

Smart Adventure: Context-aware Crowd-Sourcing Mobile Application

Marija Alagjozovska¹, Zlatko Andonovski² and Vladimir Trajkovikj¹

¹Faculty of Computer Science and Engineering, Skopje, Macedonia
marija_ala@hotmail.com trvlado@finki.ukim.mk

²CreationPal, Skopje, Macedonia
Zaltko.andonovski@sportypal.com

Abstract. The biggest challenge in mobile computing is introducing new type of application that has the ability of adapting and exploiting the changing environment.

In this paper, a smart phone context-aware crowd-sourcing application SMART ADVENTURE will be presented, offering users context aware services. The main application contexts are location, time and phone orientation. According to users' location, previous usage and current date, application generates information about activities and possible threats. Congruent with the phone orientation, application displays different screen.

Motivation for developing this kind of an application lies in constant trend for improving human health by doing different kind of open-air activities. At the same time, the proposed solution represents a high level tourist guide.

The main contribution of our work is providing proof of concept of how crowd-sourcing can influence few different domains (health, ecology, human culture).

The proposed solution is service oriented, implemented in android environment.

Keywords. Crowd-sourcing, collaboration, mobile applications, geo mapping

1 Introduction

The evolution of mobile devices and their huge potential of mobile processing and services made mobile computing a field with many challenges. The biggest challenge of all is developing a new type of software that will exploit the changing environment [2]. This kind of software can be treated as an entity that adapts to its location, time, available hosts, accessible devices and other environmental states called contexts. But what is the meaning of context and how can be defined? The most accurate definition about what the word "context" really means seems to be the following: "any information that can be used to characterize the situation of the entities (person, place or object) that are considered relevant to the interaction between the user and the application, including the application and the user itself"[1]. From this definition it can be said that context is the set of environmental states and settings that either determines an application's behaviour or in which an application event occurs and is interesting to the user [3]. In other words, context is a piece of information that can be used to

characterize the situation of a participant in an interaction [2]. Context helps to enrich the communication in human-computer interaction and makes it possible to produce more useful computational services. The main three aspects that context has are: where are you, who are you with and resources nearby. But context is more than user's location; it encompasses lighting, noise level network connectivity, communication costs, communication bandwidth, and even the social situation. Software with this kind of features is characterized as context aware software. Thus, software is context aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task [1].

Many of the applications use the context for providing useful data. Modelling this data, than use them in the context aware application is not a simple thing. Good modelling means choosing the right context model. Choosing it right, may depend of the architecture of the system and compatibility with the context model itself. There are many ways for modeling context information, but the following approaches are most accurate and most used by the developers.

- Key - value model
- Markup scheme models
- Graphical models
- Object oriented models
- Ontology based models
- Tree - like graph

For simplifying the process of developing a context aware application an abstract framework is needed. The framework will provide the client with the needed data and also will permit registration of new distributed heterogeneous data sources. There are several context frameworks available: SOCAM (Service-Oriented Context-Aware Middleware), CASS (Context-Awareness Sub-Structure), Hydrogen, WildCAT etc [4].

In this study, context aware crowd-sourcing application for smart phones is presented. The main application contexts are location [5], time and phone orientation. Location aware service represents one of the most crucial needs for users that own some kind of a smart phone [6] [7]. Its importance lies in necessity of finding location based information when it influence the overall behaviour of the system and might increase its performance. Location aware services can be used for finding travel information, shopping, entertainment, event information and other types of filtering [12]. In our application, location aware service filters a list of possible activities and threats in accordance with user position on the map. Positioning is done by GPS receiver integrated in the phone [8]. GPS (Global positioning system) represent a spaced-based satellite navigational system that provides time and location information, synchronous or asynchronous [9]. Location information based on GPS is from crucial meaning because it covers the user security issue (rescued if he is in danger) and it also renders events and places of interest (user can find the event or the place he is interested in) [10]. For more accurate data, time filter is implemented. The time filter does another filtering, optimizing the list on activities and threats that are specific for that period of time. The user's enjoyment level adjustment is done by implementing a phone orientation context. Depending on how phone is being held, different screens are displayed. If the phone is being held horizontal a map is generated, if it is being held vertical,

augmented reality is displayed, giving users enhanced information about their surroundings. Augmented reality (AR) represents a technology in which a user's view of the real world is enhanced or augmented with additional information generated by a computer. It combines real and virtual object in real environment, registers (aligns) real and virtual objects with each other; and runs interactively, in three dimensions, and in real time [20] [21]. Displaying different screen is done by the acceleration sensors (i.e., accelerometers) [24]. The accelerometer represents a device that measures the acceleration of the device on the x (lateral), y (longitudinal), and z (vertical) axes. Accelerometer is used in engineering, biology, industry, building and structural monitoring, medical applications, navigation, transport, vulcanology, consumer electronics (motion input, orientation sensing, image stabilization, device integrity, and gravimetry). In our application, the accelerometer has another function despite displaying the proper screen, it also detects fall. Fall detection is done by gathering and analyzing accelerometer data with several threshold based algorithms and position data to determine a fall. Activity of changing a phone orientation differs from activity of falling in a matter of time. Time of falling is longer than time of changing the phone orientation. When some falls it starts with free falling, causing acceleration's amplitude to drop significantly below the 1G threshold, representing the actual time of falling. For fall to be complete it must stop. This causes a spike in the graph. Then the amplitude is crossing an upper threshold which has the minimum value of around 3G, suggesting the fall. Serious injuries are represented as flat line in the graph [25] [22].

The proposed application can basically serve as a tourist guide [11], but it differs from other similar applications in terms of how it incorporates collaboration [13]. In our approach, users enter their one point of interest such as activity, animal or plant. Points of interest (POI) are entered as multimedia data by using the smart phone built in camera. User takes picture of his point of interest which is geo tagged (it has geographical coordinates), then enters its description in the application and makes it available to other users. This way, they are building a distributed collection of shareable items, making the application a crowd-sourcing system (CS). CS system enlists a crowd of users to explicitly collaborate to build a long-lasting artifact that is beneficial to the whole community. Since it enlists a crowd of users, this application face four key challenges: how to recruit contributors, what they can do, how to combine their contributions, and how to manage abuse [19]. In our approach, contributors are all users from all over the world that are keen on doing open air activities. With their contributions they can share activities specific for that region. The problem of abuse is solved by function that checks all words entered in description of the POI. If a vulgar word is detected, the POI is deleted, and never shared among users.

Depending on the context of point of interest entered, the same application can be used for environment saving, preserving national treasure, reawaking ecological conscience, visual navigation, sharing old fashion activities added by users from all over the world and for mobile learning (real time learning for local animal and plants).

SMART ADVENTURE supports two working modes: online and offline. Online mode differs from offline mode in terms of how application is used. When used online, application serves more like a nature navigator. For proper online working, GPS and IP mobile network are needed. When used offline, application serves more like a brochure for a specific region. Locations are downloaded and stored locally on

the phone memory with the first application installation and they are updated every time phone is connected to IP mobile network. This application represents a link that connects 21 century technology benefits and the old fashion way of doing activities in nature.

The main contribution of our work is to prove that by crowdsourcing with geo mapping we can influence different domains that have few points of tangency (health, ecology, human culture) [15] [14] [16] [17].

In the second chapter we will give brief introduction of the system, giving a system overview (components of the system and its collaboration). The third chapter gives details of system implementation, while the fourth chapter explains proposed application user interface and interaction. The final, fifth chapter concludes the paper.

2 System overview

The general architecture of the proposed application is given on **Fig.1**. : It consists of smart phone with internet access, GPS, mobile network (GSM/WCDMA), web server that incorporates user data base.

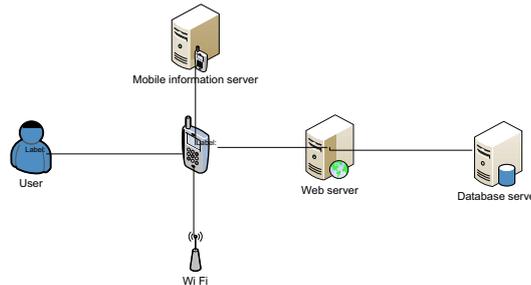


Fig. 1. System overview

Smart phone connects to an internet using mobile network and GPS. Web server handles the request for data from the user and gives him feedback. Requested data are stored on data base. When user asks for data, web server connects to data base and filters requested data. Web server is responsible for users support (member or non member), by monitoring their movement providing them with safety in every moment. The help request handles the mobile network by sending SMS alert to help centre and to predefined number (or any predefined web service). The number (web service) to whom the message will be send is set by the user. The help SMS for members is sent to both help centre and predefined number. Users without account (non members) can only send SMS to help centre.

Proposed application is implemented as a prototype on android platform. For accessing application features, users have to connect to internet using mobile network and GPS. When user is logged in he can add POIs. If user is not logged in, system treats users like non members, and provides them with few application features (finds the user position on the map which has been cached earlier, and seeing points of interest which are saved locally on the phone). Integrated GPS in the phone sends data to the server, and server stores the data in its memory. If there is no internet access, mo-

mobile network or GPS, application can be used in offline mode. When it is used in offline mode, it offers other features. Users can call for help and can see locations and points of interest that are already downloaded and stored locally on phone. In this manner, application is used more like a brochure for a specific region.

Smart adventure is defined as an alternative of classical tourist guide. It can be used as additional source of information for certain locations. The main idea of Smart Adventure design is that users with smart phones can log on or register from anywhere and get additional information for the place they are current. If there is no GPS and IP mobile network, they can inspect downloaded regions and learn about them. **Fig. 2.** represents the use case diagram of the system. A user chooses to locate or see locations. Then he logs in, skips or registers in the system. If the user is a member (user with account) he/she can see and add a point of interest (animal, plant, and activity), post on Facebook or Flickr, augment his surrounding or ask for help in case of potential danger. Otherwise if he/she is not a member he/she can just ask for help or see points of interest (animal, activity, plant). When adding points of interest, user can add a picture of the point (optional). If he/she chooses to see locations, a geo-tagged map is generated.

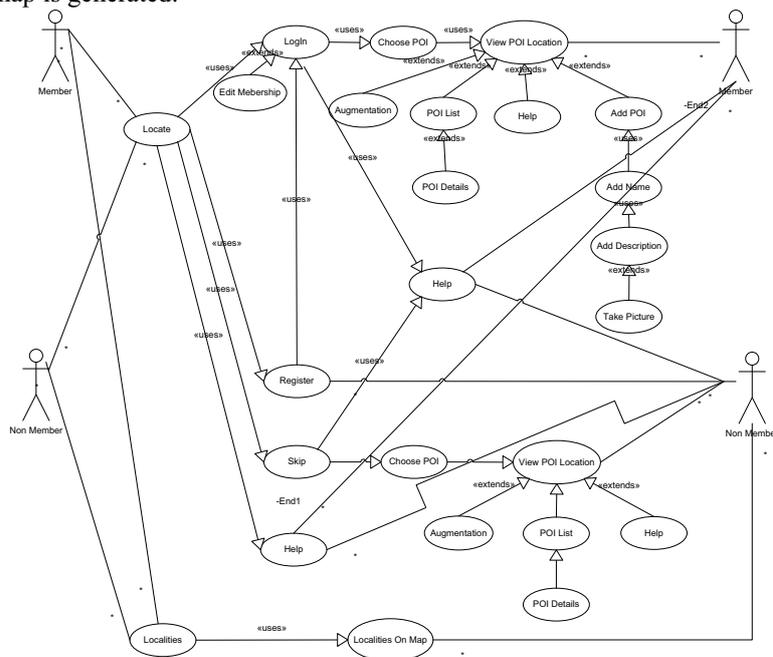


Fig. 2. Use case of the “Smart Adventure” system

3 Implementation details

The whole system is service-oriented and implemented in android environment using java for service development. It was developed in eclipse IDE environment Android

1.6 SDK, and coded in java object oriented language. The application can be used only by user who has smart phones with android platform. Android represent a software stack for mobile devices that includes an operating system, middleware, and key applications. The Android SDK provides the tools and libraries necessary for developing applications that run on Android-powered devices [23] [24].

The system contains one package, “Adventure”, in which classes are placed. The package contains two subpackages: “Data” and “Model”. The “Data” sub-package contains classes that provide information about activities, animals, plants in accordance with their location. The “Model” sub-package contains all the classes that are not directly connected with the users’ views (everything that has to present something real or abstract which existence is not direct connected to the application.) **Fig. 3.** represents the class diagram, in which the structure of the system represented by the classes, their attributes, operations and relationship among them is given. The given class diagram is truncated in order to reduce survey’s fussiness. In the class diagram only the classes which have the main importance in system structure are presented.

When the application starts, the Main Activity is activated and the users can choose one of the offered system features. The Main class handles the user’s choice and starts the LiveMap Activity which communicates with the LiveOverlay class. The LiveMap class determines the use of location on the map, and LiveOverlay displays icons on the map (animals, activities, plants). Our Activity class is the model class for all points of interest (animal, activity, plant); it contains all information related to POI’s like coordinates, names, etc. This class also has a time filter that filters the POI’s in accordance with the current system date and time. FakeDataProvider manipulates crucial data about users' points of interest (data for animals, activities, plants) in accordance with their location. It is used to provide fake data and enable us to test the application. It will later be replaced with a local database or external data source mediator.

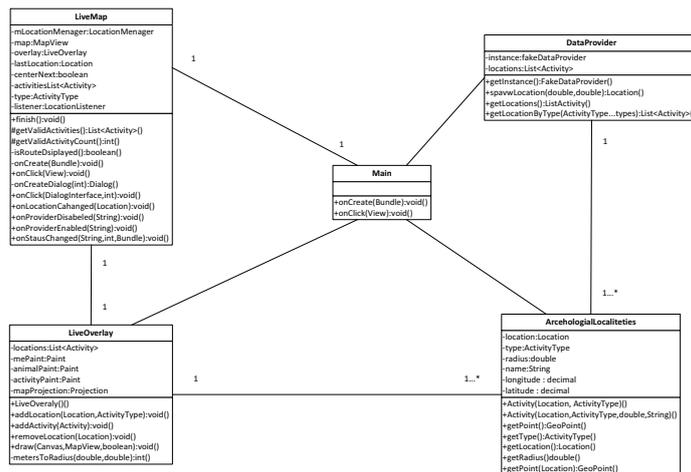


Fig. 3.Class diagram of the “Smart Adventure” system

4 User interface

Fig. 4., **Fig. 5.**, **Fig. 6.** and **Fig. 7.** represent the most important features of the application user interface.

Users, after they have skipped, registered or logged in the system, have to choose one of the offered application features (animal, activity, help, and plant) **Fig. 4.** The menu is organized in this way for easy accessing. After choosing one of them, map opens and the user location is marked in it with bright blue colour dot **Fig. 5.** The list is generated by clicking the POI button positioned in the bottom. From the list user can choose one of the poi's and sees all the details **Fig. 7.** and its radius of coverage **Fig. 6.** represented by the big red circle. If the user is in any potential danger he just has to click and hold about five seconds (five second pres) the help button. The five second press is to prevent sending of false alarm. The position of the help button is set in the left and right corner for easy access for both left hander and right hander users.

For better understanding of application usage, we have chosen a concrete location, and for that location we have chosen a concrete animal – grass snake.



Fig. 4. Smart Adventure menu



Fig. 5. User located on map

Fig. 5. represents a located user in the nature and positioned on the map. User position is marked with bright blue dot. On this picture user is located in Skopje area, Kozle estate.



Fig. 6. Grass snake coverage

In Kozle estate (Skopje, Macedonia) grass snakes are the animals that user can come across. Grass snakes coverage is marked with big red circle **Fig. 6.**



Fig. 7. Description of grass snake

The description of the grass snake is given in **Fig. 7.** In the description are given detail information about the snake including a picture of it, so the user can recognized it very easy when he'll come across it.

5 Conclusion

In this study an Android application for smart-phones was presented.

The application is object oriented and it embeds crowd-sourcing and geo-mapping. It is context aware and main application contexts are location, time and phone orientation. For modeling the context data, the application uses an abstract framework which provides the client with the needed data and also permits registration of new distributed heterogeneous data sources. The issue of abuse control that

every crowd-sourcing has, was solved by service that checks users input and decides its correctness.

References

1. Dey, A.K., Abowd, G.D.: Towards a better understanding of context and contextawareness. In: Proceedings of the Workshop on the What, Who, Where, When and How of Context-Awareness, ACM Press, New York (2000)
2. Guanling Chen, David Kotz.: A survey of context aware mobile computing research. Tech. Rep TR2000-381, Dartmouth, November (2000)
3. Dey, A.K.: Understanding and using context. *Personal and ubiquitous computing*, Volume 7, Number 5, November (2001)
4. Trajkovik, V., Bakraceski, G.: Wildcast context-aware framework: case study for place selection. The 9th Conference for Informatics and Information Technology (CIIT 2012)
5. Raento, M., Oulasvirta, A., Petit, R., Toivonen, H.: Context iPhone: A Prototyping Platform for Context-Aware Mobile Applications. In: IEEE CS and IEEE ComSoc, May (2005)
6. Kaasinen, E.: User needs for location-aware mobile services. In: *Personal and ubiquitous computing*, Volume 7, Number 1, November (2002)
7. Aato, L., Gothlin, N., Korhonen, J., Ojala, T.: Bluetooth and WAP Push Based Location-Aware Mobile Advertising System. *MobiSys'04 Proceeding of the 2nd international conference on Mobile systems, applications and services*, June (2004)
8. Zaeipekis, V., Glaglis, M.G., Lekakos, G.: A Taxonomy of Indoor and Outdoor Positioning Techniques for Mobile Location Services. *ACM SIGecom Exchanges-Mobile commerce*, Winter, (2003)
9. Djuknic1, G.M., Richton, R.E.: Geolocation and Assisted-GPS. In: *IEEE Computer Society*, August, (2002)
10. Malladi, R., Agrawal, D.P.: Current and Future Applications of Mobile and Wireless Networks. Vol. 45, No. 10 *communications of the ACM*, October, (2002)
11. Mark van Setten, Pokraev, S., Koolwaaij, J.: Context-Aware Recommendations in the Mobile Tourist Application COMPASS. *Adaptive Hypermedia and Adaptive Web-based System*, Lecture Notes in Computer Science, (2004)
12. Baus, J., Cheverst, K., Kray, C.: A Survey of Map-based Mobile Guides. In: Meng, L., Reichenbacher, T. and Zipf, A. (Eds), *Map-based mobile services - Theories, Methods, and Implementations*, Springer-Verlag, (2004)
13. Oulasvirta, A., Raento, M., Tiitta, S.: ContextContacts: Re-Designing SmartPhone's Contact Book to Support Mobile Awareness and Collaboration. *MobileHCI'05*, Salzburg, Austria, September 19–22, (2005)
14. Parikh, T.S.: Using Mobile Phones for Secure, Distributed Document Processing in the Developing World. *Pervasive Computing*, IEE, May (2005)
15. Palmer, M.A., Bernhardt, E.S., Chornesky, E.A., Collins, S.L., Dobson, A.P., Duke, C.S., Gold, B.D., Jacobson, R., Kingsland, S., Kranz, R., Mappin1, M.J., Martinez, L., Micheli, F., Morse, J.L., Pace, M.L., Pascual, M., Palumbi, S., Reichman, O.J., Townsend, A., Turner, M.G.: 21st Century Vision and Action Plan for the Ecological Society of America. In: *Frontiers in Ecology and The Environment*, Volume 3, Issue 1, February (2005)
16. Li, C., Liu, L., Chen, S., ChenWu, C., Huang, C., Chen, X.: Mobile Healthcare Service System Using RFID. *Networking, Sensing and Control*, 2004 IEEE International Conference, September (2004)

17. Bellavista, P., Küpper, A., Helal, S.: Location-Based Services: Back to the Future. In: Published by the IEEE CS, (2008)
18. Motiwalla, L.F.: Mobile learning: A framework and evaluation. In: Computers and Education, Volume 49, Issue 3 November (2007)
19. Doan, A., Ramakrishnan, R., Halevy, A.Y.: Crowd-sourcing system on the World-Wide Web. In: ACM Press, Volume 54, Number 4, New York, April (2011)
20. Ronald T. Azuma, R.T.: A survey of Augmented Reality. In: Teleoperators and Virtual Environments 6, August (1997)
21. Krevelen, D.W.F., Poelman, R.: A Survey of Augmented Reality Technologies, Applications and Limitations. The International Journal of Virtual Reality, (2010)
22. Brown, G.: An Accelerometer Based Fall Detector. Development, Experimentation, and Analysis, University of California, Berkeley, July (2005)
23. Google Inc. Android. www.android.com.
24. Google Inc. Android developers. developer.android.com
25. Tyson, G., Sposaro, F.: iFall: An android application for fall monitoring and response. In: Engineering in Medicine and Biology Society, Annual International Conference of the IEEE, September (2009)