Model of an Open-source Web GIS Application for Observation in case of Wildland Fires

Stefan Stefanov

Institute of Information and Communication Technologies, Bulgarian Academy of Sciences, Bulgaria

Corresponding author: Stefan Stefanov, Email: stefans.stefanov303@gmail.com

The purpose of this study is to present a net-based GIS application that was created via open-source software and toolkits. It shows data taken in real time and recorded in a SQL database from a personal meteorological station in Kresna, Blagoevgrad, Republic of Bulgaria. The software visualizes open weather data from Open Weather Maps (OWS) and Copernicus Emergency Management Service to provide more detailed information on the present situation (CEMS). OWS provides customers with access to a wide range of weather information. CEMS offers rapid and reliable geospatial data to all players involved in natural disaster management. The article includes the concept as well as the software system implementation of the Web GIS application for surveillance in the case of wildland fires. The app was built using QGIS and other open-source applications and technologies.

Keywords: Qgis, open-source software, Copernicus Emergency Management Services, Lizmap, Open Weather Maps.

1   Introduction

Forest fires have impacted more countries than ever before, according to a report released by the European Commission (EC) in 2018. These fires have a huge impact on the planet's natural balance.

The data demonstrate that in some of the indicators for the occurrence of wildland fires in Bulgaria, the Mediterranean region's average values have been met, if not exceeded, many times [1].

One of the most essential properties of GIS is its capacity to publish and disseminate geographic information to huge groups of people through the Internet. In a variety of applications, sharing geographic data is an essential and productive method of working. Geospatial information consists of not only maps and locations of landmarks/structures, but also various characteristic data, socio-economic data, terrestrial photos, aerial photos, satellite photos, and other static/dynamic data. The Internet greatly improves accessibility, responsiveness and comprehension compared to traditional paper-based map distribution or symbol-based web-based systems. Users will have more control over what information or layers they view, as well as how they combine maps to meet their needs [2].

Every minute of the day, meteorological data is crucial to everyone. People have an urgent demand for meteorological data depending on their location, topography, and climate, as well as specific sectors of the country and regions of the world. Severe climate harm to lifestyles and assets is all too prevalent; however more advantageous choice aid structures that consist of the most up-to-date meteorological facts technology, inclusive of real-time meteorological facts observations and GIS, can significantly enhance notification, planning, and recovery [3]. The goal of this research is to assist people in making more accurate and timely decisions based on real-time weather data.

QGIS is a free GIS. The blueprint began in May 2002 and was officially launched as a SourceForge project in June of that year. QGIS is compatible with a wide range of operating systems, including Unix, Windows, and macOS. QGIS is written in C++ with the Qt toolkit. This suggests that QGIS is quick and has a pleasant, simple graphical user interface (GUI). QGIS has the appearance of being a user-friendly GIS with common functions and settings. The project's initial purpose was to create a GIS information viewer. QGIS has progressed to the point that it is being used for everyday GIS data viewing, information taking, advanced GIS analysis, and display in the form of refined maps, atlases, and reports. QGIS operates with a wide range of raster and vector data types, and additional format support may be added quickly and easily using the plugin construction [4]. The blunt assimilation of a WMS and WFS server into QGIS enables a smooth transition from desktop to web. The server merely copies the projects created in QGIS Desktop. QGIS Server recognizes layer styles and settings without requiring any additional adjustments [5].

The net GIS application is intended for the display of geospatial and real-time data. The application's development relies heavily on the GIS applications QGIS Desktop and QGIS Server. It analyses digital data collected by a meteorological station in the town of Kresna in the Bulgarian city of Blagoevgrad. Digital data saved in a database is used to generate layers, which are then transformed into geographical data (layers). The produced layers are transferred to QGIS Server, where they are read and shown by the application. The application can update in real time as new geospatial or digital data is added. The application is directly updated in real time using the open-source GIS program QGIS Desktop.

2 Model of an open-source Net GIS application for observation in case of wildland fires

The model for designing a Web GIS application for wildland fire observation includes: (see Fig.1)
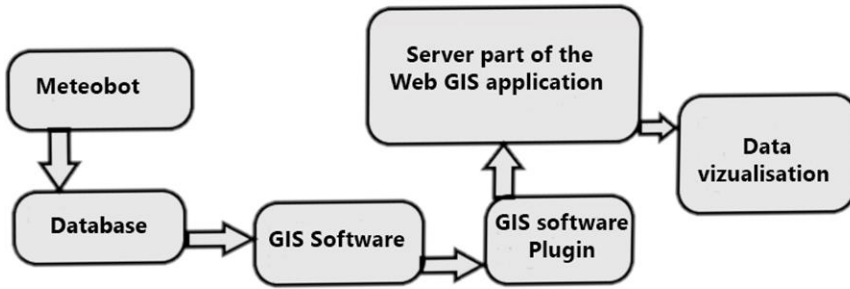
Fig. 1. Model of a freenet GIS application for wildland fire monitoring

The Model consists of:

- Meteorological stationit's miles located with inside the hobby vicinity. The meteorological station facts facts including air temperature and pressure, wind pace and direction, air humidity, soil temperature and humidity, and different variables in actual time. The facts amassed might be extraordinarily precious to people who are tracking the modern-day scenario of their vicinity of hobby;

- Database – A database is a way to store data from a weather station. Users can view the saved data for further verification.;

- GIS software – Provides solutions and toolkits (layers) to analyze, process, and transform digital data into geographic data. Data can be displayed as a map.;

- GIS software Plugin - Used to prepare programs, settings and fine-tuning;

- Server part - Various software components are used to keep, treat, and envision data.;

- Data visualization – the representation of geospatial data in a web browser.

The open source web GIS application model for forest fire monitoring is fully developed using open source licensed software and tools (see Fig.2).

The model's software realization:

- Meteobot is a private weather station that provides real-time data on temperature, barometric pressure, wind speed and direction, humidity, soil temperature and moisture, and other weather-related variables.;

- PostgreSQL - An open-supply, object-relational database device that makes use of and extends the SQL language and lots of different functions to reliably save and expand even the maximum complicated information requirements. PostgreSQL is an open supply database control device that

runs on all foremost running systems, is ACID compliant for the reason that 2001 and has effective additions inclusive of the famous PostGIS geodatabase extender. It isn't always unexpected that many humans and corporations have selected PostgreSQL as their open supply relational database; [6].

- QGIS is a GNU General Public License-licensed user-first-class Open-Source GIS. The Open-Source Geospatial Foundation has targeted QGIS as a genuine project (OSGeo). It allows an intensive kind of vector, raster, and database formats and functions and runs on Linux, Unix, Mac OSX, Windows, and Android [4].

- Lizmap QGIS plugin – Its intention is to apply QGIS Server to configure internet software dynamically created through Lizmap (PHP/JavaScript software). This plugin lets in you to installation one internet map according to QGIS project. Lizmap is internet software that must be established at the server [7].

- QGIS Server is an open-supply implementation of WMS, WFS, OGC API for Capabilities 1.0 (WFS3), and WCS, in addition to state-of-the-art cartographic capabilities for thematic mapping. QGIS Server is a C++-primarily based totally FastCGI/CGI (Common Gateway Interface) utility that works at the side of an internet server (e.g., Apache, Nginx). It helps Python plugins, permitting for speedy improvement and deployment of latest functionality [4].

- The Apache HTTP Server is an unfastened and open-supply internet server that makes use of the net to supply internet content. It`s referred to as Apache, and it speedy have become the maximum famous HTTP patron at the net after its development [8].

- NGINX is a high-overall performance HTTP server, opposite proxy, and IMAP/POP3 proxy server this is unfastened and open-source. NGINX is famous for its notable overall performance, stability, sizeable characteristic set, ease of configuration, and coffee aid usage [9].

- Lizmap Web Client makes use of QGIS Server to dynamically produce an internet map app (php/html/css/js) (QGIS as OGC Data Server). It needs to be installation at the server [10].

- OpenLayers is a feature-rich, high-overall performance library for generating dynamic on-line maps. On any net page, it is able to show map tiles, vector data, and markers loaded from any source. OpenLayers changed into created to inspire the use of all forms of geographic data. It`s surely loose to use [11].
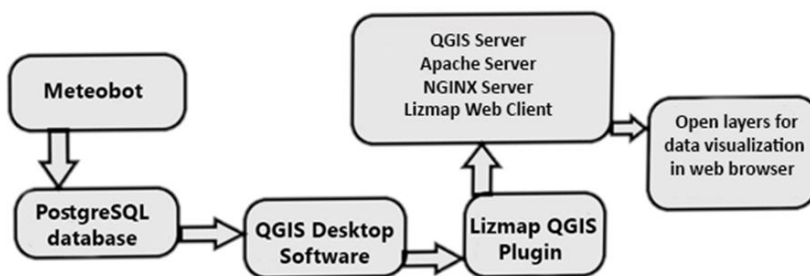

Fig. 2. The model of an open-source net GIS tool for wildland fire observation has been realized as software

The constructed internet GIS utility for wildland hearth place surveillance offers dynamic and actual-time statistics from a nearby database, OpenWeatherMap, and the Copernicus Emergency

Management Service. QGIS, an open supply software program, serves as the muse for the utility. The GIS software program could be used to control it. The utility offers customers the cap potential to feature sparkling geo-spatial statistics in actual time.

3 Net GIS application for observation in case of wildland fires

One of the key advantages of the Web GIS application is the ability to switch between specified layers and base map layers. The main screen of the Web GIS application for wildland fire observation.(see Fig.3).

Predefined layers contain real-time data from meteorological stations, OpenWeather Map, and the Copernicus Emergency Management Service.

They are open data map layers such as street maps, stamen maps, and so on. OpenStreet Map provides the base map layers.

- **OpenWeather Map:** It is an OpenWeather Ltd-owned web service that delivers global weather data through API, including current weather data, predictions, now casts, and historical weather data for any geographical region. For any place, the firm gives a minute-by-minute hyperlocal precipitation forecast. OpenWeatherMaps delivers data for weather risk management to industries such as energy, agriculture, transportation, construction, municipalities, travel, food processors, retail sales, and real estate on an individual agreement basis [12].

- **Copernicus Emergency Management Service**: It provides geospatial information to inform decision-making for all actors involved in the management of natural or man-made disasters. CEMS keeps a close eye on Europe in order to forecast, analyze, and offer data for resilience plans. Satellite, in situ (ground), and model data are used to develop its products. This displays disaster information on a size, timeframe, and viewpoint that only geographical data can provide. [13].

- **OpenStreet Map:** It is made possible by a global network of mappers who provide and maintain data on roads, trails, cafés, train stations, and other locations. OpenStreet Map is a non-profit group dedicated to creating and disseminating free geographic data all around the world [14].
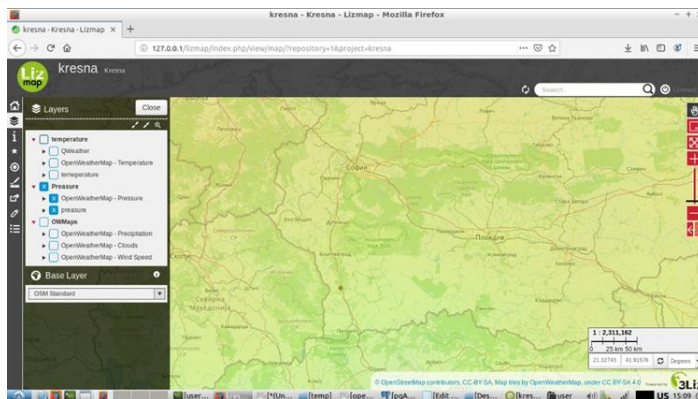
Fig. 3. The main screen of the Web GIS application for wildland fire observation

Users can adjust the opacity and use the full extend feature for the predetermined layer they've chosen. It is possible to group the predefined layers. They can be turned on or off.

Zoom in and zoom out buttons, a slider, zoom by rectangle, pan button, and beginning to full extend button are all available to users. They can calculate the size of a selected area by measuring a distance. Users can also use a geo location function based on the device's location, a Google search bar, and a link to the admin panel. The Draw feature is one of the most powerful tools provided by the Web GIS program to its users (see Fig.4). It allows users to add objects to the application in a variety of methods, such as box, point, line, shape, and so on. They can pick from a variety of hues. Users can edit, delete, hide, and export the newly formed layer to JSON, GPX, and KML files. KML and JSON files can be imported into the application. Users can utilize the sketch tool to mark the location of a fire and share it in real time with other app users.
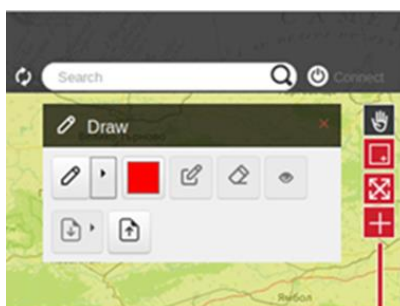
Fig. 4. Draw feature

4   Conclusion

The built net GIS application for wildland fire surveillance envisionlive-time data from a personal meteorological station in the Kresna area of Blagoevgrad, Bulgaria. The software provides users with actual time data from OpenWeather Maps and the Copernicus Emergency Management Service. It gives the opportunity to users for a better possibility for observation and speedier decision-making in the event of wildland fires in their region of interest. On the field, users can use the application to locate and label the hazard, as well as to notify others about it. The model provided in this research, as well as its software implementation was created using open-source software and software tools. The administration of the app is intuitive. Its users can enter fresh data straight into the QGIS and visualize it on the application with simple steps. The data that has been visualized can be used for a variety of analyses. The program does not require users to have specialized understanding of GIS and GIS applications.

Acknowledgment

References

[1] Duarte, O. (2018). Forest Fires in Europe, Middle East and North Africa. *JRS Technical report,* doi:10.2760/1128.

[2] Boulos, M.N.K. and Honda, K. (2006). Web GIS in practice IV: publishing your health maps and connecting to remote WMS sources using the Open Source UMN MapServer and DM Solutions MapLab. *International Journal of Health Geographics*, 5: 6.

[3] Samet, R. and Tural, S. (2010). Web-based real-time meteorological data analysis and mapping information system. *WSEAS Transactions on Information Science and Applications*, 7(9):1115-1125.

[4] *QGIS website*. https://docs.qgis.org/3.16/en/docs/user_manual/preamble/foreword.html, last accessed, 2021/10/20.

[5] *GISlounge website*. https://www.gislounge.com/introducing-the-quantum-gis-ecosystem/, last accessed 2021/10/20.

[6] *PostgreSQL website*. https://www.postgresql.org/, last accessed, 2021/10/20.

[7] *Github website*. https://github.com/3liz/lizmap-plugin, last accessed, 2021/10/20.

[8] *Apache server website*. https://httpd.apache.org/, last accessed, 2021/10/20.

[9] *NGINX Server website*. https://www.nginx.com/resources/wiki/, last accessed, 2021/10/20.

[10] *Lizmap website*. https://www.lizmap.com/en/, last accessed, 2021/10/20.

[11] *OpenLayers website*. https://openlayers.org/, last accessed, 2021/10/20.

[12] *OpenWeatherMap website*. https://openweathermap.org/, last accessed, 2021/10/20.

[13] *Copernicus Emergency Management Service website*. https://emergency.copernicus.eu/, last accessed, 2021/10/20.

[14] *OpenStreetMap website*. https://www.openstreetmap.org/, last accessed, 2021/10/20.