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Voice Control of Maps

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***Abstract*—The use of digital maps has increased considerably in recent times in everyday life. New concept of voice control of the map and car navigation brings benefit for handicap people and car drivers. This article describes overview of voice commands that are suitable for voice control of the map and navigation. Application of the voice control for geographic information systems (GIS) is also mentioned. The voice control is discussed from the viewpoint of the geoinformatic science, from experience in map portal design and digital maps creation. The state of art in the voice recognition is considered.**

***Keywords*—map, navigation, voice, geographic information science.**

I. Introduction

As information technologies developed over last two decades, the using of traditional paper maps have changed to the using of digital maps. Today maps are also prepared mainly on computers in digital form. This process produces both the final print maps and both digital maps displayed on computers, map portals and mobile devices. Map portals are very commonly used for address location, the finding of the shortest route by internet users in ordinary life. GPS navigation has become a regular support for drivers in car. New researches and automotive industry have brought the new idea of join the map navigation and voice control of devices.

Digital maps and plans provide more functions than paper maps. Paper map is limited only for reading in one graphic form. Digital map can be handled by many functions. The number of function depends on the application. The functions e.g. a change of scale and the change of the extent of view belongs to the basic function that can be found in all applications. The question is whether it is possible to replace the manual control of digital map with the voice control. Voice control substitutes the computer mouse and keyboard in the process of a map handling.

Two broad spreading map applications can be determined. The first is an internet map portal, and the second is car navigation. Internet map portals can be used on the monitor of PC or also on mobile phones/computers with smaller display. The third possible implementation can be specific application - such as geographic information systems (GIS) - that are aimed for collecting of spatial data in the field. The user segment of the third group is smaller.

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A voice control can be useful for two groups of user. The first are physically handicapped persons. The voice control of PC on the whole, including the map portal, is the advantage for them. Voice GPS navigation for blind people is mentioned by Pressl and Wieser [1]. Application increases orientation of blind people in an urban area. The GPS hardware and software solution helps blind users in their daily outdoor mobility movement. Sound-based software and the GPS satellite navigation embedded in a mobile PC provide information to blind people in moving and orientation throughout various points of interest in the city [2].

Car drivers are the second group of potential users. The main reason for voice dialog is safety traffic. Driver's hands hold the steering wheel at all time, and driver is not taken away from the surrounding traffic. Moreover, the voice control is more comfortable than manual control.

II. Voice Control

The mouse clicking to buttons, dragging map window and selecting choices are the basic handling with the map. Input row is aimed for searching address on map portal. More input rows are designed for input information for searching driving route (the starting point, the ending point, the visiting point).

The commands for controlling of maps can be divided into two sets. The same division can be found for the voice controlling. Commands for the handle of whole map belong to the first group. The second group can be called searching commands.

Group of commands are:

1) **Map control commands** - change views by voice.
2) **Search commands** – look for place, route by voice.

Some commands are standard on the map portals also on the car navigation, especial from the first group. Some commands are specific for application and depend on GPS module. E.g. voice command - sentence "Where am I?" belongs to Search for command. GPS module sends coordinates of user (the same as coordinates of equipment - mobile PC) to map application to show the position on the map. Map application additionally zooms in the map to that position in an appropriate scale. The overview of command is in the table 1.

A. Basic Map Control Commands

The to basic map command belongs commands that change a view. The change of view mainly changes the **scale** of the map. Operation **zoom in** and **zoom out** can be realized by the short voice command "Zoom out." and "Zoom in." without long sentences. The portion of scaling is set constantly (twice, half) by program [3]. Zooming is realized by steps, by the repetition of the same command of zooming. The clicking on

scale line or input row for accurate number is used on the manual control of the map. Scale line is on Fig.1 on the left side. The input of accurate number of scale can be realized by voice command, if the words for number are recognized. Example command is "Set scale to 1:5000". The accurate number scale is more beneficial in GIS than in common map. Users are not familiar with scale portion.

TABLE I
GROUP OF VOICE COMMAND

Group	Function
Map control command	
	Change scale
	Change map extent
	Fit map – full extent
	Switch between base maps
	Switch on/of overview map
	Switch on/off layers
Search command	
	Search address /country
	Search POI
	Find the route (shortest, fastest)
	Navigation

The change of the map extent is realized by **pan** function. Map is dragged by mouse in manual control. In voice control is necessary set the orientation of dragging. The voice commands are:

"**Move** top/bottom/left/ right." or
"**Move** north/south/east/west."

It is near old map portals where navigation was realized only by arrows on the edge of the map window. Zoom and pan command are implemented in both the map portals and both car navigation. It is useful when system is also able to recognize alternative words in voice control: top is the same as north.

Command **fit map** belongs to the command group "change view". It means to maximize the map to the full extensions of the screen or window in the application. Full extent can be the whole world or only one country or only one town. Voice command can be:

"**Fit** map.", or
"**Full extent**."

The third subgroup of map control command is switching of the **map base**. The default map base is a base topographic map with roads and street network on the map portals. User has a choice to switch to aerial/satellite photo as a base map. Only one base map is displayed. New types of base maps have been offered recently. The map portal mapy.cz offers aerial map of various time periods (from 2003 and from 2006). Interesting map base is the historical map (1836-1852) on that portal. The touristic map is suitable for planning outdoor leisure time activities. Google maps offer switching to the terrain base map where relief is expressed by grey hill shade (Fig. 1).

The voice commands have to correspond to choices of the map base. Only comprehensible sentences as follow are enough.

"**Switch** on the satellite image."
"**Switch** on the touristic map."

It is not necessary to determine source map base in the switching process. Combination of satellite and touristic maps is sometimes allowed when touristic map contains lines of touristic routes.

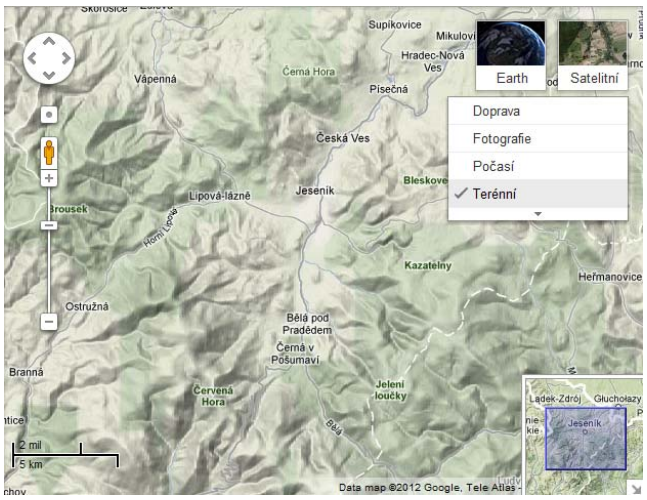

Fig. 1. Map base – Terrain (http://maps.google.com).

The car navigation sometimes offers the switching to 3D view (perspective map) in cities. 3D view is more realistic than 2D. 3D view is useful for real imagination of buildings and surroundings objects during a car navigation in the town.

Fig. 2. 3D view in car navigation (http://www.sygic.com).

The next function is switching on/off the map layers. Layer of point of interests (POI) can be switch on for displaying on the map base. Point symbols appear on the map. The names of layers are various according to group of points of interests. Map portals differ in grouping POI. Sometimes historical and culture points are together in one layer. On the contrary, separate layers exist for restaurants, post office, schools, shopping, sports, parking places etc.

Voice commands have to correspond to name of layers. The words "map layers" is not necessary in voice command. Examples are:

"**Switch** on/off accommodation."
"**Switch** on/off sports."

The layers of POI can be also optionally "switch on" at the car navigation. Localization of gas stations and parking places are crucial for drivers.

Additionally, a small overview map can be displayed in the corner of a large detail map window. The overview map is not used in car navigations. The displaying is optional and can be switch on /off by command:

"**Switch** on overview."
"**Switch** of overview."

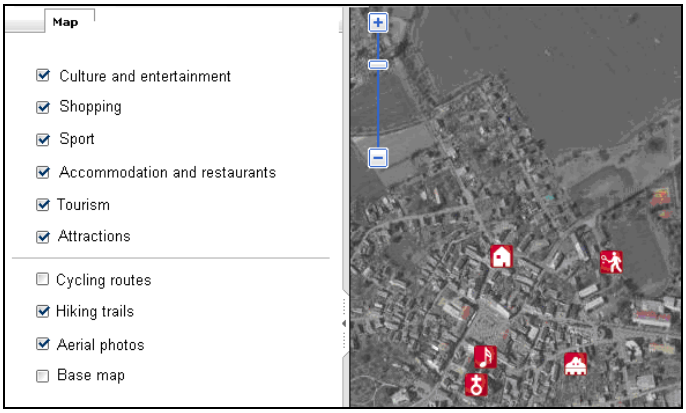

Fig. 3. The map layers on the map portal of town Jičín. (http://gis.mujicin.cz/tms/turist_a/)

B. *Search Command*

The second significant group is the search commands. This group of command is served for search an address, country and interesting places. The find of the route also belongs to this group. Map portals call the function "Route Planner" (amapy.cz). Both type of function can be found on the map portals and the mobile car navigations.

Search for address is realized by one row input box. The name of town, the name of the street and number are putting in together. Voice command for finding address is arranged by one sentence:

"**Search / Find** Zaragora, Calle del Coso 6."

The finding can be supported on map portals by whisperer that offers suitable variation of location. Whisperer does not usable in the voice control of navigation. The solution is the voice dialog between drivers and the voice communicator (the car navigation). The navigation offers suitable variations of the target address. The finding can be limited to map base of one country or continent or without limitation.

Driver: "Find Ottawa?"
Navigation: "Do you mean Ottawa in Canada?"
Driver: "No."
Navigation: "Do you mean Ottawa in Mexico?"
Driver: "No."
Navigation: "Do you mean Ottawa Street in the New Zealand?"
Driver: "Yes."

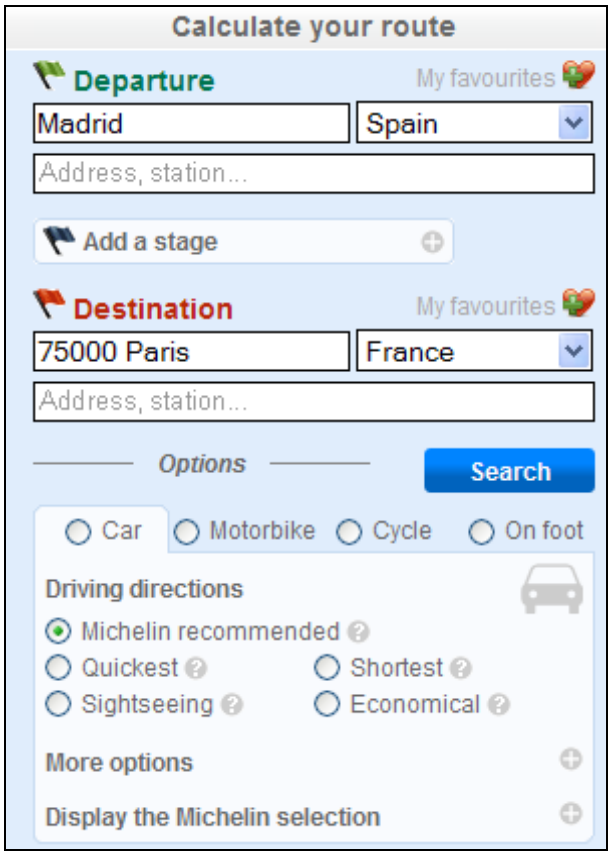

Fig. 4. The route planner at Michelin. (http://www.viamichelin.co.uk/)

Fig. 5. Whisperer at Google Maps. (http://maps.google.com)

Moreover, the search of point of interests is very popular. The location can set accurately by name of the country, the name of the town. It is important to recognize the point of interests (restaurants, school, city hall, swimming pool) and to combine query with the location condition. Location by word "the nearest my position" is allowable with GPS equipment.

"**Find** cinemas in Berlin."
"**Find** hotels near airport in Berlin."
"**Find** the nearest fast food."

Last search commands are navigation commands. The simplest form is setting the destination from the actual

location of car. From the point of recognition, it is the same as searching of one address.

"**Go to** Brno.", or
"**Find the route** to Brno, Cejl."
"**Get directions** to Ostrava Poruba."

Route planner with setting the address of departure, the address of destination and with address of the stop stages is more complicated for the voice recognition then the recognition of one destination. The solution is also dialog with the voice communicator. All information is separated in several questions and answers about the departure place, the destination place and stages. The dialog starts:

Driver: "**Find route!**"
Navigation: "Where is the departure?"
Driver: "Madrid."
Navigation: "……"
Driver: "……"
Navigation: "Where is the destination?"
Driver: "….."

It is possible to set the specification of route in the some route planner. Options are the shortest, without paid highway or a route with sightseeing. It can be set also by dialog.

Final voice command after finding the resulting route is "**Navigate**!" and the voice map navigation will be started. It is possible to set the destination more informally.

"**Go/drive home**!"
"Go to the office/school!"
It is necessary to assign the accurate address to the word "home", "office", etc.

III. Voice Communication

The chapter II contents overview of voice command. There is a valuable idea about voice dialog with communicator. The best result brings full communication with map application in both ways. User says command and application responds to users. Especially for car drivers, dialog is useful and safety. The response is useful in confirmation of some commands. The right recognition of the voice command can be the sound confirmation by repeating of the command or address etc. Example software is Vlingo [4]. Vlingo software covers more application than map and car navigation.

The main process of the voice control of map is not only important. The starting point of the voice recognition can be discussed. It can be started by clicking to the icon on display or by pushing a button on the dashboard in car. This solution is BMW cars [5]. The voice control in BMW cars servers not only for the car navigation. Other helpful functions are the voice dial a telephone, send SMS. The text-to-speech function can read aloud emails or SMS messages. Each function has a unique command for the starting. The car navigation starts by voice command "Map". The third solution is the voice calling the name of the application. All verbal communications in the car are picked up by a hands-free microphone all the time. Common interview with passengers is not relevant for voice control in car. Recognition starts after wake up of application of voice control [4]. It is better than manual pushing of a button or icon.

Filtering of common verbal communication and filters out background noise in a car is connected with successful recognition. The complex acoustic environment of car interiors lowers the performance of speech recognition of navigation systems. The experience with the tree commercial solution brings A. Goulati, D. Szostak at their article [6].

Fig. 6. Button on the BMW dashboard.

IV. Voice Control of GIS

GIS (Geographic Information System) is an example of specific software application that maintained map and spatial information. One interesting solution in the voice control of GIS brings Voice-Insight [7]. The connection is with ArcPad (from Esri company) application in mobile mapping in the field. Esri ArcPad is for real time mapping in the open space. VQL Voice Assistant for ArcPad is the extension for voice control of that application. Tablet PC is recommended.

A. Database Update

In addition, the voice commands not only control map window and search location. Other functions are add to controlling. Most importantly is manipulation with database objects by voice:

- Select objects based on different criteria's and categories and fit the selection in the middle of the screen
- Read attribute data associated to a selected set of objects
- Retrieve user forms with attribute data
- Update the content of data or of user forms fields.

Voice Query Language allows the user to query by means of his voice on any existing database application content. The voice activation of existing data and content, being a real mobility and productivity enabler, permits the user to perform all kinds of complex search and update of database content on his mobile devices, by use of his voice.

Example of man machine dialogue for attribute update is:
User: "Select the nearest road?"
GIS: "Road selected."
User: "What is the width?"
GIS: "The width is 4 meters and a half."

User: "What's the type? "
GIS: "The type is primary."
User: "Change type into Residential."
GIS: "The type is residential."

B. *Geometry Update*

Furthermore, spatial data (shape of line, polygon) can be create and update using GPS and voice. VQL for Geography on the GO™ can work directly with the signal sent by the GPS receiver to the GIS system. Therefore, the user can digitize via voice any type of geographic information in the field.

Example of man machine dialogue for geometry creation is:

User: "Select the layer Cycling routes?"
GIS: "Cycling routes is selected."
User: "Create a new feature."
GIS: "Go to the starting point."
User: "This is the starting point."
GIS: "Go to the next point."
User: "This is end point."
GIS: "Finish sketch?"
User: "Yes."
GIS: "The new cycling route was created."

User goes thought all nodes of new line. The new position is taken from GPS after a user voice response at every nodes of line. The same operation is for the creation of a new polygon. User goes around the edge of polygon and to set the points of the edge.
The geometry and attribute update have many future deployments in maintaining of utilities (water lines, electric lines, gas lines, sewers, etc.).

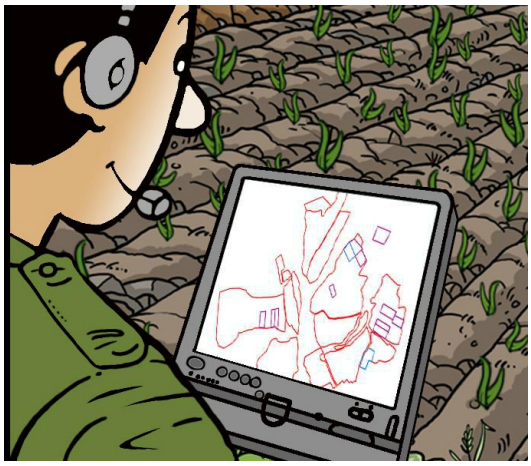

Fig. 7. Voice update of data in GIS [7].

V. CONCLUSION

The voice control of map application is a new utilization of the voice recognition and the voice synthetics. An interesting point of view from the specialist in geoinformatics is presented. Article brings set of experiences with various map portals and their using. Our reflection is a combination of the possible voice commands for map portals and their implementation to the voice car navigation commands. Many commands are the same: for control of the map window. Some voice command depends on GPS module connection (Where am I?). It is possible to divide the voice control commands to the two basic groups. The first set of the map is the control commands and the second is the set of search commands

More important is the voice car navigation on mobile computers than the voice map desktop applications. The voice control has several implementations. The voice car navigation makes journey even safer and more comfortable for drivers. This area is a challenge for the automotive industry and computer science also geoinformatics.

REFERENCES

[1] B. Pressl, M. Wieser, "A computer-based navigation system tailored to the needs of blind people", *10th International Conference on Computers Helping People with Special Needs*, ICCHP 2006, Linz, 2006.
[2] J. H. Sanchez, F. A. Aguayo, T. M. Hassler, "Independent outdoor mobility for the blind". *Virtual Rehabilitation, IWVR*, 114-120, 2007.
[3] Z. Dobesova, J. Brus, "Inteligentní systémy v digitální kartografii" [Intelligent systems in digital cartography] in V. Vozenilek, J. Dvorsky, D. Husek (eds.) *Metody umělé intelligence v geoinformatice*, [Methods of artificial intelligence in geoinformatics], Publishing house of Palacký University, Olomouc, 2011, pp. 169-173. (in Czech)
[4] Vlingo. Available: http://www.vlingo.com/, cit. 20.1.2012.
[5] BMW Voice control system. Available: http://www.bmw.com/com/en/insights/technology/technology_guide/articles/voice_control_system.html. cit. 20.1.2012.
[6] A. Goulati, D. Szostak, "User experience in speech recognition of navigation devices: An assessment". Paper presented at *the Mobile HCI 2011 - 13th International Conference on Human-Computer Interaction with Mobile Devices and Services*, 2011, pp. 517-520.
[7] Voice-Insight: "Voice Integration Solutions – Geography", Available: http://www.voice-insight.com/Geography_1.html, cit. 20.1.2012