MSc. Computer Science for Communication Networks

Computing Project

Google Maps for Geo-localized Data

User Manual

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User Manual

0.1 Background

Google Maps for Geo-localized Data provides a simple web application to graphically visualize roads quality information. A mobile application captures the data and stores it in a XML file with a specific format. This file is treated and transformed into a KML file in order to be able to represented on Google Maps.

This document intends to guide the user on the execution of the application, and the developer on the generation of an appropriate KML file for the map deployment, in case of improvement or extension of the project.

0.2 Project Files

We proceed to present the file structure inside the project and describe each directory:

- **resources:** contains a directory with the icons that are used for pothole's representation on Google Maps, a KML sample file and the original XML file provided by the mobile application's developer.

- **documents:** contains the documentation of the application. It includes a directory jsDoc with the JavaScript documentation automatically generated using jsDoc tool.

- **script:** contains the shell script and the files necessary to generate the KML file.

- **app:** contains a HTML, JavaScript and CSS file that constitute the web application perse.

```
Geolocalized-Data
├─ resources
│   ├─ icons
│   ├─ output.kml
│   └─ sample-data.xml
├─ documents
│   ├─ jsDoc
│   ├─ report.pdf
│   ├─ specifications.pdf
│   └─ userManual.pdf
├─ script
│   ├─ compute-intensity.xqy
│   ├─ create-kml-file.sh
│   ├─ example.kml
│   ├─ placemark-template.xsl
│   ├─ readme.txt
│   └─ roads-data.xml
├─ app
│   ├─ geolocalized-data.html
│   ├─ maps-api.js
│   └─ style.css
└─ tests
```

0.3   Tools

Taking into account a Linux development environment. In order to generate the KML file, installing the following tools is necessary:

- **BaseX:** XQuery Processor based on Java Language. Version 8.2.3 was used [1].

- **xsltproc:** XSLT processor. [2]

0.4   XML File

The basic structure that the XML file data must follow in order to be correctly processed is the following:

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<EVENT_RAW>
    <type>2</type>
    <ACCELERATION_LIST>
        <ACCELERATION>
            <X>-9.557653</X>
            <Y>0.16639702</Y>
            <Z>-4.675876</Z>
        </ACCELERATION>
        . . .
    </ACCELERATION_LIST>
    <POSITION_LIST>
        <POSITION>
            <latitude>48.61854836592925</latitude>
            <longitude>2.4339868004967764</longitude>
        </POSITION>
        . . .
    </POSITION_LIST>
</EVENT_RAW>
```

- **<EVENT_RAW>:** node that represents an event.

- **\<type\>:** element tag to indicate the event type. It must be 1 for pavement quality, and 2 for potholes.

- **\<ACCELERATION_LIST\>:** presents a list of acceleration nodes. Acceleration values are used to compute the intensity of the event according to the type.

- **\<ACCELERATION\>:** it is described by the magnitude on the 3 axis (X,Y,Z).

- **\<POSITION_LIST\>:** represent the series of locations of the event.

- **\<POSITION\>:** it is described by the coordinates (latitude and longitude).

Other nodes may be included but will not be considered.

0.5 Data Processing

The file *compute-intensity.xqy* is a XQuery Script that is used to compute the intensity of the events found on the XML input file. It uses BaseX (XQuery processor) to generate a new XML file.

The script filters the information according the type of event and adds an attribute corresponding to the acceleration computation.

Pavement Quality Calculation

The quality of the pavement is computed using the list of accelerations of the type-1 events. The magnitude of each acceleration on the list is calculated, then, the averages is considered as the quality of the event.

It is calculated using the following formula:

Given

```
<ACCELERATION_LIST>
    <ACCELERATION>
        <TIME> TIME1 </TIME>
        <X> X1 </X>
        <Y> Y1 </Y>
```

```
        <Z>  Z1  </Z>
    </ACCELERATION>
    <ACCELERATION>
        <TIME>  TIME  </TIME>
        <X>  X2  </X>
        <Y>  Y2  </Y>
        <Z>  Z2  </Z>
    </ACCELERATION>
    .
    .
    .
    <ACCELERATION>
        <TIME>  TIME  </TIME>
        <X>  Xi  </X>
        <Y>  Yi  </Y>
        <Z>  Zi  </Z>
    </ACCELERATION>
</ACCELERATION_LIST>
```

$$average = avg(\sqrt{X_i^2 + Y_i^2 + Z_i^2})$$

$$\forall i \in (1, Number of accelerations)$$

This value is inserted in the new XML file as following:

```
<PATH>
    <LOCATION>  POSITION  </LOCATION>
    <QUALITY>  average  </QUALITY>
</PATH>
```

Potholes Intensity Calculation

The intensity of the potholes is computed using the list of accelerations of the type-2 events. The magnitude of each acceleration is compared to 9.8. Then, the maximum value is considered has the intensity of the pothole.

It is calculated using the following formula:

Given

```
<ACCELERATION_LIST>
    <ACCELERATION>
        <TIME> TIME1 </TIME>
        <X> X1 </X>
        <Y> Y1 </Y>
        <Z> Z1 </Z>
    </ACCELERATION>
    <ACCELERATION>
        <TIME> TIME </TIME>
        <X> X2 </X>
        <Y> Y2 </Y>
        <Z> Z2 </Z>
    </ACCELERATION>
    .
    .
    .
    <ACCELERATION>
        <TIME> TIME </TIME>
        <X> Xi </X>
        <Y> Yi </Y>
        <Z> Zi </Z>
    </ACCELERATION>
</ACCELERATION_LIST>
```

$$maximum = max(|\sqrt{X_i^2 + Y_i^2 + Z_i^2} - 9.8|)$$

$$\forall i \in (1, Number of accelerations)$$

This value is inserted in the new XML file as following:

```
<POTHOLE>
    <LOCATION> POSITION </LOCATION>
    <INTENSITY> maximum </INTENSITY>
</POTHOLE>
```

0.6   XSL Template

The file **placemark-template.xsl** contains the template with the XSL transformations that are applied to the XML file generated by BaseX. It was created based on the KML documentation [5].

The XSL language allows to specify templates that are applied to given nodes on XML files. Two templates were created as following:

Pavement Quality Template

The template for the pavement quality (type 1 events) is defined on the node:

<**xsl:template** match="EVENT_RAW/PATHS/PATH">

It sets the style and the coordinates for each event on the XML file.

- The style is assigned depending on the quality attribute. Specifically, 5 styles were defined with the colors green, yellow, orange, red and black.

- The path's coordinates are specified on the node *<LineString>*.

Potholes Template

The template for the pothole's representation (type 2 events) is defined on the node:

<**xsl:template** match="EVENT_RAW/POTHOLES/POTHOLE">

It sets the style and the coordinates for each event on the XML file:

- The style is assigned depending on the intensity attribute. Specifically, 3 styles were defined. They assign a pinmark icon with the colors yellow, orange or red. The icons are publicly located on the Google site of the project [6]. The reference to the icon's URL is made on the style definition.

- The pimark's coordinates are specified on the node *<Point>*.

0.7   Generate the KML File

The following command line generates the KML file with the desired structure:

$ ./create-kml-file.sh *roads-data.xml compute-intensity.xqy*

placemark-template.xsl output.kml

create-kml-file.sh is a shellscript file that receives 4 arguments. Arguments must be given on that specific order and all of them are mandatory.

1. **roads-data.xml:** the original data containing the event to represent on Google Maps.

2. **compute-intensity.xqy:** XQuery file that compute the intensity of the events and includes them in the XML file. It does not modifies the original.

3. **placemark-template.xsl:** XLS file with template to transform the XML file on a KML file.

4. **output.kml:** name of the output KML file. It is important to remark that if there exists a file with this name on the current directory it will be overwritten.

0.8   Project Registration and API Key

In order to use the Google Maps services, it is necessary to register the application on the Google API Console and generate an API Key that must be included on the application. The Google Maps API Get API Key guide [3] clearly describes this process.

For the moment, the project is registered on one of the developer's Google account. And a generic, unrestricted API key was generated. The key is indicated on the file *Geolocalized-Data/app/geolocalized-data.html* as follows:

```
<script async defer
src="https://maps.googleapis.com/maps/api/js?v=3
&key=API_KEY&callback=initMap">
```

$</$**script**$>$

0.9   KML Public File

In order to add data to the map, the JavaScript API provides a KML layer. However, there are some restrictions:

- The maximum size of the KML file is 10 MB.

- The KML file must be hosted in a publicly accessible URL that does not require authentication to access.

- The maximum number of KML layer that is possible to generate is not fixed. It depends on the number of KML layer classes created and the length of the URLs used. Normally the maximum number is between 10 and 20 KML layers.

Some considerations:

- In the application, the KML file URL is specified in the variable **src** on the file **Geolocalized-Data/app/maps-api.js**

- For the moment the KML file for the application is located in:

  https://sites.google.com/site/kmlfilestsp/kml/test.kml

- More information about can be found on the Google Maps API KML and GeoRSS layers guide [4].

0.10   Aplication Execution

To execute the application it is only necessary to open the file **Geolocalized-Data/app/geolocalized-data.html** on the web browser. It is important to assure that the KML file is well referenced on the file **Geolocalized-Data/app/maps-api.js** as indicated in section 0.9

Bibliography

[1] BaseX Documentation. `http://docs.basex.org/wiki/Main_Page`.

[2] C. L. for GNOME. xsltproc. `http://xmlsoft.org/XSLT/xsltproc2.html`.

[3] Google. KML and GeoRSS Layers. `https://developers.google.com/maps/documentation/javascript/get-api-key`.

[4] Google. KML and GeoRSS Layers. `https://developers.google.com/maps/documentation/javascript/kmllayer#overview`.

[5] Google. KML Documentation. `https://developers.google.com/kml/documentation/`.

[6] O. Guillén and P. Reinoso. Google Maps for Geolocalized Data Google Site. `https://sites.google.com/site/kmlfilestsp/kml/`.