Implementation of a system of the mobile terminal position tracking using Google Maps

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The article describes how to implement part of the tasks of geolocation system and mobile data terminal registration related to servicing tasks by a central node. The entire system consists of two parts. The first part - mobile node, is situated on the side of the user, who uses the mobile data terminal equipped with GPS module and connected to the Internet, e.g. through GPRS system. The second part of the system (central node) is responsible for collecting essential data from the database, processing it, and displaying current position of the device along with additional information (time, speed) on a map from Google Maps resources. The article describes the rules of implementing Google Maps API - programming interface which allows using Google Maps on websites. Google Maps API allows for integrating a fully functional map on a website, including the features for handling events connected with the mobile data terminals geolocation process.

KEYWORDS: positioning system, tracking system, GPS, Google Maps, GPRS

1. Introduction

Lately, the increase in demand for the systems enabling remote registration of mobile device position has been noticed. Nowadays a lot of solutions enabling positioning and registration of the mobile vehicles for the transport companies are being implemented. This paper presents a real time tracking system that provides accurate geolocation of the tracked mobile device. The tracking systems described in [1 – 4] are designed to track and monitor automobiles status. However, when it comes to person geolocation by mobile phone position, there are not so many solutions. By implementing monitoring systems using GPS tracker it is possible to monitor e.g. employees doing field work. Using mobile device positioning systems or built – in positioning systems in company cars has not been clearly regulated. When using this monitoring system one needs to strictly follow regulations in civil code, constitution and labour laws. The law does not regulate how to inform employees about using geolocation. It is assumed that this information should be given clearly, so that everyone could be familiarized with it. The development of geolocation system and mobile data terminal registration required using web design methods with the use of HTML and PHP, creating scripts in JavaScript language and interacting website with database. Thanks to using Google Maps API it is possible to precisely and quickly put on markers indicating the position of mobile devices [5 – 7].

2. Description of the positioning system

The system consists of two parts. The first part, mobile node, is a user who uses the mobile data terminal equipped with GPS module and connected to the Internet, e.g. through mobile network. The mobile device sends data on the geographical position, time and speed to the database server. The second part of the system - central node created on the Client's computer is responsible for collecting essential data from the database and then processing it and displaying current position of the device along with additional information (time, speed) on a computer screen. In figure 1 the block diagram is presented showing the general scheme of the positioning system.

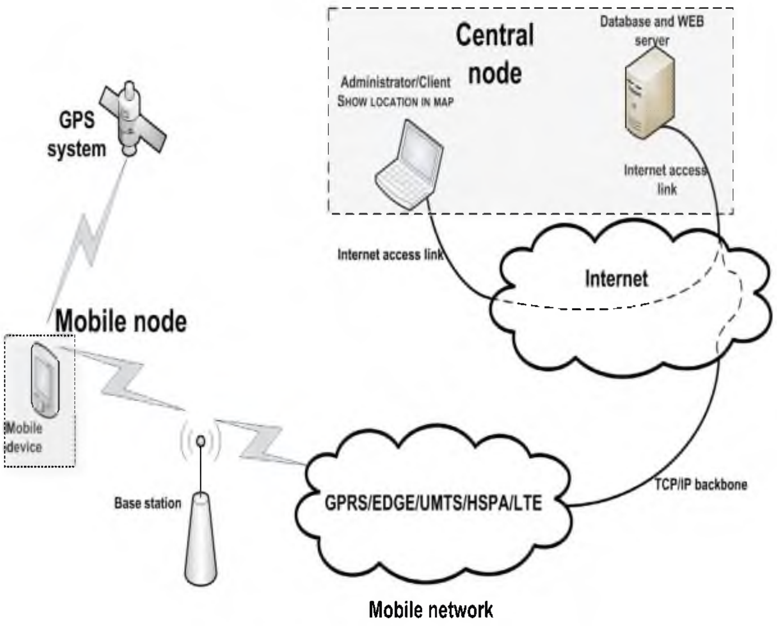


Fig. 1. The general scheme of the geolocation system

The tasks of the central system are collecting data from the mobile device and registering it in database as well as data processing. In this part of the system the application installed on the system administrator computer establishes the connection with the database server through Internet connection and then downloads data from server. The next step is processing downloaded data and displaying it. A main part of creating central positioning system is the website. The website is written in accordance to HTML language specification. JavaScript language is used to call Google Maps API functions. Database is created using MySQL system.

3. Implementation of Google Maps API

Google Maps API is a tool created by Google company to allow inserting any map to a website. Access to API is possible from JavaScript, ActionScript 3 (Google Maps API for Flash) or through an image (Google Static Maps API). The service is free of charge. Google Maps API allows for integrating on a website a fully functional map including the private data and functions for servicing events. Early implementations of Google Maps API did not provide some of the advanced features, available only on Google Maps website. The newest version supports almost all of the features, including geocoding, drawing, creating polylines and filling with color, getting directions with mid points and list of steps, Street View, etc.

The content of the map is generated automatically and the data is downloaded from MySQL database. Data is read by a browser from the file dane.php, the content of which is generated with the use of the script written in PHP. Marker tags are between markers <dane> and </dane>. Each marker is represented by a single tag <marker/>, each marker tag contains attributes: *lat*, *lon*, *ikona, predkosc, kategoria, wspolrzedna_id*, and *nazwa* corresponding to, respectively: latitude, longitude, Icon URL, speed, individual ID for each coordinate, and username.

When downloading is complete, the function with two arguments is called - *dane*, meaning the content of the file and *kodOdpowiedzi* (response code). If the response code is 200 (the correct completion of data download) the code responsible for parsing will be executed. If the *kodOdpowiedzi* is different, (e.g error 404), the appropriate error message will be displayed. The next step is data parsing. Parsing is the conversion of text chain into the instructions understandable for the given programming language. Data is parsed using the *GXml.parse()* function, presented below:

```
var xml = GXml.parse(data);
```

The variable *markery* is created and all objects with the *marker* tag are set to it.

```
var markery = xml.documentElement.getElementsByTagName("marker");
for(var i=0; i<markery.length; i++)
                        {
var lat = parseFloat(markery[i].getAttribute("lat"));
var lon = parseFloat(markery[i].getAttribute("lon"));
var ikona_url = markery[i].getAttribute("ikona");
var nazwa = markery[i].getAttribute("nazwa");
var czas = markery[i].getAttribute("czas");
var kategoria = markery[i].getAttribute("kategoria");
```

Then the function inserting marker on a map with necessary attributes is being called:

```
var marker = dodajMarker(kategoria,lat,lon,ikona_url,nazwa,czas);
                        odswiezSidebar();
```

The message informing of the number of loaded markers is shown below:

alert('Wczytano '+markery.length+' markerów').

Initiating the map is a simple action, the difficulties appear when the application is being expanded by new features. It would be useful to put indicators simplifying using and moving around the map.

The typical view of the map is presented in the figure 2. The following indicators were used. 1 – navigation control, class GLargeMapControl, 2 – map type control, class GMapTypeControl, 3 – information window, class GInfoWindow, 4 – position marker, class GMarker, 5 – Mini-map, class GOverviewMapControl. The next element used in the process of creating application is the map initiating function:

function mapaStart().

Next, the check of browser compatibility is being performed:

if(GBrowserIsCompatible

and creating the map object in the element of HTML code with the ID "mapka":

mapa = new GMap2(document.getElementById("mapka").

Centering the map in the place of given coordinates and given zoom is made by the function:

mapa.setCenter(newGLatLng(53.41935400090768,14.58160400390625),10).

Adding map controls is ensured by the commands:

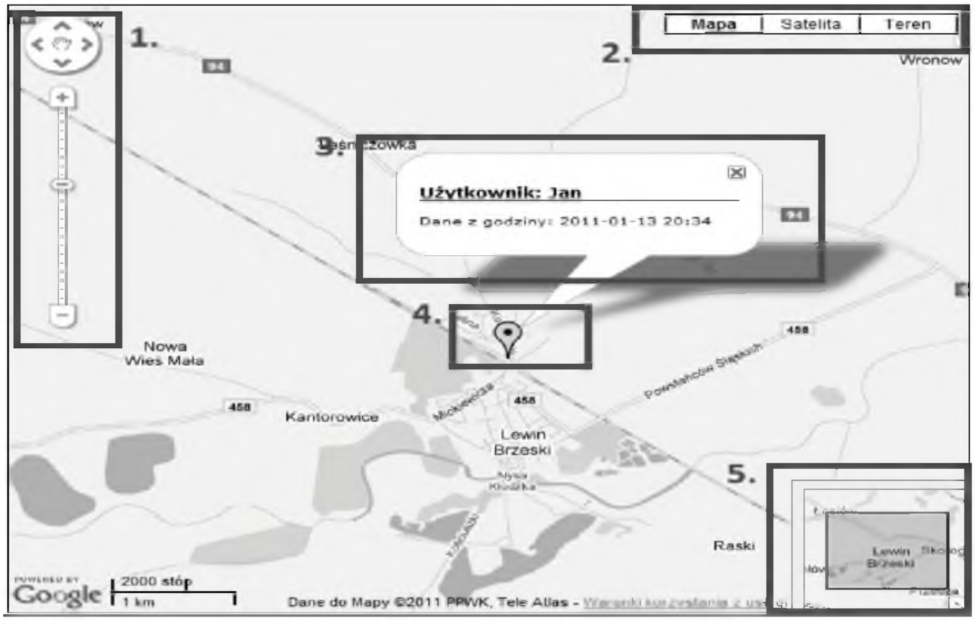
mapa.addControl(new GLargeMapControl());
mapa.addControl(new GMapTypeControl());
mapa.addControl(new GOverviewMapControl());
mapa.addControl(new GScaleControl());

Thanks to the use of the above functions, the basic map can be called and embedded in the application written in HTML. Additionally, a sidebar will be added to the map with the information on markers currently displayed on map. Markers not displayed on map will not be displayed in sidebar. The reference mark will be the name of the user tagged on map. The presented positioning system also has a very useful feature - displaying an approximate address of the chosen point using geocoding. Execution of the script connected to this process allows for displaying address in the information window next to the chosen map point.

Figure 3 presents the example screenshot documenting the process of registration of mobile data terminal movement.

Picture 4 presents the example screenshot documenting the process of registration of mobile data terminal movement for pedestrian with one second registration period.

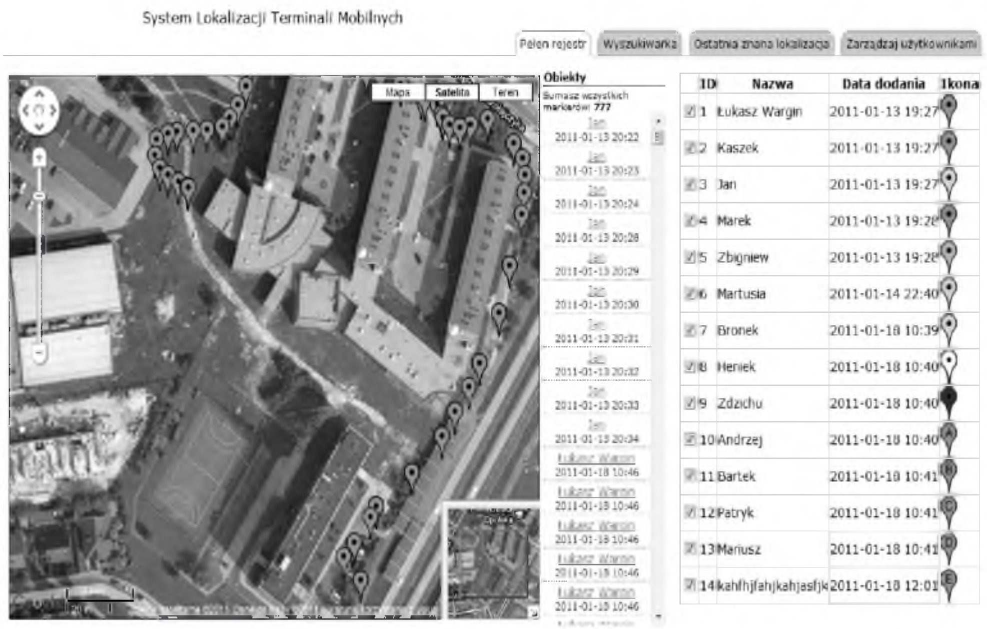
Figure 5 shows the live location of an automobile with five second registration period.



Użytkownik: Jan

Dane z godziny: 2011-01-13 20:34

Fig. 2. Screenshot of generated map



Obiekty

Sumasz wszystkich markerów: 777

Jan
2011-01-13 20:22
Jan
2011-01-13 20:23
Jan
2011-01-13 20:24
Jan
2011-01-13 20:28
Jan
2011-01-13 20:29
Jan
2011-01-13 20:30
Jan
2011-01-13 20:31
Jan
2011-01-13 20:32
Jan
2011-01-13 20:33
Jan
2011-01-13 20:34
Łukasz Warcin
2011-01-18 10:46
Łukasz Warcin
2011-01-18 10:46
Łukasz Warcin
2011-01-18 10:46
Łukasz Warcin
2011-01-18 10:46
Łukasz Warcin
2011-01-18 10:46

	ID	Nazwa	Data dodania	Ikona
✓	1	Łukasz Wargin	2011-01-13 19:27	●
✓	2	Kaszek	2011-01-13 19:27	●
✓	3	Jan	2011-01-13 19:27	●
✓	4	Marek	2011-01-13 19:28	●
✓	5	Zbigniew	2011-01-13 19:28	●
✓	6	Martusia	2011-01-14 22:40	●
✓	7	Bronek	2011-01-18 10:39	●
✓	8	Heniek	2011-01-18 10:40	●
✓	9	Zdzichu	2011-01-18 10:40	●
✓	10	Andrzej	2011-01-18 10:40	A
✓	11	Bartek	2011-01-18 10:41	B
✓	12	Patryk	2011-01-18 10:41	C
✓	13	Mariusz	2011-01-18 10:41	D
✓	14	kahfhjfahjkahjasfjk	2011-01-18 12:01	E

Fig. 3. Client/administrator interface view

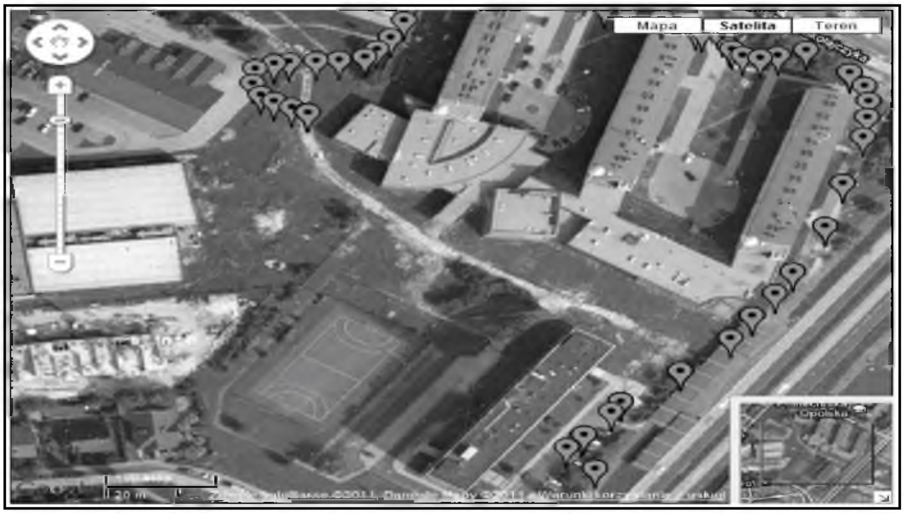


Fig. 4. Google Maps Snapshot showing the live location of the tracked pedestrian

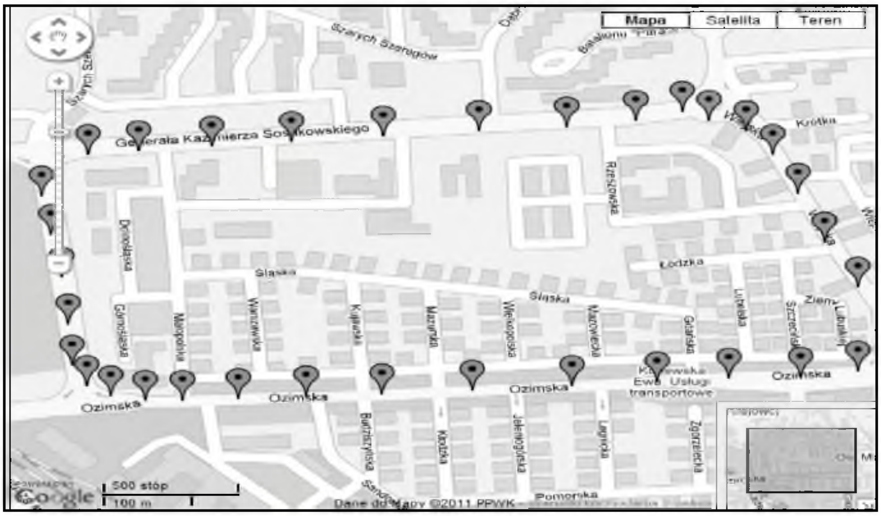


Fig.5. Google Maps Snapshot showing the live location of the tracked automobile

4. Summary

Thanks to the implementation of Google Maps API, mobile users positioning system easily allows for such features as: adding and deleting users, adding localisations based of collected data, the selection of user visibility, displaying only the last registered position of user, showing approximate address for the chosen point, switching to the point on map marked in the sidebar, searching for the location according to inputted address and displaying information on any point, such as:

- time of sending information,
- username,
- temporary speed of device movement,
- coordinates,
- approximate address.

The system project allows to implement further extensions with new features and possibilities allowing to create reports and statistics based on collected data. System does not need specialized database servers. During the tests, mobile system sent the position data with the minimum step of 0.5 s. Here we can expect the position error of 1 step which is acceptable for pedestrian objects. Pedestrian moves 0.5 m in 0.5 s. It shows that the inaccuracy is about 10 times smaller than the standard GPS error.

In current form system can have many uses. The main use can be controlling the position of the employees, children, disabled and elderly people. The functionality of the system in the present form is limited to putting the current position on map as well as presenting and processing basic information - time and speed of the device. After implementing necessary modifications, the system could be a basis for creating mobile telemetric system.

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