

## DESIGN OF THE BASE WORLD MAP FOR ONLINE-MAPPING SERVICE

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### INTRODUCTION

A base map is the core of any online-mapping service. The most overall and at the same time interesting task of any map designer is the creation of global map coverage (a world map).

One may argue if the paradigm “one-size-fits-all” base map is an obsolete one and it will be replaced by an extensive number of variations of geospatial base coverages. But it is the base map, its universality, interoperability and multi-scale options that generate the growing interest to the cartography from the very appearance of the online-mapping.

Today each of the major Internet-portals alters the interface and fills a new content in that base map. Therefore the subject of this study is styling tools used for its creation and constraints in their application arising due to differences in creation of web maps and traditional paper and digital ones.

What is the secret of the perfect web map? Is it the information content only that brings success to online-mapping service? If we put ourselves aside the “popularity” principle, expressed by the number of web-site visitors, and take a look at the web map as an independent piece of art, then we will be able to mark out basic principles used to reason why the users find this or that web map more attractive and user-friendly.

A designer working on the content of a world map and its visual representation has to think big and create a universal map, taking into account the mentality of the user. From one side he should use innovative approach relying on the designer postulates from the other side be based on the traditions of the cartography. Innovative approach includes creativity in representation of cartographic information. However, creativity in this case does not allow taking a leap of the designer’s imagination to the full extent, as the cartography rules are quite pragmatic and conservative.

Therefore, we may delineate three basic components of a web map under the designer’s control.

This is, first of all, the visual esthetic representation of a map (color balance, color scheme model, the font and its size etc.). Secondly, it is the structuring of the content by filling in different content into different scales and the approach to generalization of map data and detailing of scale levels. And thirdly, the semiotic space of a map: its abstraction level, metaphor factor and friendliness. The map should be simple and logic to meet all the expectations. Spatial objects, linear symbols, reference characters and icons, indicating any type of event or object applied on the map should be easy-to-understand and intuitive for a user.

Developing the design of the world map for the <http://kosmosnimki.ru> service, its authors marked out a number of basic principles used as a reference to work on the three components of the map’s design. Guided by these principles one may create an accomplished cartographic product. Examples from different popular web maps were also selected for this study. They were used for benchmarking and for detection of their influence on the user.

Now authors would like to pay much attention to the first component of this study – the creation of a map color style. The study of the the semiotic space of a map can be found in publication for the Intercarto-InterGis 15 digest [Воронина..., 2010]. The third and summing up study on this topic is scheduled for the near future.

### PERCEPTION OF COLOR AND MAP COLOR STYLE

For understanding of the gist of virtual communication “in unison” of the user with the web-map we will rest on the analysis of map color style from the viewpoint of the color perception theory. The color has both communication value, defining the connection between natural elements and sites, and symbolic value, pointing at the events, objects or subject matters. It also has an expressive value (expression), transmitting specific feeling and bringing corresponding emotions.

Historically the color was used as a simple tool of communication between objects, then as a sign-symbol. Currently it is used in a language system. Formation of color sign systems, definition of color meaning and value runs in specific historical conditions, directly connected to the development of a human being and his mentality. A man always acquires information in color based on his experience, culture and education

in the living conditions of one separate country or region. Therefore it is logic to build in universal color signs as the basis of its color style while drawing the world map.

A map – is the model of the actual world, where objects, reality or some concepts, distinguished mainly by color tints, are displayed on the map as a conventional, unconventional or coded color. The unconventional sign - is the color documentary image, where color is its essential integral feature. The conventional sign – is the black and white image and its convention is increased when color is lost. A coded color symbol does not have visual similarity or is not associated with the object being depicted, and to understand its meaning the knowledge of the color system of conventional signs, which this symbol is referred to, is required. This can be interpreted as follows, for example, to illustrate inhibition signs the red color is used, whereas blue and black colors are used for information only.

When choosing a color style, the map designer uses first of all unconventional color signs. They are perceived automatically, on the subconscious level, and if the green tinting of forests and blue color of water bodies is the complete identity of the reality, then grey color of industrial areas can indicate the anthropogenic content, whereas residential areas are mostly colored in warm beige and pink tones as an allusion of life-warmth-energy.

Perception is the result of psychological processes. It involves meaning, interrelations, context, value judgments, previous experience of a man and memory. In other words, perception is a result of ordination of feelings and their transformation into knowledge about objects and events of the outworld [P.Л Грегори P.Л, 1970]. Perception of the color of any object also depends on how well the man is familiar with it and on those associations that it brings up in mind. Color is a personal psychophysical feeling, incarnated in specific emotional conditions in different people. A map-maker may harmonize the color perception. It is possible that color harmony is not an objective reality that needs only to be disguised as many people like Newton believed, but just a feature of our esthetic sense as Goethe believed; there is no harmony beyond our perceptions as there is no such a notion as “color” beyond our perception. Therefore, in many epochs different nations had different chords (harmonic combinations), i.e. absolutely different combinations of colors were regarded as harmonic or non-harmonic. Until recently, most web-mapping services have been sticking to classic color styles, where color is the principle tool of expression. Appearance of the new Bing Maps design with almost no area’s fills and washed out colors may indicate a new trend.

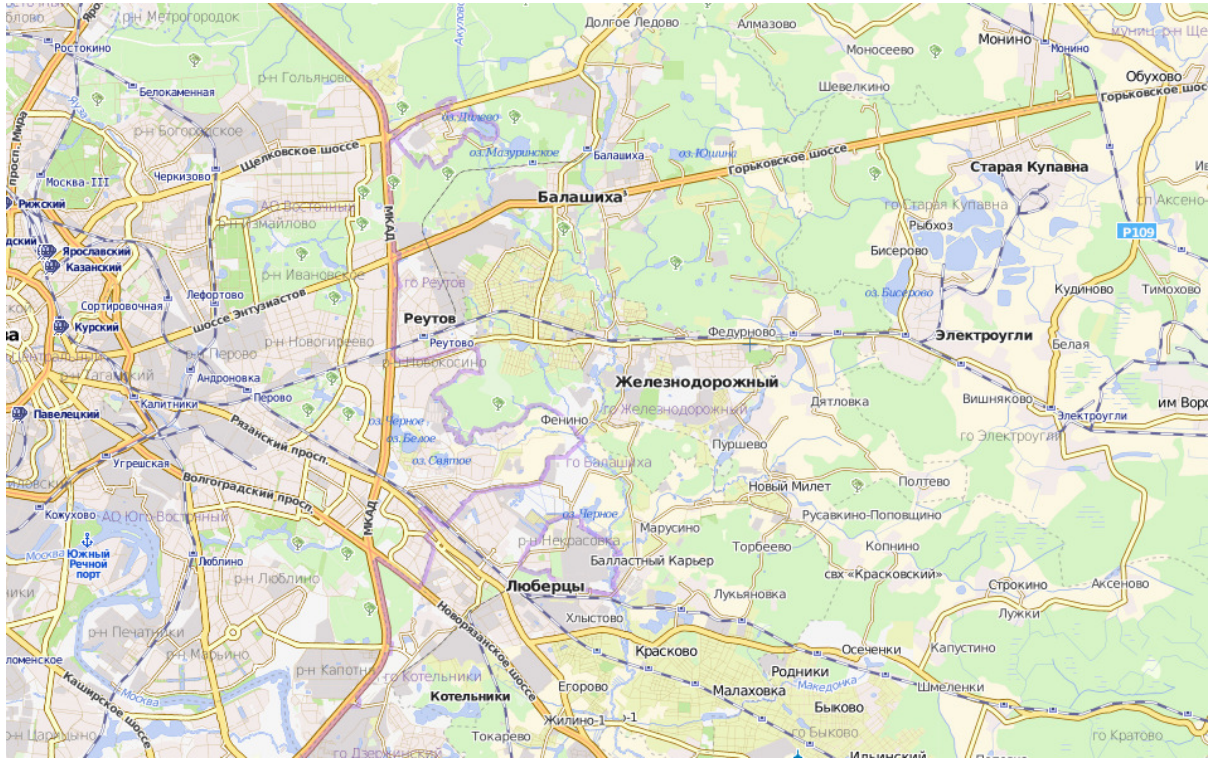
In any case possibilities of different color harmonization are unlimited. One may achieve a harmonic combination of any colors, keeping only in mind (i.e. changing, selecting) their intensity. Changing the luminosity of the tone of colors being combined is one of the most powerful and universal tools of harmonization. Change in contrast may change the entire color harmony beyond recognition, with some colors fading away and others flashing as bright color tones. When they speak about a color harmony, one should not think about a successful or unsuccessful combination of a pair of some colors [Железняков В.] Factors, at first not perceived by the mind (unconscious impulses, unlike conscious ones, not always can be perceived) and understood on the psychological level as primary impression influence the perception of web-maps as a whole colored images. Only during meticulous study of all details and complexes it becomes clear, where do different feelings from viewing come from and what do they depend on.

#### **COMPARATIVE ANALYSIS OF WEB-MAPPING SERVICES' COLOR STYLE. QUANTITATIVE APPROACH**

The authors took identical in content samples (screenshots) from some web-mapping service as test examples in this study. A comparative analysis of images’ color palette was carried out base on this, as well as a conclusion was made about the impact of applied colors on a hypothetic user. The authors relied on basic parameters, defining the perception of color by men: visual-esthetic (color tone, color style model, font and its size), psychological (impact of a color on psychophysics of people), socio-cultural, physiological (age, sex, eyesight capabilities and others) and technical impact of color.

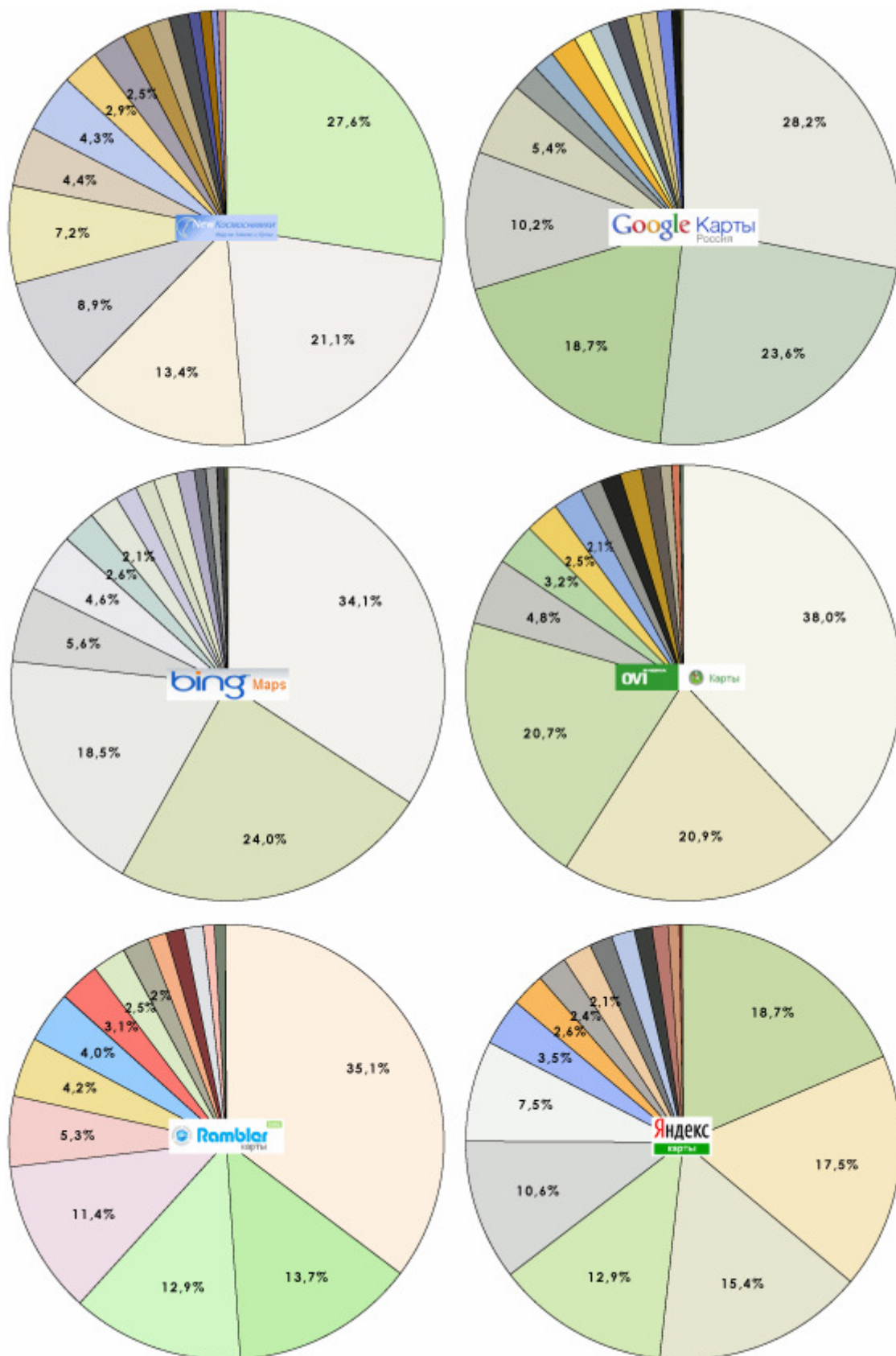
Six fragments of one size were used as test examples, at the scale of 1:300000 and with typical map contents (hydrographical objects, vegetation, roads, etc.) from popular web-mapping portals: maps.yandex.ru; maps.bing.com; maps.google.com; maps.ovi.com; maps.rambler.ru; kosmosnimki.ru of the territory of eastern part of Moscow and Moscow Region.

*Fig. 1 A map sample being studied (kosmosnimki.ru)*



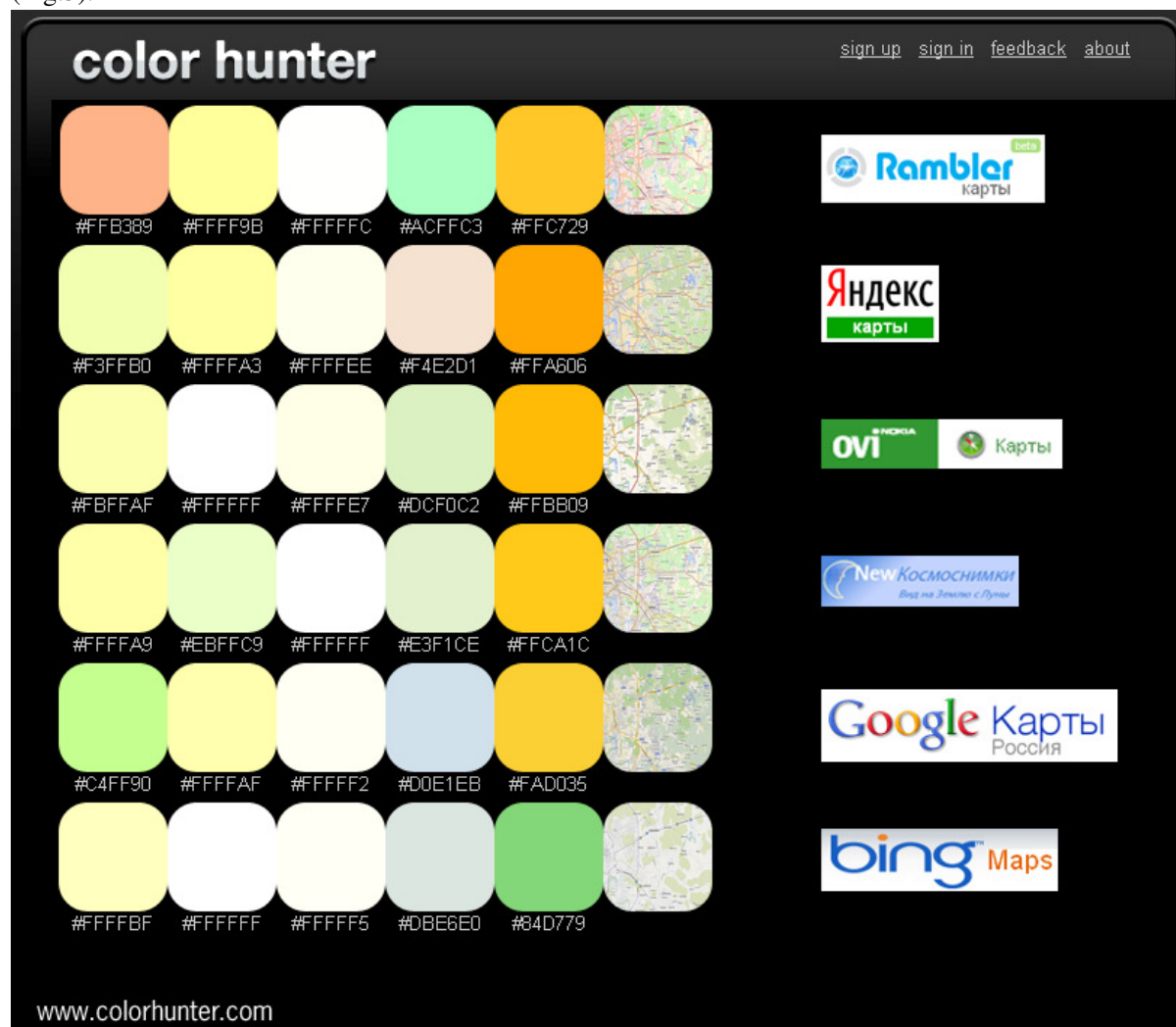
Let's take a look at the visual-esthetic impact during the evaluation of a color solution of selected samples (general provisions of creating a cartographic product will not be considered in this study). A visual-esthetic factor opens through the semantics (color perception), font (color and size) and design from pragmatic viewpoint. All selected samples underwent mathematic analysis in order to find percentage of used colors. The set of fonts, color and size of inscriptions on the map are taken into account, as they play an important role in overall comprehension.

*Fig. 2 Scheme of color distribution in samples being studied*



The selected samples used to calculate the percentage of colors have basically similar content. The percents (share of pixels of this or that color) were calculated from the total number of image pixels. To do so, screenshots were transformed in GIMP program in indexed 16-color image. Color palette and the number of pixels of specific color in it were obtained using ImageMagick software application.

Definitely, green and grey-olive tones having higher percent in diagrams, representing forests, determine the color tone of the background filling of maps. Only maps.rambler.ru have some deviations from the traditional pattern. Pink color dominates here, pushing out greenish, which is reflected in color scheme. The created automatic palette on <http://www.colorhunter.com/> resource confirms the above supposition (Fig.3).



All samples contain practically similar sets of main colors, which is first of all due to same contents of maps. It looks like for main areal objects on web-maps the principle of color selection is the same, whereas an emphasis on details is achieved with the help of additional conventional signs, textures, contrasting outlines and inscriptions.

For example, maps.bing.com has more neutral main colors, grayish, blurred and looking “well-laundered” on the map scales being reviewed. The authors themselves call their style as sexy maps [Bings Map Blog]. Only some percents of vivid living colors, related mainly to depiction of road legends, attract attention and hint at a “personal touch” of each web-map.

Proceeding from the notion of the color harmony, the two colors used together still cannot be regarded as harmonious enough without adding any other colors and without increasing brightness and contrast or vice versa reducing them.

In our case this is obvious when displaying the picture of roads. The samples, where roads do not have a sharp outline, but have a deep clear bright color of the line filling, not contradicting to the background, have an advantage over the samples, where filling is more faded with no contrast to the background. If a map designer does not see right to increase the brightness of details, he applies the effect of highlight. This is attained by the combination of the applied colors and this can be used to change general color properties. For example, using of a thin bright or dark strip on the roads may radically change the picture color, make it look more dusty, blurred out, faded or more three-dimensional, vivid and highlighted. All depends on showing specific details in demand on any given map.

As to the font color, its type, style or size, it is reasonable to regard inscriptions as a picture bringing a certain color. It is therewith important that an inscription does not look as something alien. It should be in harmony with the general color palette. Due to inking thin inscriptions become contrasting and readable. Too many bold fonts sometimes “overload” the map and their number and location break the structure of color index, making the map look like a newspaper.

The schemes clearly depict what color of fonts and shadings of roads are used on the samples. They occupy least of sectors. For example, the scheme built based on the maps.rambler.ru sample has no black and dark-grey colors at all. Google maps use contrasting yellow and orange tones, with the smallest sector of black color falling on the fonts. Kosmosnimki portal’s map also lacks solid black colors, however there is a sector with the dark-grey color. The motive was to “lighten” bold fonts.

### **COMPARATIVE ANALYSIS OF THE WEB-MAPPING SERVICES' COLOR STYLE. INDIVIDUAL ESTHETIC PERCEPTION OF MAPS BY USER**

To detect the mechanism of perception by user of a map’s color palette, it is required to review the impacts of the color on human psychophysics or the so-called socio-psychological and physiological impact. Socio-psychological impact includes psychological perception of color and form; impact of color on the user’s character type and his purposes; social, national and culture-historical aspects. Physiological impact is included in some specifics of the human vision: eyesight quality, deviations from vision norms (color blindness, astigmatism), age and sex of the user. Unfortunately, this study did not include the results of sociological inquiries, carried out among target groups of users, as the results had not been completely processed by the time of publication. Therefore we will confine ourselves to theoretical layouts on this issue.

As a matter of practice, the eyesight of the user, his personal features (character, spirits, habits), type of character, psychological condition (gloomy, playful, high, etc.), health and even the degree of his weariness (tired, buoyant, sleepy, etc.) cannot be always taken into account when selecting color for the web-map.

For example, in order to allow for the specifics of the eyesight of some users (about 15% of the population are color blind), it is workable to double a map in its monochrome version. Black-and-white, contrasted and carefully selected tones of the gray-scale may reflect map details and render color as good as the polychrome ones. Modern professional painters, creating picturesque canvases take black-and-white photos of them in addition to confirm that the selected color, contrast and saturation and other features were the correct ones.

Also despite theoretic potentials of creating the map design out of a great number of color tones the human eye cannot make out all color hues on the screen. The eye retina has photoperceptive elements, called “rods” and “cones”. The first are responsible for perception of tones and the second – for the perception of color. Different people have different ratio of rods and cones, therefore their perception also varies. Some people perceive more color, others - more form. Rods dominate among men, cones dominate among women, which means that color and consequently mood have more value in design for women and the form, consequently, content, have more value for men. Cones and rods are rest on the retina unequally, so the perception of objects, located within the field of view of the eyes will be different. Eye sensibility with respect to short-wave light reduces while people get older. For example, violet and blue colors are more vivid for kids, then for elderly people.

The fact that a person belongs to one or another social, national and cultural group may also have an impact on the perception of the map color palette. What is this person’s education, job position and even the marital status? The time of the day (morning, lunch time, evening, night) and the day of week is by no means less important in perception. All these factors impact the mood of the user and consequently the perception of color, the acceptance or rejection of principle colors on the map. It is impossible to guess the psychophysical condition (weariness, buoyancy, etc.) of all map users. Vivid colors may have a beneficial effect on a buoyant high-spirited user and may have an adverse impact on the weary and depressed user, whereas dull colors may have both negative and positive effect. This results in increase or decrease of the degree of memorability of the service by users.

Psychological motivation and how important the displayed information on the map for the user is (the degree of its interest), as well as how quick the tasks set forth by the web-map user are resolved, regardless of its color solution, play an important role in selection of a web-map service. In most cases the habit to use the map from the default search service, opened automatically when the browser is loaded, triggers. Otherwise the professional use of API for specific tasks urges a more careful selection of a web-map and service.

Ideally, it is required to take into account technical specifications of devices and applications, used for reading maps. Those are: monitor performance, specifics of different browsers to display colors, API properties, data transmission rates, monitor properties and quality. All this could have an impact on the perception and on how the user will be devoted to the web-map he liked for its color style.

The above specifics of color perception with due account for different psycho physiological condition of the user is one of the main reasons, why the map design aimed, at mainstream audience, should be neutral. It is impossible to find the correct color style of the map, suitable for all the net users.

## **CONCLUSION**

It is untrue that there is no accounting for tastes, when it comes to good taste .[Чихольд Ян, 1948].

If we put aside the principle of a good promotion of any given web-mapping product and take a look at the web-map as an independent piece of art, then theoretically we may highlight main principles used to prove, why we like or do not like this or that map. In practice though, only a narrow circle of specialists-experts may express a shared vision, if a map is a masterpiece or not quite. The bulk of the audience will stay unperceptive of small changes in the map color style and will react only on global changes in design. Nowadays a web-map still becomes popular only if it is up-to-date, complete and “fully loaded”.

Nonetheless, all principle map resources make their map color palette user-friendly, applying neutral and non-saturated colors, keeping in mind the main function of the base map – to be a sub-layer for plotting different additional, interactive and mash-up information.

Anyway, to date, every one using the style customizing tools of a map, offered by some Internet portals, can become a map designer. Whether the number of hacks will increase or we will see new masterpieces in the future, depends on us – the cartographers - as well.

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