

A STUDY OF RELIABILITY RECOGNITION OF THE SYMBOLS FOR NAVIGATION MAPS

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Abstract

The object of this study is a group of signs in the symbol system of the USA Company Garmin. The experiment was conducted with first year students as a test. The task of the participants was to identify the meaning of the signs and to select the more reasonable symbol of each triad with a sense of the sign.

The results show that the signs used in navigation maps do not account sufficiently the characteristics of these maps. In the existing systems are used symbols with obscure meaning, visually grouped at random manner, and most of them are uploaded by users of these maps.

In conclusion, there were given some guidelines for improving the symbols for navigation maps and increasing consistent security of their reading.

Keywords: Navigation maps, Symbol system, Experiment, Visualisation, Mobile Cartography

INTRODUCTION

In recent years more and more maps are used for personal navigation in real time by mobile users. The number of navigation devices in Bulgaria is also growing. Worldwide there are numerous scientific studies for the design of these maps, but Bulgaria still lags behind. In the literature was introduced the term **Small Display Cartography**, which is defined as a modelling, symbolizing and selecting a graphic rules, principles and specific requirements for a specific cartographic applications and devices to support a **location-based service**. The specificities of this type of cartography have been investigated and continue to be developed in various projects.

Navigation maps differ mainly in that they must be used on a relatively small display, no legend, and their signs should be perceived quickly. Let's don't forget that the main purpose of these maps is guiding the user turn by turn from the standing position to the chosen routing. In that case the signs along the route must be able to be apprehended quickly and clearly. The functionality of the navigation maps allows supplementing additional data - so-called **POIs** (Point Of Interest), introduced by the consumer according to his interest, which can contain except coordinates and object type, also address, phone number and other information as well. This suggests different levels of abstraction and set specific requirements to sign systems. It should be born in mind that the users of navigation maps usually don't have enough knowledge of cartography and navigation and small displays have limited size, resolution and colour depth.

PECULIARITIES OF BULGARIAN REALITY

The existing navigation maps in Bulgaria have uncompleted contents and not enough good accuracy. There are several developments for the navigational maps of our country, but they are on unprofessional level and rely on users to supplement the information through the tracks and waypoints. Very often the accuracy and comprehensiveness of the maps is not the same for different parts of the country. The data is entered in the database through standard symbols used by navigation systems which are standard signs in the rest of the world where they are developed. Studies have shown that the effective perception of cartographic symbols and maximizing the potential of navigation systems depends on:

- Situation - location and time during the day
- User - opportunity, knowledge, preferences
- Application tracking system, navigation, search, identification, verification
- Information - Environment and facilities
- System - hardware and software

One of the problems in the Bulgarian development is the insufficient detail level of the signs. This reflects on readership of the map. Great used set of signs using the same size in different scales. Another problem is the use of point marks for objects that are depicted on the map by area or line. An incomplete database is ubiquitous drawback it doesn't appreciate a special features of the road network and traffic.

SYMBOL SYSTEM - FEATURES AND REQUIREMENTS

The most important issue is choosing the appropriate symbol system for representation of information on navigation maps and it depends on experience and knowledge of cartographers. New developments using basic visual characteristics of the symbols defined by **Jacques Bertin** are published constantly for more effective presentation:







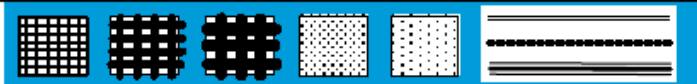
Bertin's Original Visual Variables	
Position changes in the x, y location	
Size change in length, area or repetition.	
Shape infinite number of shapes	
Value changes from light to dark	
Colour changes in hue at a given value	
Orientation changes in alignment	
Texture variation in 'grain'	

Fig.1. The Cartographer's visual resources (according to Carpendale, 2003)

These features can be used and applied with different values for each element of the map - point, line or area. Several categories often used simultaneously to highlight important information or to improve the readability of the map. Informative and aesthetic signs are defined depending on the application of the above visual characteristics.

The features of the symbol system in navigation maps are conditioned by manner of creation, usage and functional possibilities of the navigation maps. The signs must follow multitude of requirements:

- The symbols must be readable even in case of partial overlap. The symbol system must allow a visualization of several symbols for one address. If you set corresponding signs for these objects in the same place, the map becomes abstruse.
- The symbols must be simple with less constructive elements and be constructively complete. This way they will be perceived faster without filling much space.
- Use of associative symbols – the signs causing relation to the object or its properties. The pictograms used often. They are stylized images, usually directly understood, with no legend needed.
- Use of signs – traditional symbols. By frequent use of a symbol in a certain context it becomes permanently connected to its represented object and becomes a symbol. (Vasilev, S., Bandrova, T., 2009)
- The symbols must be fast readable and with a high confidence of symbol perception – non-signs that can be confused with one another. Distance from which to read the map with driving is about 50 cm, but must take into account the time for distraction to attention of the driver. Studies show that drivers are reluctant to give sight of the road for more than 2s.

- Use of common elements in different groups of signs, so be clear classification of symbols.
- Have a clear relation between the classification of symbols and their importance in the map context.

The main problems are to work out the optimal number of colours and elements, the minimum pixel size of the signs so they can be read and understand the most secure and fast. For example, in project **GiMoDig** (2003) in **Small Display Cartography** is based minimum size 3x3 pixels of most of the signs. Most strongly affects colour perception, but the use of many different colours is not a good solution. The contrast of colour is more important here. Selecting the colour depends on the importance of the object. When there's no legend, the proper ratio of dimensions not only adds value but also helps to adopt the meaning of the sign.

EXPERIMENT

The object of this study is a selected group of signs in the symbol system of the navigational maps of the USA Company Garmin. This is one of the most popular producers in the world and assumes that the average user has seen at least some of the signs. There still is not developed a national navigation map for the territory of Bulgaria. Selected symbol system contains many signs where they have not admitted specificities of navigation maps (Vasilev, S., Bandrova, T., 2009). There were prepared three groups of signs. The purpose of this experiment was to test the security of recognizing the signs and to explore consumer's preference for some of the symbols with the offered alternative symbols. The signs are easily recognized when are placed in familiar surroundings on the map. In that case the task is simplified by not overloading the map and not overlaps with other characters. Thus aims to examine the sign itself and how surroundings do not affect the recognition. Symbols are enlarged 1.5 times. The experiment was conducted with first year - regular and correspondence students by the UACEG. We may be deemed that participants in the experiment have the capabilities of the mass consumer of the navigation devices and maps such as skills for reading maps and reliance on the symbol system.

The selection of the first group of signs was based upon the assumption that they are not uniquely identified. Participants in the test had to choose the correct meaning of the sign proposed by three answers. The second group of symbols the participants had to recognize the meaning and write it down. The presumption is that there were proposed known signs. Together with the existing signs in the third group were included symbols with the same meaning, but with a change in any of the visual variables (colour, size, shape). The task of the participants was to choose more acceptable sign by each triad according to same user.

First group of signs

For the first task were selected signs indicating the location of **Police Station, Ground Transportation, Pizza, Museum** and **Cinema** (Fig.2).



Fig.2. **Police station**

Proposed meanings for this sign are **Fire station, Police Station** and **City hall**. 42 percent of the participants have recognized the correct meaning. Twice fewer players have indicated **Fire Station** and 37 percent of all chose **City Hall**.

Convincing explanation for the recognition of this sign is likely due to the shape and colour used for background. By shape the sign can be likened to the coat of arms and thus may determine that it is a state institution. On the other hand the colours perceived as relating to a Fire Station and Police Station, are red and blue.



Fig.3. **Ground Transportation**

The second sign symbolizes **Ground Transportation**. The figure is stylized Bus and 45 percent of participants have chosen it but 42 percent had selected **Subway Station**. Only 13 percent have made a mistake with **Auto Repair**.

The given meanings are of the same class - Transport and Transport services. In the Garmin maps this sign is used as an aggregate mark of Public Transport. For the territory of Bulgaria this symbol is used only to indicate the locations of Subway station. This explains the test results. There should be separated different signs for all types of Public Transport, which are associative and do not confuse the consumer.



Fig.4. **Pizza**

The sign looks like a piece of **pizza** and 53 percent have done the task but 47 percent have selected **Fast Food**. The third meaning is **Restaurant** and it was not mentioned by any participant.

Here the meanings of objects were also from the same class. Perhaps the results were such because some participants assume that Fast Food is a general term and includes Pizza itself.



Fig.5. **Museum**

The choice of participants was between the **Public Building, Museum** and **School**. 42 percent of participants have known that the meaning of the sign is **Museum**, 50 percent stated **Public Building** and others have chosen **School**.

Introduced sign for Museum is uniquely recognizable. The user could hardly understand the meaning of the symbol that resembled a house.



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Fig.6. **Cinema**

Pictogram of the **cine-camera** implies higher percentage recognition of the meaning of signs. results have shown 60 percent true answers, 30 percent of players indicated **Police Camera** and 10 percent - **Car Wash**.

The general conclusion of the experiment with these five symbols shows that they are not sufficiently clearly defined and recognizable to the mass consumer.

Second group of signs

For the second task were selected a signs that are familiar to users and could be called traditional symbols.



- **Airport**



- **Restaurant**



- **Bank**



- **Hotel/Motel**



- **Medical Facility**

Fig.7. **Second group of signs**

There were only one wrong answer for the **Airport** sign and another one for the **Restaurant** sign among all participants. All other participants indicated correct answer. Other signs are not so clearly identifiable.

The symbol, which marked a **Bank** have designated as such by 57 percent of the participants, 13 percent have opted for **ATM's**, 18 percent have posted a **Change** and 10 percent had difficulties and have not indicated response. There are two answers vineyards but this may be due to the similarity with the sign \$ - adopted and binding in Bulgarian Topographic maps for displaying vineyards. Results have shown that participants differentiate and suggest that there are different signs for **Bank, ATM's** and **Change**. In fact, this sign is common and unifies these three meanings.

The next sign put to the test is a sign of **Lodging**. The significance incorporates all the sites on which users can settle and sleep. Thus 76 percent of participants indicated correct answer through options such as **Hotel, Motel, Hostel** and **Place for overnight**. 21 percent have posted response while two participants indicated such answers **Highway** and **Post office**, which are probably a matter of oversight.

The sign for **Medical Facility** is the last of this group of symbols. 85 percent of participants have indicated response **Hospital**, which is inherently correct answer. In this case, the sign used in the map is a summary without customize the kind of objects. 3 percent of respondents have registered **Veterinary Clinic** explaining that the blue colour of the cross is used for this type of property. The other wrong answers (12%) were the exception rather than from misunderstanding. It was indicated **Pharmacy, Road assistance** and **No Answer**.

Third group of signs

The last group contains five triads of signs. There were proposed another two symbols with different variations and parameters of the main visual characteristics of the graphic elements of the sign. The meanings of each three characters have been mentioned in the test. The task of the participants was to select the most appropriate and attractive symbol for them.

The first three signs refer to the portrayal of **Pharmacy**.



Fig.8. **Pharmacy**

The Garmin maps used the symbol referred to Fig.8a. The sign comes from **R** (recipere) character, which is often written as "rx" in typed text. Pharmacy organizations often use other symbols, such as the **Bowl of Hygieia**. The second symbol is known in Bulgaria. Therefore, developed options for this sign are the basis of **Bowl of Hygieia**. Fig.8b mark is the same as colour and shape as used in the maps of Garmin, but the symbol inside the edge is replaced by a conventional symbol of Pharmacy in Bulgaria in the same blue colour. The third version of the sign (Fig.8c) has the same symbol like the second sign, but depicted with black colour.

Test results show that 68 percent of participants picked the sign featured in the Fig.8c. 29 percent opted the second digit (Fig.8b) and only 3 percent chose symbol used in the navigation map.

The next triad represent a **Post Office**



Fig.9. Post Office

Sign in the navigation map is depicted in Fig. 9a. The symbol is almost exactly an image of an envelope. The proposed options are displayed on the other two pieces. Accordingly Fig.9b - a stylized original logo of the "Bulgarian Posts" with the corresponding yellow colour for filling and Fig. 9c - an envelope with a simple pattern and crisp lines. The difference in the preference here is 14 percent in favour of the sign depicting the logo of the "Bulgarian Posts" (Fig.9b) compared with the third sign (Fig.9c). Participants which have selected third sign were 56 percent and the second – 42 percent. Only one answer (2%) given and put to sign used in navigation map.

The Gyms and Fitness centres are incorporated under one sign in the Garmin maps. This symbol is featured in the Fig.10a.



Fig.10. Gyms and Fitness centres

Variation here is the symbol within the outline of the signs. Fig.10b depicts a stylized weightlifter and a Fig.10c – a ball. In this case 85 percent of participants indicated the second digit (Fig.9b), 13 percent - a symbol used in the map and only one (2%) chose the sign with the ball (Fig.10c). The result is expected because the ball does not stir association with Fitness centre rather a hall or stadium. Small percentage of the first symbol is probably a result of the fuzzy outlines of sign contours.

The next sign represent a **Petrol Station**

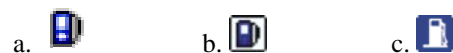


Fig.11. Petrol Station

The sign is sufficiently easily and uniquely recognizable. The symbol shown in the Fig.11a is used in the Garmin maps. Second sign (Fig.11b) contains the same symbol, but smaller, without a cross in the middle, with a white background and black outline. The symbol in Fig.11c is different. It is depicted **Gasoline Column** but with inversion of colours and without black outline.

The choice of the participants is unequivocal - 81 percent in favour of the last symbol (Fig.11c). Symbol in the Fig.11b was chosen by 19 percent and no one of the participant chose the sign used in the maps.

The latest sign that is the object of study represents the location of **School**.



Fig.12. School

The sign used in the Garmin maps is featured in the Fig.12c. This is a pictogram on a yellow school-bus. Proposed are two symbols - a bell, symbolizing the school-bell to Fig.12a and stylized building of Fig.12b. The yellow colour is maintained as well as the black outline of the signs.

Of proposed signs depicted in the Fig.12b (stylized building) collect the highest percentage - 58. Bell was chosen by 32 percent and 10 percent have chosen the school-bus. Expected is the small percentage of the signs depicted on Fig.12c. As an U.S. company Garmin this sign is associative for the American, but in Bulgaria it is not thereby. Rather, the user will mistake the bus stop.

CONCLUSION

The speed and the unambiguous of the reading navigation map is perhaps the most important requirement for the signs besides the accuracy of the map. Whether the user is driving, riding a bicycle or walking, he can pay only a bit of his attention for reading the map's content. Therefore, signs must be studied very carefully and selected to satisfy the needs of users and not divert attention.

The results show that the used signs in the navigation maps do not reflect adequately the characteristics of navigation maps. The reported average rate of recognition with given meanings of the signs is 48 percent. When the participants themselves should indicated the meaning, but selected signs are familiar to users, percentage is 85. In the third task of the experiment only 8 percent on average have chosen the signs of Garmin map.

In conclusion can be stated that the existing sign systems are used unclear signs and significance unreported strengthened over the years traditional cartographic symbols to the area. The reason is that consumers often create the integral part of the character system of the card, but only few have the necessary competence and knowledge.

In the lack of a legend, using the map at a relatively small display and during movement is very important to the classification of signs. It should cover all classes and objects so that there will be a juxtaposed number of objects at each classification level. Then consumers will not be wrong signs which indicate similar things.

Experiment results confirmed preliminary expectations and demonstrate the need for change in the used symbol system and the development of new signs or processing of used ones.

Presented experiment is part of a series of symbol systems in the different navigation system maps. The aim is to find the optimal solution for the signs that meets the requirements of the Bulgarian consumers and reduces the likelihood of errors in reading the map.

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