and *potámi* into *river*). This procedure is useful for the automatic translation of the geographic features that are included on a tactile map or its legends into English

braille. For example, in a Greek tactile map that includes the label "νοσοκο μ ει΄ο ΄Αγιος Δη μ η΄ τριος," this label will be converted to "hospital ´Agios Dimítrios." Thus, the word "νοσοκο μ ει΄ο" has been translated to "hospital," while the toponym (place name) "΄Αγιος Δη μ η΄τριος" has been transcribed. Some choices are available for a group of geographic features (such as lake, river, mountain, and hospital), as well as further text boxes for any additional replacement by the user.

## Conclusion

For decades, there has been considerable discussion of and research on the transcription of conventional maps; various Romanization systems are now widely accepted and used. In this article, I approached the issue from the perspective of the tactile map. TTME, which is designed to permit the automated transcription of Greek tactile maps into the Roman alphabet, is the first stage in this endeavor. Despite the number and complexity of the special rules that are involved in this transcription, I believe that a design of this kind can be adopted for the conversion of tactile maps that are produced in other countries, so that more maps can be read by people who are visually impaired. However, a general study of the transcription of tactile maps that are produced in each different country into English braille will require coordinated action by agencies from different countries or responsible

unilateral action by the specialist organizations in each country. Whatever approach is adopted, the design and production of these tools will need to follow the international standards laid down by the United Nations (1983).

The process of transcribing tactile maps using TTME does not require any special knowledge. Furthermore, it is accurate and rapid. For example, the overall time required to convert a map that contains 1,000 place names is about 2 minutes; a map that contains 500 place names requires 1.4 minutes, and one that contains 100 names requires 50 seconds.

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