Mobile GIS applications based on a developed XML styling language

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ABSTRACT: *In this paper, we present an innovative approach for visualizing geographic features using point, polyline complex polylines and polygon geometry in mobile GIS applications based on a developed XML styling language for defining custom styles and mapping layer subclasses to the specific style benefits including extending basic styles and applying a custom user-defined style for distinguishing objects belonging to the same layer visually separated objects for highlighting a specific attribute value for quickly identifying objects in time-critical situations in typical emergency situations various response teams all accessing different aspects of same geospatial data a flexible and customizable style definition language for general vector data for separate field services having custom visualisation of shared community spatial data.*

I. Introduction

A geographic information system (*GIS*) is special type of computer-based information system tailored to store, process, and manipulate geospatial data [1]. The ability of *GIS* to handle and process both location and attribute data distinguishes *GIS* from other information systems. It also establishes *GIS* as a technology important for a wide variety of applications [2].

The fundamental information unit that *GIS* deals with is called a geographic feature. Geographic feature is an abstraction of a real world phenomenon associated with a location relative to the Earth [3]. Every feature may have a number of properties. One or more of the feature's properties may be geometric. Geometry provides the means for quantitative description of the spatial characteristics of features, including dimension, position, size, shape, and orientation. A geometric object is a

combination of a coordinate geometry and a coordinate reference system. In general, a geometric object is a set of geometric points, represented by their coordinates. Basic geometric objects are points, polylines, and polygons [4].

The importance of the visual portrayal of geographic data in *GIS* cannot be neglected. The skill that goes into portraying data is what transforms raw information into an explanatory or decision-support tool. Fine-grained control of the graphical representation of geographic features is a fundamental requirement for any professional mapping community. Allowing user to define styling rules for visual portrayal of geographic features requires the existence of a styling language that the user and *GIS* application can both understand [5].

The paper is organized as follows: Section 2 presents previous work. Section 3 describes creating custom layer styles that can be applied to any vector layer. Section 4 shows flexible simbology mechanism in mobile *GIS* application. Section 5 summarizes the achieved results.

2. Related Work

Mobile *GIS* application, as integral part of complete *GIS* solution in the domain of defense and security, is developed on basis of GinisMobile platform [6]. It is capable of visualizing geospatial data in the form of raster and vector layers [7]. All data required for specific field operation is prepared in advance using desktop *GIS* part of the complete solution and deployed to mobile devices using *GIS* server and standardized *WMS* and *WFS* interfaces. Geospatial data being deployed to mobile device is separated into two groups:

• Data which is not of primary interest for specific operation. Data in this group is not expected to change during field operation and it will not be changed by specific field team using the mobile device or any other field deployed team. This data is referred to as background data and is visualized as static raster background map.

• Dynamic data which is primary focus of specific field team. Data from this group is organized as vector layers and individual features of these layers can be modified by field team using the mobile device or any other field team involved in the operation.
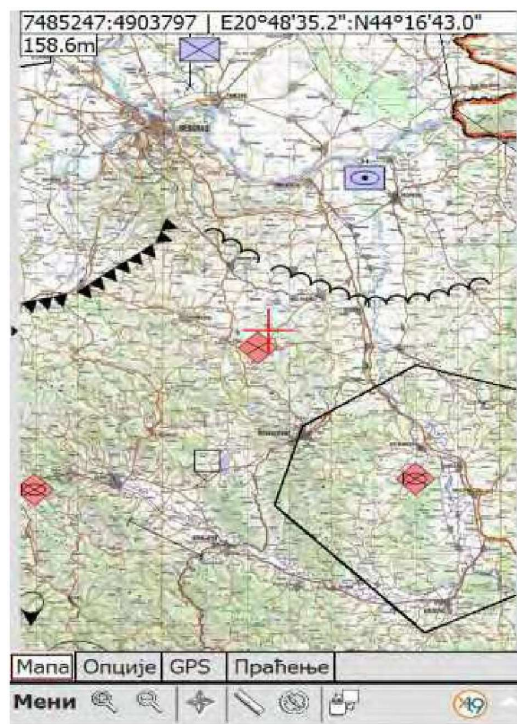

Figure 1. Combined maps in mobile GIS application

Data from the first group mainly contributes to spatial orientation and landscape/terrain recognition. In the domain of defense, security and intelligence operations data from the second group is organized into situational map and this shared situation map becomes central hub for collaborative field operations. One example of combined visualization of background raster map with situational map overlaid is shown in Figure 1.

All general purpose *GIS* operations are implemented and supported. These include numeric coordinate transformations between various (well known and manually defined) coordinate systems, measurements (length, circumference, area etc.), zooming and panning map manually. Measurements and cartometric functions are shown in Figure 2.
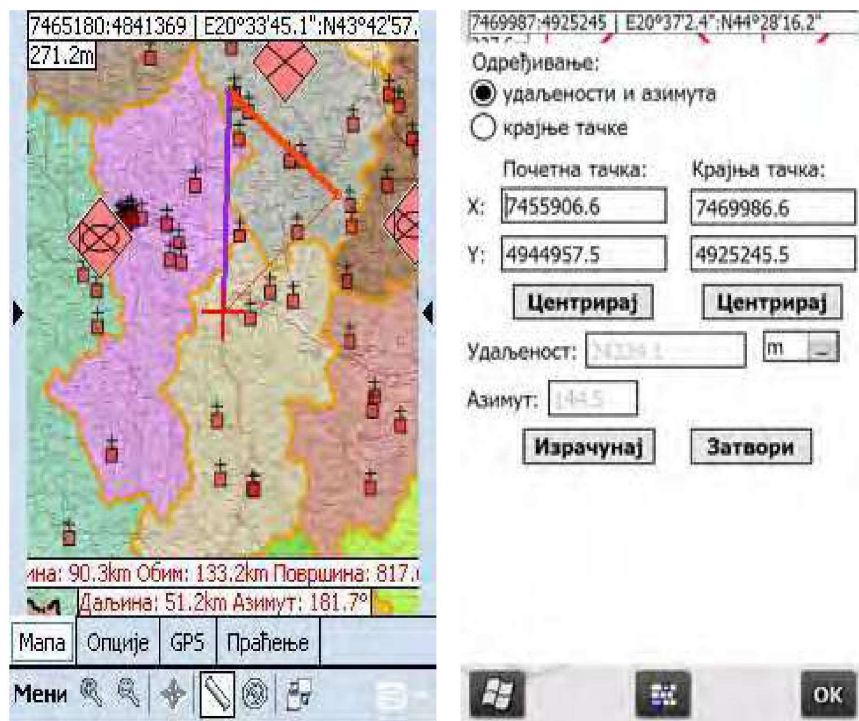

Figure 2. Basic GIS functions in mobile GIS application

All operations are based on map view central point. User drags map and centers crosshairs on situational map elements. Crosshairs shape depends on focused type of operational map element and is shown in Figure 3.
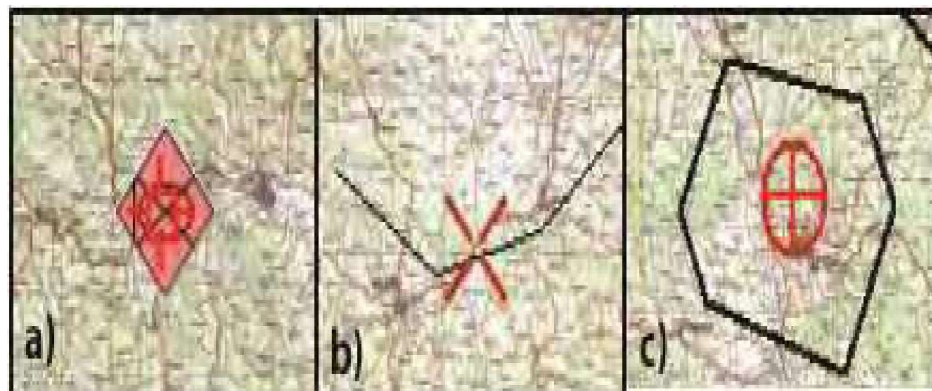

Figure 3. Selecting operational map elements

3. Create Custom Layer Style

While desktop applications offer more detail because of the greater amount of available resources (memory, processing power, and no restrictions on the battery), mobile application stand out in a more efficient use in field conditions. With the price of sensors recently declined significantly, sensors such as *GPS*, accelerometers, and gyroscopes are incorporated as standard in modern mobile devices. Application of mobile applications that will be discussed in this paper refers to the Geo-Information Systems. The paper will describe a mechanism for flexible symbology of geospatial objects. Mobile *GIS* application relies on the use of *OGC* defined standards.

Mobile *GIS* applications are most frequently used in navigation, but it is a narrow set of mobile *GIS* applications. In this paper we are focused on the use and modification of geospatial data using mobile applications. Data can be in. shp. dbf format or any specific format, or may be obtained from the service.

Using this method it is possible to load data from *OGC* standardized data source memorized in the local file in format(.shp, .dbf). Also, data can be loaded from the service (*WFS*). It is important to emphasize that the objects which are loaded are vector objects whose location and other attributes can be changed in real time.

The loaded data contains one or more attributes related to the geometry of the object itself, and additional attributes that describes detailed information of the object. Each layer of geospatial data consists of data whose geometry is the same type (eg. point, line, polygonal). After you load the data layer is displayed in the default style.

For data that is loaded into the mobile application, later can be applied created style. Style depends on the geometry type of layer loaded. In this way, the mobile application styles are grouped into three classes: styles for point objects, line objects and polygon objects. For point sources, we can define the symbol color and shape and size of the spot object. An example is given in Figure 4 a). In line objects can define the color and line type and line endings. An example is given in Figure 4 b). For polygonal objects, we can define the color and type of linje which marks the edge of the object, and then we can define the color and type of fill. An example is given in Figure 4 c).
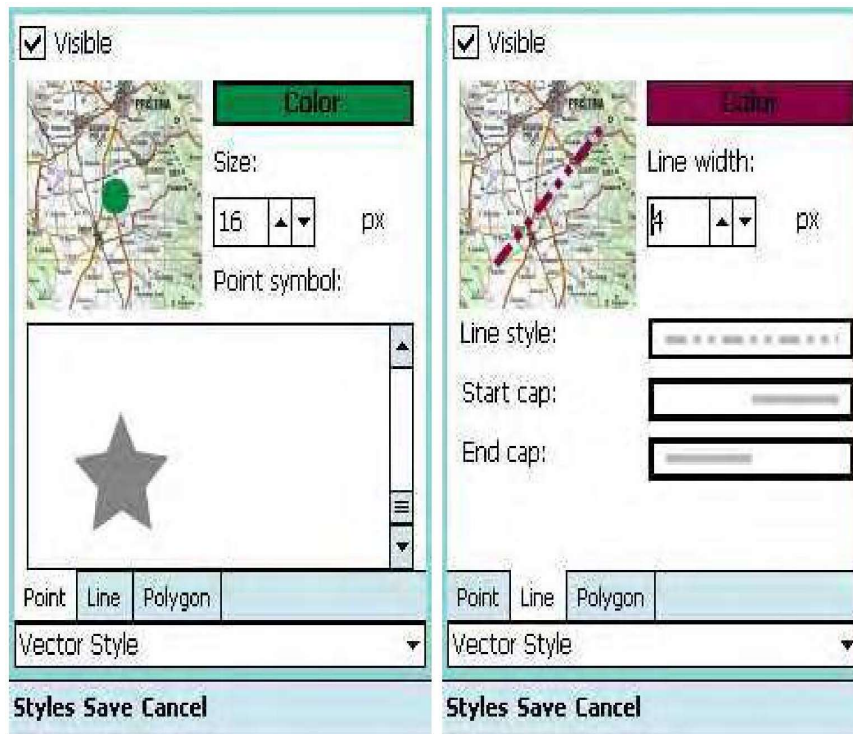
a)   b)
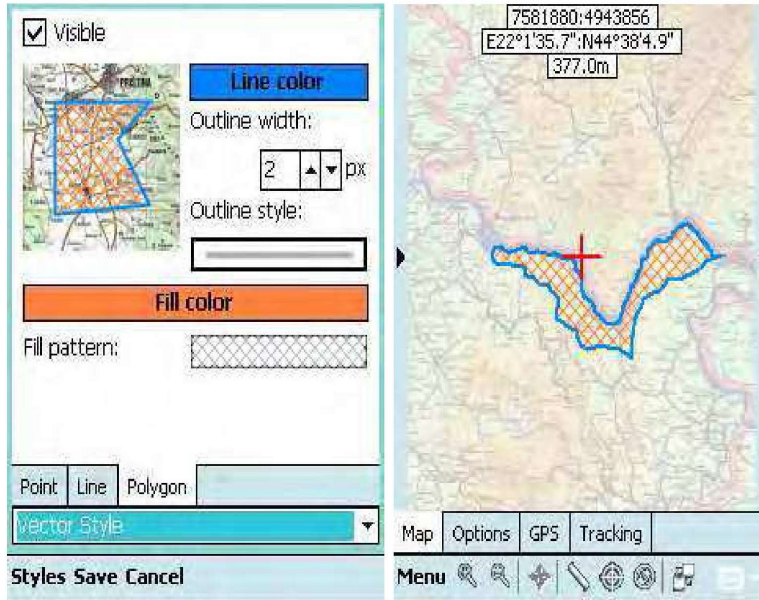
c)   d)

Figure 4. Setup style for whole layer based on layer geometry

On Figure 4.d) is shown one object that belongs to layer "National parks" of Serbia on which polygon style is applied.

Previously mentioned manner can indicate a particular layer or vector data to distinguish between two layers of the same geometry type, but has conceptually different meaning. All this is enough for use in mobile applications in navigation. If you need to show or indicate one type of points of interest (*POI* Eng.), but what if you want the visually differences of data that are belonging to the same layer. With that purpose a mechanism has been developed for flexible symbology in a mobile *GIS*.

Figure 5. Mapping an attributes from data source to specific domain hierarchy

4. Flexible Symbology Mechanism in Mobilegis

The mechanism is based on *XML*-defined mapping of attributes of mobile on visual representation of the object. It is necessary to define a hierarchy or a subset of data for a given layer. Once we define subsets of data for a given layer, it is necessary to prepare the appropriate raster or texture for the visual representation of instances of classes. In this way, all objects are classified into a special classes of one layer, if you look at climate change visualization of natural disasters can be more detailed graphically represented with visualization of measured values. Disaster management can greatly facilitate services on the ground to determine the appropriate plan of action.

As a data source can be any standard defined data source, you need to configure mapping of one attribute from source to a particular that can be used as symbol identifier. Each class in the hierarchy is defined by selected attribute. This can be done through a defined *XML* file that will be used for mapping or in the application. For specialized display, source defined ttribute that serves to identify the symbols subclasses. Figure 5 Shows mapping process, on Figure 5. a) all source attributes are displayed unmapped. When user select an attribute, list of possible match from hierarchy is displayed and user can perform mapping. If source doesn't have all attributes from hierarchy, then those attributes are not considered during display process. Unmapped attributes from source are added as additional set of attributes beside hierarchy attributes, although they are not involved in display process.
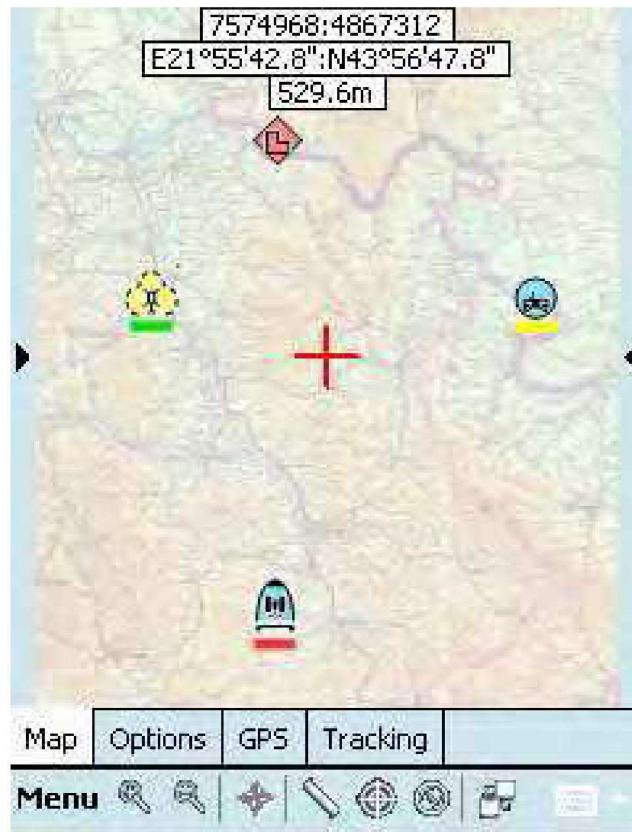

Figure 6. Applying different style on one layer objects

Figure 6. Shows four objects that belongs to same layer but they are visualized differently, based on previous mapping. Each object has geometry that indicates location of object, other attributes describe objects in details. We configure mapping between object attribute and symbol identifier. We create list of textures and include them in mapping.

User can create object using mobile application and see preview of the object based on previous mapping, shown on Figure 7.
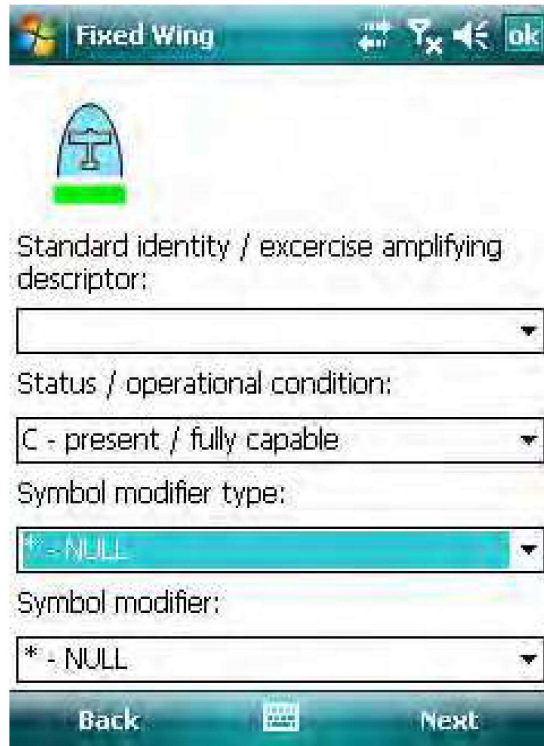
Figure 7. Creating new raster image for visual representation of object with preview

5. Conclusion

To improve the use of mobile applications, a mechanism for flexible symbology of objects in mobile *GIS* applications has created. This mechanism extends basic styles and improves usability of mobile application. Big improvement has made in creation custom styles that apply on each object based on specified attribute value. Mechanism contains tree simple steps to configure custom mapping. First step is to classify subsets of objects for specified layer based on object attribute value. Second step is creation of raster images or textures. Final step is creating unique mapping. From user perspective, different kind of services can apply their own simbology in order to visually represent object from specific domain. This improvement allows extending visual representation of same geo-spatial data according to domain in which data are used.

6. Acknowledgments

References

[1] Worboys, M., and Duckham, M. (2004). GIS: A Computing Perspective,   Second Edition, CRC Press, Boca Raton, FL.

[2] Chang, K. (2005). Introduction to Geographic Information Systems, Third Edition, McGraw-Hill, New York, NY.

[3] The OpenGIS Abstract Specification, Topic 5: Features (Version 5.0), document 08-126, Open Geospatial Consortium Inc., January 2009, http://www.opengeospatial.org/standards/as

[4] OGC Reference Model (Version 2.0), document 08-062r4, Open Geospatial Consortium Inc., November 2008, http://www.opengeospatial.org/standards/orm

[5] Styled Layer Descriptor profile of the Web Map Service Implementation Specification (Version 1.1.0), document 05-078r4, Open Geospatial Consortium Inc., June 2007, http://www.opengeospatial.org/standards/sld

[6] Predic, B., Stojanovic, D., Djordjevic-Kajan, S. (2006). "Developing Context Aware Support in Mobile GIS Framework,"9th AGILE Conference on Geographic Information Science, Visegrád, Hungary.

[7] Rancic, D., Predic, B., Dimitrijevic, A. (2006). "Optimizations of raster map visualization in mobile GIS," Proceedings of the 10th WSEAS International Conference on COMPUTERS,   Vouliagmeni, Athens, Greece, July 13-15 (pp. 1191-1195) ISSN: 1790-5117, ISBN: 960-8457-47-5.