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# MAPS ON SMALL DISPLAYS

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*Computers don't make good*
*or bad maps, cartographers do.*

## 1. LIMITED SPACE

The inclusion of GPS receivers in various kinds of mobile computers, as well as cell phones, and smart phones, and the rapid evolution of technologies such as GSM, GPRS, UMTS, as well as the ongoing work on technical and semantic interoperability in the GI domain let us get closer toward the most challenging goal of mobile geocomputing: to enable people to collect, analyse, and share spatial data whenever and wherever they want, based on a completely digital flow of information.

The map, an important information product for spatial data in the past, will retain this role on such mobile devices in future. Many producers of mobile applications have never studied cartography, but provide us with maps. In many cases, it is difficult to provide complete maps on small displays. Cartography, as a form of communication, says that the measure of a good map is how well it conveys information to its readers to enlighten, convince, or persuade. Due to the size of displays of small mobile devices, the space to include complete information that enlightens, convinces or persuades, is limited.

In the following sections, problems of the communication of spatial data on small displays will be discussed. Some suggestions will be outlined, focused on the integration of different communication techniques to provide adequate information to map users.

## 2. CARTOGRAPHIC KEY ELEMENTS

When we are travelling in unknown spaces we need maps to find places, such as train stations, hotels, sightseeing points, conference sites, and others. Even when we found a specific building, we use maps to find a certain room inside. In such cases we refer to maps of physical spaces. They have a specific scale, and content, the latter dependent of the first. We consider a *good* map, if it supports us in an easy understandable way, and if we find our goal without any difficulties. In opposite, a *poor* map does not support us adequately, and using it can lead to failure. The determination of *good* or *poor* maps can be difficult and is dependent from various factors (Collinson, 2002).

To support user of a map, the key elements of a map are of special interest. Key elements, such as

- legend
- data frame
- scale
- north arrow
- title and subtitle
- citation

- border
- overview map
- graticule and indexes

have to be included when a map is created in order to aid the viewer in understanding the communications of the map.

The map elements are aimed at focusing the attention of the user, helping to answer a specific question of the user, and helping to read and understand map communication. The user, however, must be in the centre of interest. The "user first, user last" principle (Holmquist et al., 1998) is aimed at answering the following questions:

- what can the user get from the map?
- what does the user want from the map?
- does the user get from the maps what she/he wants?

There are more principles that have to be considered when designing a map. Some of them are not "hard" (in the sense of quantitative, numeric), but "weak" (in the sense of qualitative, various definitions and/or interpretations possible). Furthermore, one should take into account that "...maps are more than just an aid for finding the way from one point in the world to another. Maps are also things of aesthetic and cultural value, which show visions of the world as imagined by the human mind" (Holmquist et al., 1998).

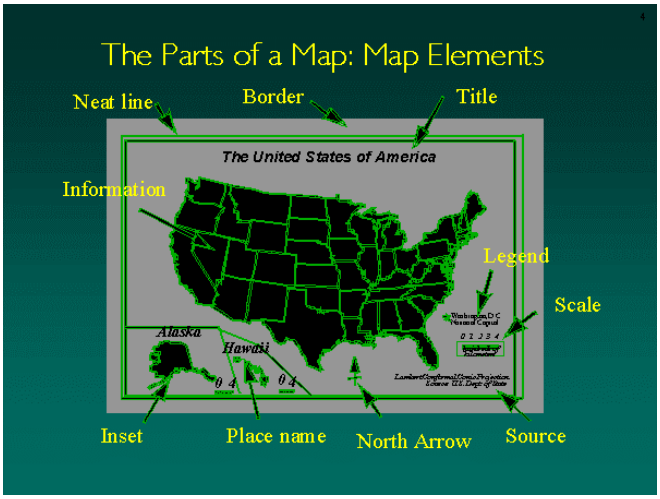


**Fig. 1** Map elements (Source: http://geowww.gcn.ou.edu/~blyons/GIS/makingmaps99/sld004.htm)

The phenomenal growth of PDAs and wireless technologies has paved the way for GIS and LBS to enter the mobile market, and the ability to mobilise data and applications has truly revolutionised how companies and other institutions use GIS: many of them identified the need for geospatial data and maps. But *good* maps should provide the key elements - regardless on which kind of display they are presented (figure 1). If there is not enough space left for such elements, there is a need to think about other ways to communicate the map information (Gartner and Uhlirz, 2002).

Scale, projection, generalisation, and symbolisation are of key issues for maps on mobile devices in particular. Nowadays the question occurs, if it is still true that "no one can use maps safely and effectively without understanding map scale, map projections, and map

symbols" (Monmonier, 1996). If related information is not communicated through map elements, can we interpret maps adequately?

Many providers of mobile, spatial applications try to find solutions for the dilemma to provide a reasonable amount of information on a small display. Such mechanisms include

- buttons for moving up and down
- zooming
- panning
- scroll bars
- pen-controlled or touch-sensitive screens
- peepholes
- flip-zooming
- other techniques

But such mechanisms mainly refer to the presentation of the geometric information, points, lines, and polygons. What about the textual information, the symbolisation, and other graphic elements (e. g. border, text boxes, etc.) that should be incorporated to represent a well organised and easy to read map? On other words: do we communicate semantics of a map adequately, if key elements are disregarded?

## 3. MAPS VS SKETCHES

Based on the thoughts mentioned before, some questions arise:

- Are maps on small displays really "maps", or a kind of "views" (Kuhn pointed on such issues some years ago, see Kuhn 1991), possibly simply "sketches" or "concepts"?
- Are the key elements dispensable for maps on small displays?

Keeping a map simple (to read, to understand, to interpret,...) is a basic cartographic requirement, "great design tends towards simplicity" (Bertin 1974). Simplification means to reduce the information. It can lead to worse communication of the information. The goal of a map must be to gain not *as much,* but *the* information needed by the user *at a glance*: It's not what you put in that makes a great map but what you take out. If the map has been designed leaving out the key elements, nevertheless maintaining it's understandability, one can argue that such a map is *good*. Maps with simplified design are more legible, and too much detail or too complex a layout can confuse readers and work against effective communication. Figure 2 shows some examples of maps on small displays as we know them from daily use. Obviously, most of them do not show the traditional key elements, but perhaps only few users miss them, because they have never been trained in cartography? Asked in another way: if such maps help the user, why care about the key elements?


**Fig. 2** Maps on small displays

## *4.* MISGUIDING MAPS

As outlined before, many of the maps provided by mobile devices are *poor* from a cartographic point of view. *Poor* maps, however, are potential sources of error, and predestined to provoke misinterpretation (Pundt and Brinkkötter-Runde 2000). Monmonier (1996) gave insight in such issues:

- the "white lies" justified by cartographers as necessary generalisation (which is a very important issue for maps on small displays)
- distortion of the map's main elements
- the common blunders resulting from the mapmaker's ignorance or oversight
- the seductive use of symbols and colours, often not adequate for the purpose they should serve
- the danger of exaggeration and suppression in maps prepared for plans and environmental impact statements, etc.

Monmonier adds: "maps need be no more threatening or less reliable than words, and rejecting or avoiding or ignoring maps is akin to the mindless fears of illiterates who regard books as evil and dangerous". Which elements are important for *reliable* maps, and which scientific, cartographic, cultural, and aesthetic aspects have to be considered to make maps on small displays a *reliable* tool to communicate spatial data?

## 5. COMMUNICATION THROUGH VARIOUS MEDIA

As we saw before, in many cases it is the simple question of how much space is left for the traditional map elements, to include them, or not. But mobile devices open new opportunities to communicate information, e. g. speech, which is the most suitable human-computer communication method (Coors and Wiedman, 1998).
The integration of various techniques (Egenhofer and Kuhn, 1998), and speech, can open new ways to communicate map-related information. An example for a mobile device that supports different media is the Xybernaut Mobile Assistant. This wearable computer supports the communication between user and application using speech, it represents maps on a head mounted display or flat panel, and the user can simultaneously see the reality (figure 3). The interaction between the user and a maps can be speech oriented: the user

accesses maps by ordering the data needed; seeing the map, information and map metadata can be provided "within" the map (using graphics and text), or "outside" the map through spoken words, delivered by the application.

**Fig. 3** Outdoor collection of vegetation data using a wearable computer that provides maps and map related information to the user. The interaction between user and application is based on various media: maps, text, symbolisation, and speec

Some tests, carried out with students in a course on "Mobile Geocomputing", have shown that the idea of wearable computing is challenging, but that there are still various deficits concerning the usability of such computers. The idea of integrating different media, including speech, will have impacts on the ongoing discussion about the visualisation of spatial data on small displays.

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