REAL TIME GPS TRACKING APPLICATION FOR WINDOWS ENVIRONMENT

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Abstract: *Real time GPS tracking application is a graphical application used to monitor a personal journey with a simple smart-phone. The software is a client-server application based on authentication. At least one first time authentication is required for the application to be able to work, because the application can also save the route offline, until the user wants to synchronize and is online.*

I. INTRODUCTION

The Global Positioning System (GPS) [1] is a space-based navigation system that provides location and time information, anywhere on the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil, and commercial users around the world. The United States government created the system, maintains it, and makes it freely accessible to anyone with a GPS receiver. Furthermore other states developed other positioning systems :

- China - Beidou
- European Union - Galileo
- Russia - Glonass

This real time gps tracking application is aimed at the general public which may want to track route of holydays, of bicycle trips with photos and videos and may want those memories to be stored in a safe place, where they can't be lost. The application can be used entirely offline or online, as the user desires, therefore the user can use the application independently of network coverage. If for some reason the application is running in online mode and some packets will not reach the destination, in this case the server, automatically will commute in offline mode.

The solution, from user side is composed from two main components:

- Windows Phone Application
- Web Site Application

II. WINDOWS PHONE APPLICATION

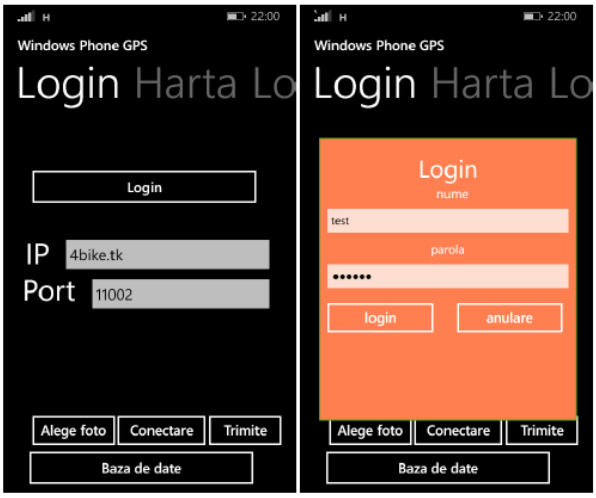

Figure 1. Login screen

The Windows Phone application [3] provides an easy access to all functionalities of the solution. It's intuitive interface is described through Xaml (Extensible Application Markup Language) an XML-based markup language developed by Microsoft. XAML is the language behind the visual presentation of an application that is developed in Microsoft Visual Studio, just as HTML is the language behind the visual presentation of a Web page.

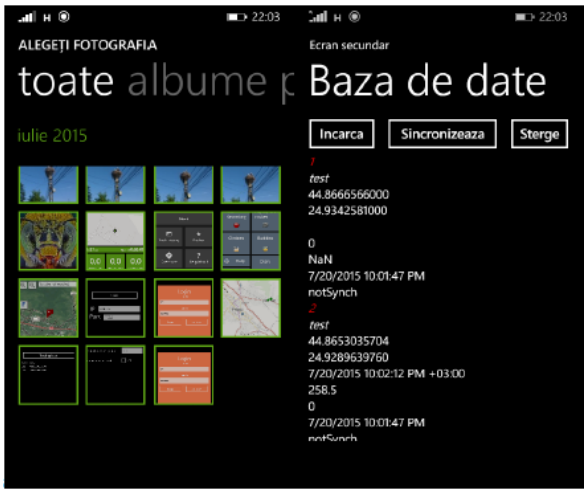

Fig. 2. Image loading screen

As mentioned earlier the application should provide availability and redundancy and it accomplishes these two important things by using TCP connection method [4] and a local database for storing lost POI or for offline mode.

TCP connection have been chosen in detriment of UDP connection because it leverage the programmer of keeping the count and status of sent packets.

Starting with Windows Phone OS 7.1, we can store relational data in a local database that resides in our app's local folder. Windows Phone apps use LINQ to SQL for all database operations; LINQ to SQL is used to define the database schema, select data, and save changes to the underlying database file residing in the local folder. The local database has the role of keeping the phone client and the server synchronized.

For recreating the route, the application has implemented the map form available for all windows platforms. The form make use of local installed maps (Here Maps) if these are available or the online maps in the other way.

Windows Phone application ensures a way of triggering an event of position change, and drawing and storing POI using this position changed event. But unfortunately the event is not accurate if greater distance between points is needed.

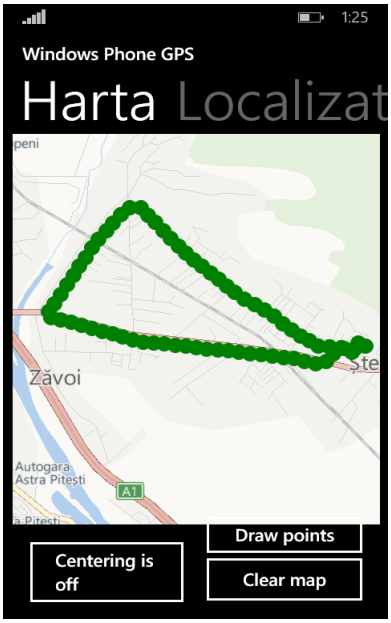

Fig. 3. A route obtained from points and Haversine [2] formula had to be used.

The Haversine formula is an equation important in navigation, giving great-circle distances between two points on a sphere from their longitudes and latitudes. For any two points on a sphere, the Haversine of the central angle between is given by equation (1)

$$\operatorname{hav}\left(\frac{d}{r}\right) = \operatorname{hav}(\varphi_2 - \varphi_1) + \cos(\varphi_1)\cos(\varphi_2)\operatorname{hav}(\lambda_2 - \lambda_1) \quad (1)$$

where:

- hav is the haversine function: $\operatorname{hav}(\theta) = \sin^2\left(\frac{\theta}{2}\right) = \frac{1-\cos(\theta)}{2}$
- d is the distance between the two points (along a great circle of the sphere, spherical distance)
- r is the radius of the sphere,
- φ1, φ2: latitude of point 1 and latitude of point 2, in radians
- λ1, λ2: longitude of point 1 and longitude of point 2, in radians

The final form of distance is the one given by the equation (2):

$$d = 2r\arcsin\left(\sqrt{\operatorname{hav}(\varphi_2 - \varphi_1) + \cos(\varphi_1)\cos(\varphi_2)\operatorname{hav}(\lambda_2 - \lambda_1)}\right)$$
$$= 2r\arcsin\left(\sqrt{\sin^2\left(\frac{\varphi_2 - \varphi_1}{2}\right) + \cos(\varphi_1)\cos(\varphi_2)\sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)}\right) \quad (2)$$

III. THE SERVER APPLICATION AND THE WEB SERVER

The server is a console application and it has the role of creating a link between the mobile clients and the database. It has been written using the C# language.

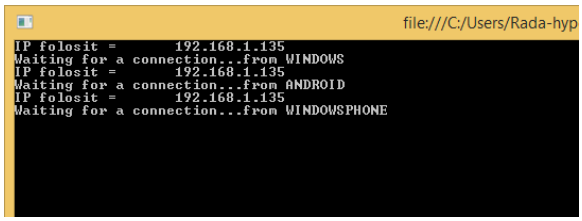

Fig. 4. The console of the server application

The application has to cope with multiple simultaneous connections from clients and in this case the application is heavily threaded (Fig. 5).

Not only the server creates threads from multiple clients, it can also accept connections from three different client's type: Windows Phone, Windows 7/8/10 and Android.

This leaves the possibility in the future for developing clients application for Windows 7/8/10 and Android.

The web server uses PHP and represents the second way a user can observe his routes and his photos (as seen in Fig. 6).

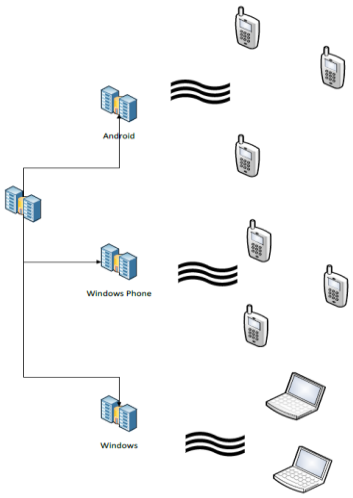

Fig. 5. Multiple simultaneous clients

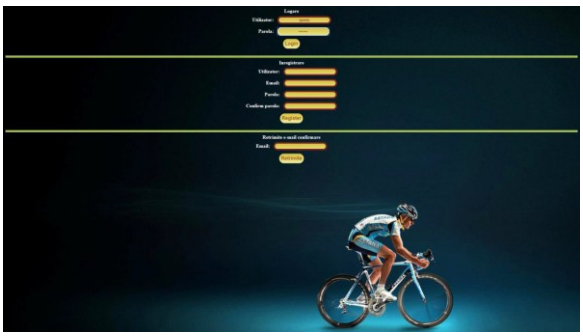

Fig. 6. Web server interface

To display the routes, Google Maps API for web application was chosen because it has many implemented tools as "Street View, Poi etc".

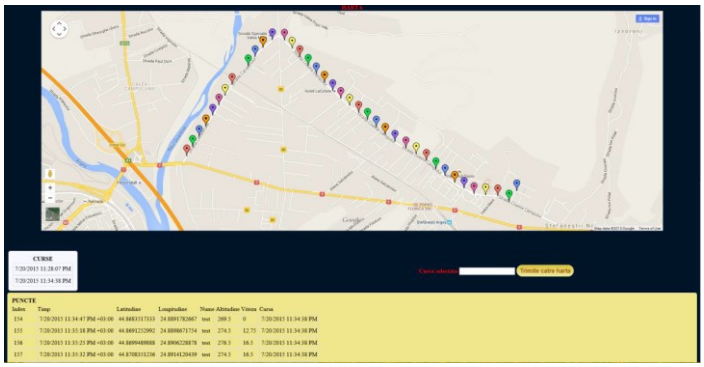

Fig. 7. A route displayed in the web page

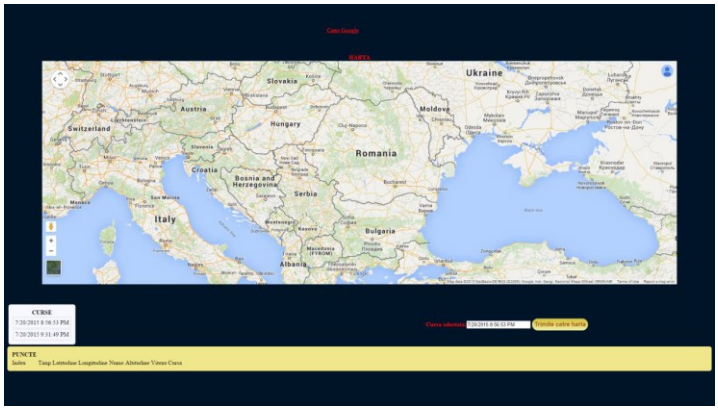

Fig. 8. A view from Google Map

IV. CONCLUSION

In this paper it was presented a complete solution for cyclists who want to preserve their routes and photos.

The application can be extended to other vehicles or other sports so the audience will grow.

REFERENCES

[1] Iustin Andronie, Mihai Andronie, Aplicatii civile cu GPS, www.agir.ro
[2]Wikipedia, Haversine formula, Available: https://en.wikipedia.org/wiki/Haversine_formula
[3] Wikipedia, Windows Phone 8, Available: https://en.wikipedia.org/wiki/Windows_Phone_8
[4] Ene A, Programare pentru web. Lucrari de laborator, Editura Universitatii din Pitesti, 2014