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CONTENTS

MODEL OF CROWDSORCE ENVIROMENTAL APPLICATION BASED ON MOBILE PHOTOS

Blagoj DELIPETREV[*], Aleksandra STOJANOVA [*], Mirjana KOCALEVA[*], Vladimir MANEVSKI[**], Ivica KOCEV[*]

[*]Faculty of computer science, "Goce Delcev" University, Stip, Republic of Macedonia
[**]Faculty of Natural and Technical Sciences "Goce Delcev" University, Stip, Republic of Macedonia
aleksandra.stojanova@ugd.edu.mk, mirjana.kocaleva@ugd.edu.mk, blagoj.delipetrev@ugd.edu.mk,
manevski81b@gmail.com, ico.kocev@gmail.com

Abstract - Smartphones have become easy affordable and powerful tool for sharing information among people. Using applications, cameras, internet connectivity, and GPS location ability, smartphones can be used for gathering information from different sources. Sources can even be ordinary people from different places, but obtained knowledge can be helpful even to scientists in process of finding most appropriate solution of some particular problems, where data from different places is crucial. In this paper we present our model of interactive, fun and easy to use application that uses geo tag photos taken from mobiles to identify the changes of environment and to increase the environmental awareness among people. We also give a brief review of existing applications that have something in common with our proposed model and present our idea for creating a "timeline".

Keywords: smartphones, GPS, mobile application, android, photo

I. INTRODUCTION

We all live in a dynamical world. While in the past the human being was able to travel a few kilometers per day, today the whole world can be circled in less than 24 hours, at the same time meaning one person is able to see and experience more than ever. However, the evolution does not stop here, thanks to the smartphones and the internet, today's people can be present anywhere in the world, can attend and follow events live directly from their homes. The industrial growth in today's society has "skyrocketed" and it is not slowing down.

Smartphones have revolutionized the Information and communication technology (ICT). In a matter of a decade of their existence, the smartphones have integrated many devices including camera, GPS receiver, watch, and the computer. Most of the smartphones today possess vast computational power providing opportunities to support powerful mobile application. Soon as we approach inevitable IoT (Internet of Things) revolution, smartphones can provide a platform for connecting smart devices and sensors that will be deployed everywhere.

Mobile app have unique features that can engage public in issues that affect them, making Citizen Science which is a form of research collaboration involving the public in scientific research projects to address real-world problems. Often the information that citizens produce has a GPS tag producing volunteered geographic information (VGI). Crowdsourced VGI is spatial information that is generated and donated by citizens, usually using spatially enabled mobile devices [1] [2].

Smartphone mobile applications are ideal and most usable tool for developing citizen science and crowdsourcing [3] [4].

Crowdsourced VGI mobile app can educate and engage the public in conservation issues. Recordings made using mobile apps with GPS devices can be made and used to plot the location, count, and spread and of pollution, animal and plant biodiversity, diseases, natural and made disasters. This data made by

citizens in the field can be used in searchable databases and map visualizations of these phenomena. This kind of spatial information donated voluntarily by citizens can be used as a low cost labor way to find solution of some global problems in different fields of science. Our aim is to create an app that is easy to use by ordinary people so it can be easily acceptable by them. Taking photos by mobile phones is the easiest and most widely used way to perceive memories. Therefore, we decided to use mobile photos as a crowd sourced information to monitor the change of the environment, because one picture is worth a thousand words.

All people are part of the planet and all of them are responsible for the changes that affect the nature and environment. Having that in mind, our model of application is quite simple. When a person or a user identifies something that is worth acknowledging (wheatear is a positive or negative) simply takes a picture from his smartphone and uploads it. Photos connected with their geo location are stored in a database, so any other user can see the photo can like or dislike it, leave a comment or can go and visit that place from the picture.

This paper reviews other existing mobile android applications, which have similar elements with our model. We present a brief review of their characteristics and way of their working. Then, we explain our proposed model and explain its main characteristics, features and technologies needed.

II. REVIEW OF EXISTING APPLICATIONS

There are other existing mobile android applications, which have similar elements with our model. We will review some of them like: C: geo, PhotoMap, PhotoTracker, Geology Sample Collector, Aumentaty Geo, Jeco Guides, My Augmented reality, Blue green map of Serbia, What is around?, GPS Photo Viewer with GoogleMap and GPS Photo Viewer with Here map.

C: geo [5] is open source, full-featured client for geocaching.com that supports other geocaching platforms (like Opencaching). This application uses Google Maps or OpenStreetMaps and user can view caches on a Live Map. The users can search for caches by various criteria, can navigate using maps or compass and can store cache information on his device for later offline access. User on every location can easily see and find all nearby places on the map. This app has more than 1.000.000 users and the c:geo interface is shown in Figure 1.
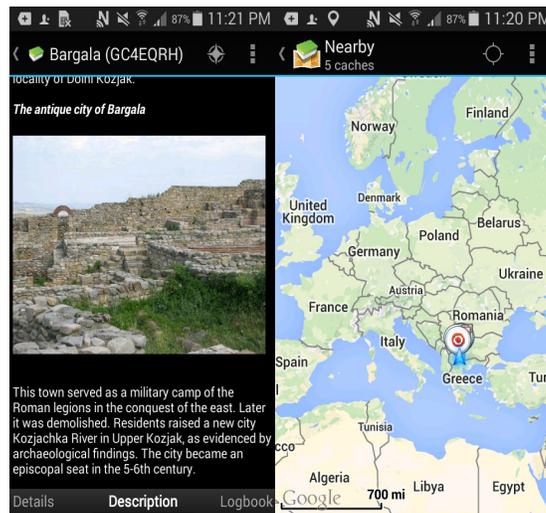
Figure 1. Screenshots from the interface of C: geo app

PhotoMap [6] has 100.000-500.000 downloads. The purpose of this app is to relieve a user's vacation by virtually travelling from one location to another. In this app, photos taken from the camera, when camera's GPS is enabled, are automatically added to the locations on the map. There is also a chance to take a photo in the app itself, because it has integrated camera starter. Photos from one user are not available to others, but there is an option to share these photos on the social networks. This app interface is shown in Figure 2.

Figure 2. Screenshot from the interface of PhotoMap app

My GPS photo maps [7] is very similar to Photomap and uses photos taken from camera with GPS tag. This app only shows the user's photos with their GPS position on Google maps. This application is personal to the user and user cannot see pictures from other users but only photos taken from his camera. This application can be used to re-live user's travels. When more pictures are taken from the same place, they are grouped together on the same mark. This application has 5.000-10.000 installs.

PhotoTracker [8] is an app suitable for people interested in travelling and photography. This application shows users' photos on a map with their geo-tag and presents photos from photo-sites such as Flickr and Panaramio. Photo Tracker is not only a photo-viewer, but also allows geo-tagging photos taken from an ordinary camera without a GPS navigator. It is also gives locations of many interesting places on the map taken from Wikimapia. User using this app can explore the most photographed places in the world, also places in his neighborhood and can filter displayed photos. This app has 10.000-50.000 users. This app interface is shown in Figure 3.
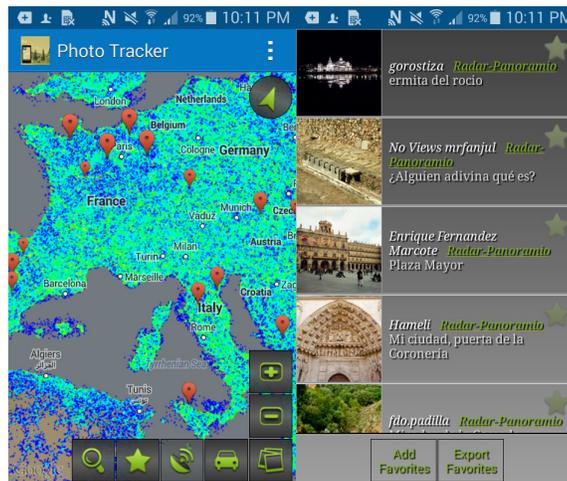

Figure 3. Screenshots from the interface of PhotoTracker app.

The Geology Sample Collector [9] is an app specially designed for geologists that allows the user to track and save his collected images, video or audio recordings. For all collected media this application saves time and place of taking, using GPS, and the user is allowed to write some other details too. This app is synchronized to a website where user can edit and/or share his work with others through social networks, e-mail, etc. Once the collecting is uploaded to the website, the user can edit the data, create reports and/or maps, and download the data or reports to spreadsheets or other documents. Once the collecting is completed, the user can automatically create a power-point or video of the sampling. Other users of the app can view only shared collections and not all collections and uploaded media from this application. Geology Sample Collector has 10.000-50.000 installs. In Figure 4 are given screenshots from this application's interface.
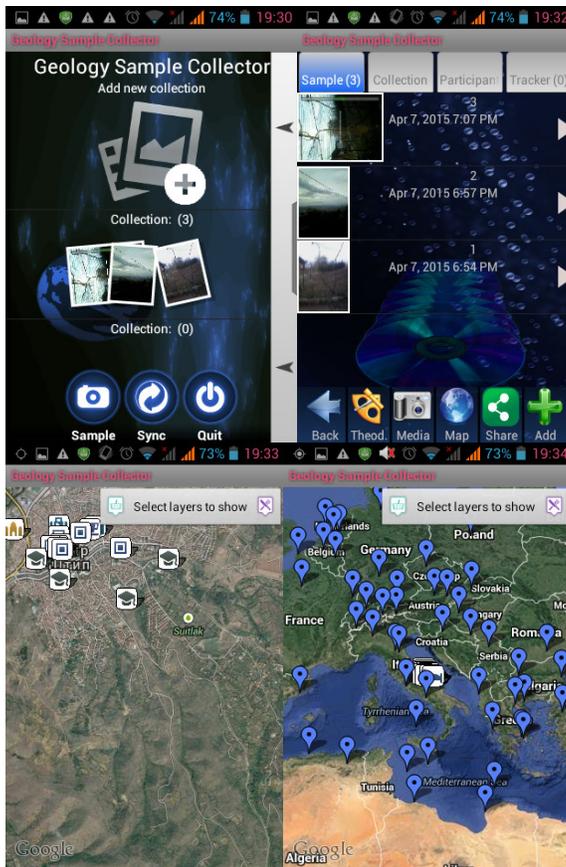
Figure 4. Screenshots from the interface of Geology Sample Collector app

Aumentaty Geo [10] is app that points most popular created routes and helps users discover new places. Geo Aumentaty combines augmented reality and geo-locations and is used to show real-time information of the points of interest created by users. The geographic augmented reality uses the physical coordinates and compass of the user's device to display overlays virtual items and place them in real positions. Users can also comment, upload contents, linking points of interest and create their own routes. Geo Aumentaty consists of two parts, a content management system and mobile application. The mobile application allows users to find the routes that have been created by other users, get the points of interest of each route, show the associated information, locate it on a map and provide direction. In addition, users can rate every route and every point of interest. Aumentaty Geo allows users looking through the camera of their mobile devices to explore the environment around them is searching for selected locations. This application has near 1.000 users. The features of mobile Aumentaty Geo mobile application and content management system are shown in Figures 5 and 6.

Figure 5. Features of Aumentaty Geo mobile application

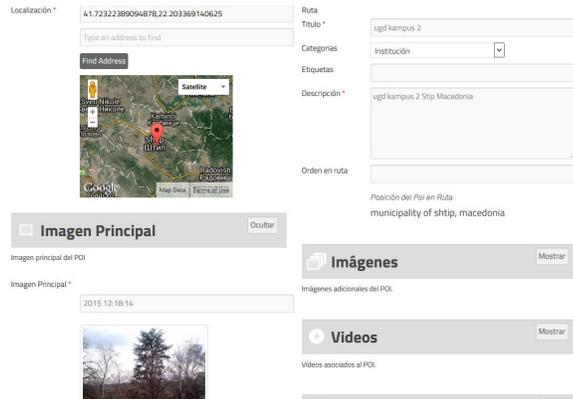In Figure 6 is given screenshot from Aumentaty Geo content management system.

Figure 6. Screenshot from Aumentaty Geo content management system.

Jeco Guides [11] app is actually a kind of library of interactive and multimedia guides. This guide can be edited by local authors. Jeco Guides allow the user to discover and explore interesting places around him. There is List, Map and Augmented Reality view. Local authors can edit guides through the Authoring Tool. Augmented reality gives information about near places on user's camera display. There is also the possibility to download the guides and they can be accessed without internet access. This app can locate the user's position and show nearby places saved with the map. This app is easy to use and drive the user in an interactive and multimedia experience. There is also cloud app where users can saves guides and free up mobile memory. This mobile app has nearly 5.000 downloads. The mobile app is shown in Figure 7 and the cloud app in Figure 8.

Figure 7 Screenshots from Jeco Guides mobile application's interface
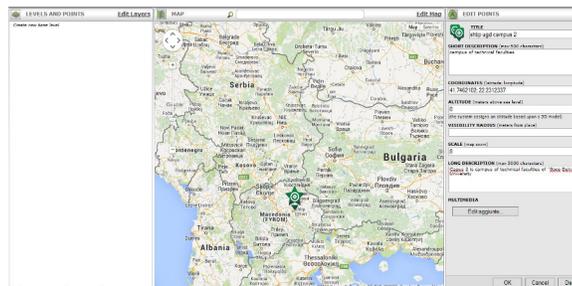
Figure 8 Screenshot from Jeco Guides cloud application's interface

My Augmented reality [12] app is used to store locations that user has been to, or intends to go and wants to find those places later. The user takes pictures from places he stores and then can use Map view or Augmented Reality (via the phone's camera) to find his saved places. It uses Google maps and only saved locations are pinned on the map. This app has more than 10.000 users. Some screenshots of this app are given in Figure 9.

Figure 9. Screenshots from My Augmented reality app.

Blue green map of Serbia [13] is specially named for travelers to Serbia. User can discover all interesting places and can get relevant information. Also in this app there is a poss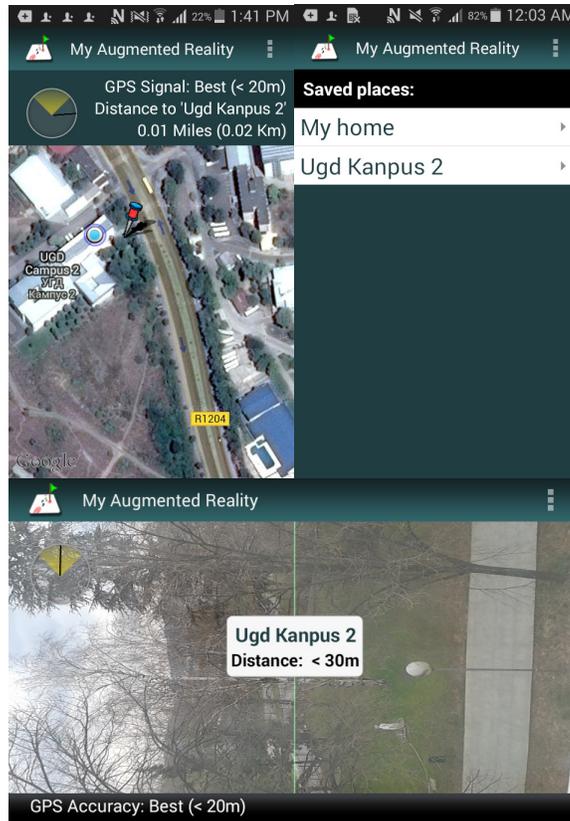ibility to use augmented reality to find locations of user's interest. There is no chance for user to import photos. This application has just 50 users.

What is around? [14] is an app that combines geo tagging with augmented reality and allows users to explore and discover places around their current location and other places on the map. User can search and explore chosen area by choosing source like: Yellow Pages, Open Table bars and restaurants, Flickr, Instagram and Panoramio pictures, Twitter, Last.fm events, Foursquare and Wikipedia places, YouTube videos. There is no option for user to take pictures and upload any kind of media, but he can search for already upload media thought mentioned sources. If a user is searching places around his current location than he/she can use augmented reality option to find places from where some content is uploaded and shared. This application has around 500 installs. Some screenshots from the application are given in Figure 10.
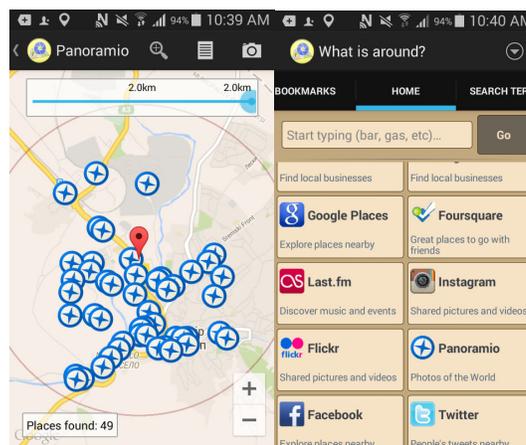

Figure 10. Screenshots from What is around? Application

GPS Photo Viewer with GoogleMap and GPS Photo Viewer with Here map [15] [16]. These applications are working on the same way but they are using different maps. The first one uses GoogleMap and the second Here map. They work better when camera's GPS is enabled and can make difference between photos which have GPS info and those which don't. Applications connect the photos with their location and show them on GoogleMap or Here map.
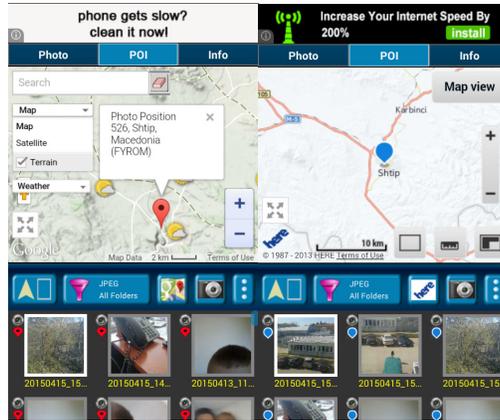

Figure 11. Screenshots from GPS Photo Viewer with GoogleMap and GPS Photo Viewer with Here map

The aim of these applications is users to share photos with friends and if they like the place then they can go there. Both apps are from same developer and the application that uses Googlemaps has 10.000-50.000 installations and the other one has 1.000 to 5.000 installations. Not all photos placed on the maps can be viewed from all users of the applications; users just can share their photos and locations on social networks or e-mail. There is not user account for using these applications. Screenshots of this app are given in Figure 11.

III.   MODEL APPLICATION

Our aim is to build application which is easy to use, user friendly and use multiple technologies and platforms that are already proven and recognized by users. The app starts when a person or a user identifies something that is worth acknowledging (wheatear is a positive or negative) simply takes a picture from his smartphone and uploads it. Every upload and location are stored in a database, thus every other user nearby can go to the same location and take recent image on top of the previous one creating a "timeline". Through the course of time with the users' photos for each location can be collected enough data to identify the changes of a particular environment. Therefore, the main objective of the application is to increase the environmental awareness among the ordinary people.

The main concept is to keep things as simple as possible and connect users' data with an adequate GEOSS maps (and data). In addition, our application will provide a qualitative and quantitative information accessible for scientists at any given time. The "timeline" is a novel feature, which is not implemented in any environmental mobile/web application.

The application will be developed using available open sources software and technologies and deployed on the Cloud (Amazon Web Services, Google cloud platform, Xen cloud platform). The model is consisted of a mobile and cloud application.

A.   Mobile Application

Mobile app is planned to have Android and afterwards an iOS version. With the start of the mobile app, it will activate the mobile phone GPS. The users can take a photo (Instagram style) and add it to his profile. The starting interface will present a map with locations gained from the database with a determined radius from the smartphone position, shown on the left in Figure 12. When clicking on a location it will show number of likes/dislikes (Facebook style) and additional button "info" that will contain comments (Twitter style), GEOSS maps and essay.

Figure 12. Prototype design of the our mobile interface

The user will have options to take a photo from the current location or to go to a location that has a timeline. If the user selects the first option, he will take the photo, put like/dislike, make comment and choose a category of based on predefined GEOSS maps. All these features are optional except the like/dislike. This first picture can be a foundation for other users to make a timeline.
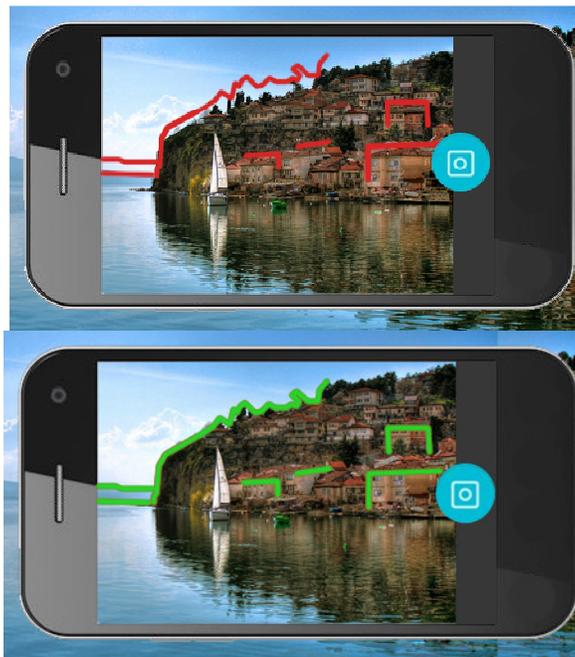

Figure 13. Prototype design of the ecoFrame contour mode mobile interface

If the user wants his photo to be part of a timeline, he/she will be needed to go to the location and get to the same position. Using GPS mobile signal and selecting the previous photos/timeline, the user will get a contour photo interface that will show contours of the previous photos/timeline, show in Figure 13. If he decides to make a photo, his photo and attributes will be part of the timeline. The timeline will contain all contributing users' comments aggregated.

The user profile will contain information about a specific user, pictures, comments and others. The prototype user profile interfaces are shown in Figure 14.

Figure 14. Prototype design of the photo mode mobile interface

From the mobile app, the user can preview other users' photos/timelines and put additional like/dislike or comment on the photo only if he is on the same position where the photo was taken (in a predefined radius). This option will prevent users commenting or like/dislike photos that they have not seen in reality.

B. Cloud Application

The users can register on the cloud application as shown in Figure 14. The registration page is the same for registered or new users and contains two forms (sign in and sign up). Each user will have its own username and password, and from the cloud application he/she will be able to view his own photos. Users will be able to see its history, visited places, photos, comments etc.
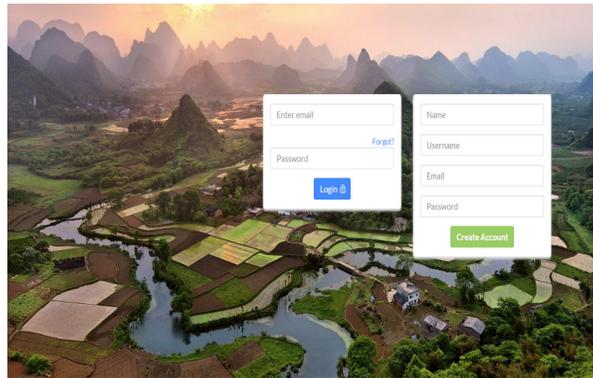

Figure 14. Cloud application registration page

The cloud application interface is composed from OpenStreetMap, menu bar and search bar. Our cloud application presents the map of Europe containing multiple locations sorted by the popularity of the event/photo (likes, dislikes, tweets). Each different zoom (layer) collects new multiple most popular events for the desired scope. We plan in the further development of the application to have several filters to select different points on the map depending on their properties (attributes), similar to Booking.com when a hotel is selected based on price, location, reviewers etc. When one event is pressed a pop up is open that presents the essential information about the location, shown in Figure 15.
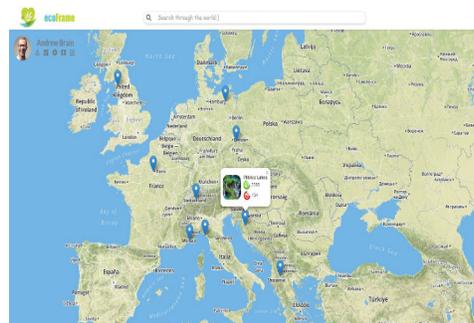

Figure 15. Cloud part application interface

The users can select from a defined GEOSS maps that are categorized in several themes: Agriculture, Biodiversity, Climate, Disasters, Ecosystems, Energy, Health, Water and Weather. The Figure 16 contains the layer of forest maps in Europe as a background. For example, the user can make a photo of a forest and connect it to the background forest map of Europe from GEOSS [22], presented in the Figure 16.
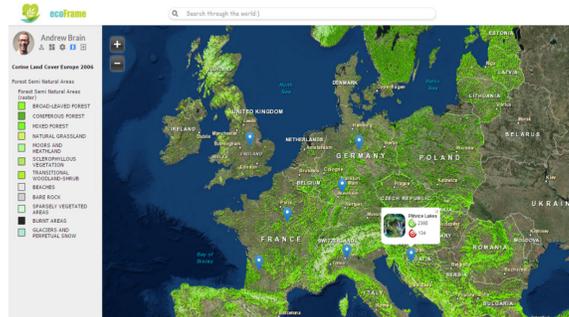

Figure 16. GEOSS integration with the forest map of Europe in our model of application

C. Architecture and technologies

The application workflow, shown in Figure 17, begins with starting the application on the smart phone. The smartphone gets the position from the GPS coordinates, which are sent to the server that returns the "hotspots" nearby locations. The mobile app asynchronously connected with the cloud app. The cloud application can be accessed from a web browser and has the functionalities described before.
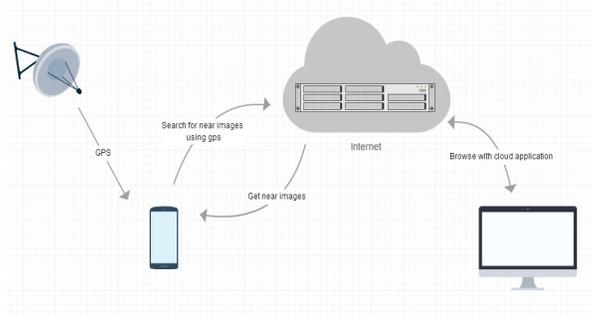

Figure 17. Application workflow

The application will be able to store temporary data about near location's hotspots in SQLite database. In addition, we plan to use OpenCV, as a technology for image processing. After the photo is taken it will be automatically uploaded to the server. The mobile technologies used are shown in Figure 18.

Figure 18. Technology required for developing mobile application

The cloud application technology and software will be based on Amazon Web Services (AWS), Google Cloud Platform and Xen cloud server. The Geomatics laboratory at the University Goce Delcev

has its own test server based on the Xen cloud platform that can support this application. We have experience in developing specialized cloud/web GIS application based on open source software similar to this application [17] [18] [19] [20].
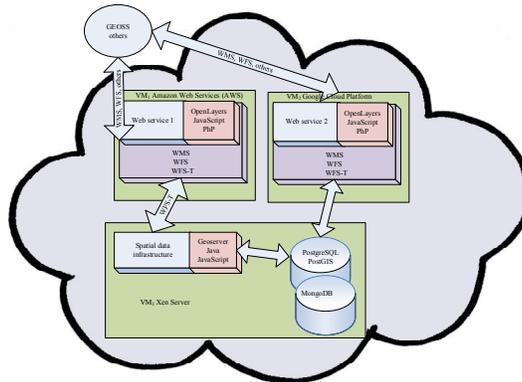

Figure 19. Preliminary our model's cloud application architecture

The front end of the cloud application will be coded in JavaScript, Node.js, Ajax and PHP. The OpenLayers library will be used to support geospatial web operations based on OGC - Open Geospatial Consortium standards (WMS, WFS, WFS-T). GeoServer is planned as a middle tier and the database can be built on PostgreSQL and PostGIS. MongoDB will be used as a database for improved scalability. All of the previous mentioned software components are open sources, interoperable and scalable. The preliminary architecture of our cloud application is shown in Figure 19. The proposed architectures and software are interoperable and portable to any platform. The MonboDB is successfully used as noSQL solution in geospatial application [21].

IV. CONCLUSION

This paper describes a model of the prototype crowdsourcing mobile and web/cloud application, and its main concepts, mobile and cloud application, key features and benefits, and preliminary architecture and technologies. Also, is given a review from all existing similar applications.

The new feature that can attract attention and users is the timeline. Our model is combining several concepts that are already proven including likes/dislikes (Facebook), comments (Twitter) and pictures (Instagram). All these concepts are integrated together with the GEOSS maps and open data sources.

Another important advantage of the proposed model application is that is based on open sources software and technologies. The cloud application software and technologies are PostgreSQL, PostGIS and MongoDB for a database tier, GeoServer as a middle tier and geospatial data management, and OpenLayer library that supports the (OGC) standards (WMS, WFS, etc.) and custom code in PHP, JavaScript and AJAX. This architecture is scalable, interoperable and deployable on different platforms. This paper presents the main idea, design and a preliminary plan for the application development.

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