

Design and Implementation of a Mobile Cloud Environmental Application for Riyadh City

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Abstract. Environmental problems are a global issue that everyone should contribute to minimize. As it is difficult for people in charge alone to locate all the cases of the environmental hazards and to address them on time, this paper proposes a cloud based mobile application with a user friendly interface that allows citizens to help their government make their city a better place by reporting environmental violence. The aim is to help the responsible agencies have easy and quick access to notifications provided by the community about environmental issues, so they can be addressed promptly. We choose to customize the mobile application to Riyadh City, the capital of Saudi Arabia. However, the software is generic and can be customized to any other city.

Keywords: Mobile application · Environmental software · Cloud computing · Android

1 Introduction

Environmental issues are increasingly gaining concern; any changes in the environment are likely to affect all living things, directly or indirectly [1, 2]. The growth of the population in the last years has put high demands on many of the environmental natural resources [3], which has led to many forms of pollution and environmental violations by people, intentionally or otherwise. Therefore, environmental protection becomes necessary [4] and specialized voluntary groups, environmental organizations and environmental software are emerging to address this need.

Environmental software applications are developed especially for environmental protection [5]. They offer resources and services that reduce environmental damage, increase protection acts, and raise awareness [6].

Nowadays, many people tend to use smartphone instead of PCs, which raises the importance of mobile applications. The number of active mobile phones will reach 7.3 billion by 2014. In other words, right now there are more active cell phones than there are people on the planet [7]. Therefore, the need for mobile environmental software is an important step forward to help minimize environmental damage.

This paper aims at increasing peoples' awareness and concern about the environment through developing an environmental mobile application that allows citizens to help their government make their cities better places. It helps the responsible agencies to have easy and quick access to notifications, provided by the community about environmental issues, so they can address and prioritize them appropriately.

Although the application can be adopted by any city, Riyadh, the capital of Saudi Arabia, was chosen to start with. Riyadh suffers from many environmental problems such as vandalism, cars left in street for a long time, dead animals on the sides of streets and a lot more. The suggested mobile application, ^{love}Riyadh, has the potential to increase Riyadh population's awareness about the danger of neglecting the environment and make the city of Riyadh clean, healthy and safe for the coming generations. The software has been developed and tested successfully and the preliminary evaluation results of the usability test of the software are encouraging.

2 Related Work

By searching the mobile applications market for related systems running on iOS, Android devices or both, three environmental software were found: Love Clean London (LCL) [8], myEnv [9] and Baladiya [10]. In Table 1, the main features of each application are listed and compared with ^{love}Riyadh.

Table 1. Comparison between environmental mobile applications

| Software Feature | LCL | myENV | Baladiya | ^{love} Riyadh |
|------------------------------------|------|-------|----------|------------------------|
| Price | Free | Free | Free | Free |
| Supports built-in camera | ✓ | ✓ | ✓ | ✓ |
| Supports picture gallery | ✓ | ✓ | ✓ | ✓ |
| Supports GPS | ✓ | ✓ | × | ✓ |
| Allows feedback/Report | ✓ | ✓ | ✓ | ✓ |
| Live map for all reports locations | × | × | × | ✓ |
| Supports saving drafts | ✓ | × | × | × |
| Displays feedbacks/reports | × | × | × | ✓ |
| Displays news and events | × | ✓ | ✓ | × |
| Push-notification alerts | × | ✓ | × | × |
| Help page | ✓ | × | × | × |

2.1 Love Clean London

Love Clean London (LCL) [8] is a mobile reporting tool. It is a cloud-based mobile application to report "grim crime" such as litter, potholes, graffiti, broken paving slabs, abandoned vehicles, footway and footpath defects, blocked street drains/gullies etc. The goal is to help people to report environmental crimes and keep the London boroughs clean and healthy. Figure 1 shows screen shots from Love Clean London application.

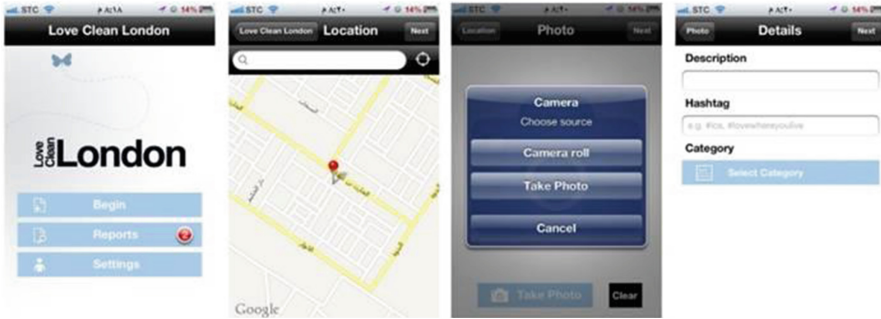


Fig. 1. Love clean London application

2.2 MyENV

My Environment (myENV) [9] application is an iPhone and Android application developed by National Environment Agency (NEA) in Singapore. This application provides useful information on the environment to the people of Singapore. This information is already available on NEAs corporate website, but the agency wanted to make it easier for users to reach important information so they can make right environmental everyday choices. Figure 2 screenshots from myENV application.

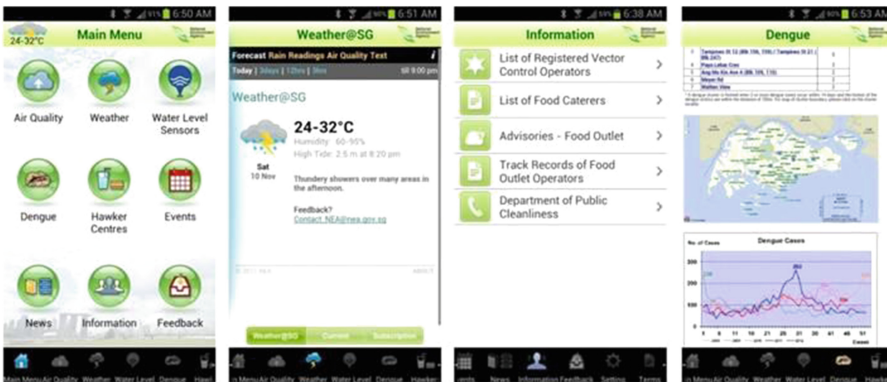


Fig. 2. myENV application

2.3 Baladiya

Baladiya [9] is a mobile application developed by Ministry Of Municipality and Urban Planning, Doha, Qatar. The application runs on iPhone or android devices, and provides several services to give Qatar citizens better and easier ways to communicate with the ministry. Figure 3 screenshots from Baladiya application.

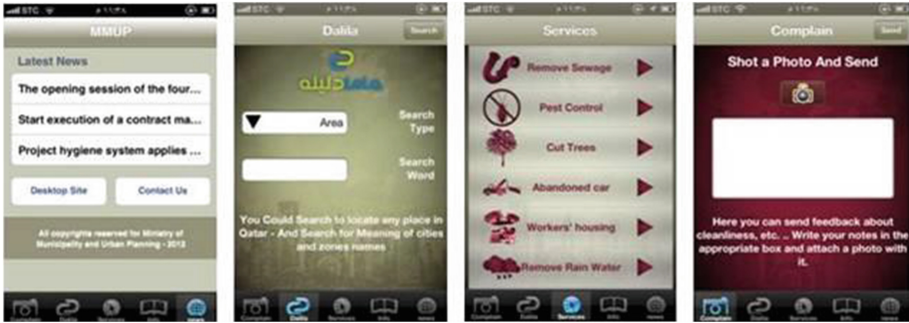


Fig. 3. Baladiya application

3 System Design

LoveRiyadh application was developed to allow volunteers to help prevent some environmental violence, such as cars left in the street for a long time, dead animals on the sides of streets and overloaded litter bins. It also allows volunteers to report issues related to streets or districts that need to be cleaned or maintained in terms of lighting or pavements and other aspects of environmental pollution, such as car exhaust, factory smoke and water swamps.

The application acts as messaging service between volunteers and Riyadh Council. It allows volunteers to send a picture and a message (report) describing the case of the environmental hazard, showing the location of the case as a map attached to the message to the council. On receiving a message, the council responds appropriate and updates the report status so each volunteer can track the progress of his/her report(s), as shown in Fig. 4.

loveRiyadh software system is composed of a mobile application linked to a mobile database and a web-based database. The latter is connected through a web service to a server from one end and an administrator interface from the other end to help the staff in their administrative work, as shown in Fig. 5.

4 Implementation

The mobile application is implemented for Android devices using Eclipse IDE, Android Emulator and Android platform. The web database is implemented using MS SQL server 2008 and Visual studio 2010 is placed on a web server that requires authorized access and contains report information (date, current status, category name, sender information) and users' accounts. The mobile database is implemented using SQLite to store all drafts and sent reports. The web service is developed using visual studio 2010 to connect the mobile application to the web server.

The user interface is encoded in the Arabic language at this stage, although it is intended to support English in a future version. The first screen is the Logo Screen, shown in Fig. 6, which leads directly to the Sign in screen, shown in Fig. 7. From this screen, the user can sign in, go to the Sign up screen or exit the application.

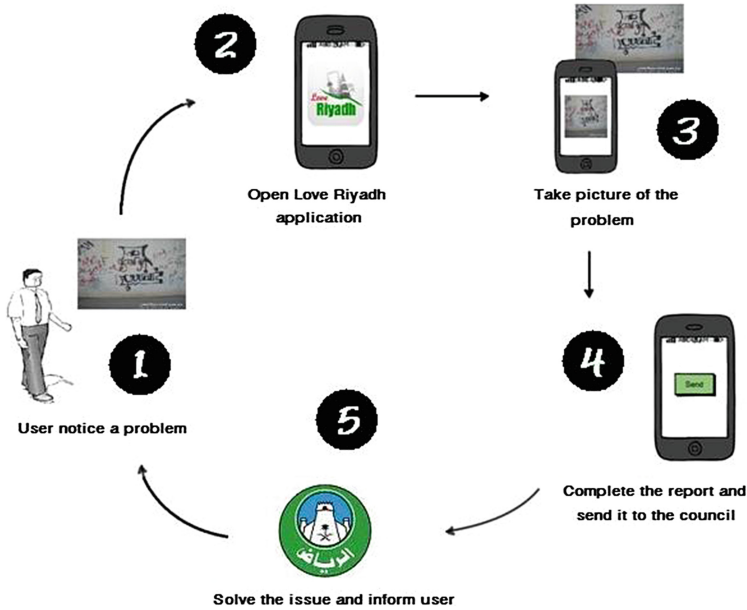


Fig. 4. Workflow of Love Riyadh application

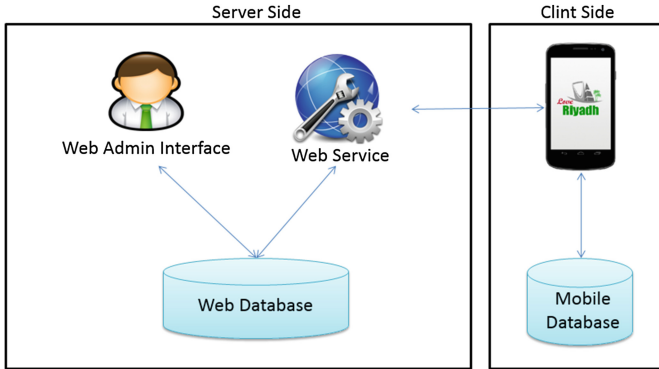


Fig. 5. LoveRiyadh system architecture

In the Sign in screen, there are two fields: one for the username, which is the user ID and the other for the password. On clicking the sign in button, the application sends the data to the web database to verify user data and a message would be displayed accordingly. The Sign up screen includes four fields, as shown in Fig. 8: a username field, which is unique, so it can be used as a user ID, a password field for secure log in and e-mail and phone number fields to contact the user. After signing in successfully, the Home screen is displayed, as shown in Fig. 9. It contains six buttons: send report,



Fig. 6. Logo screen

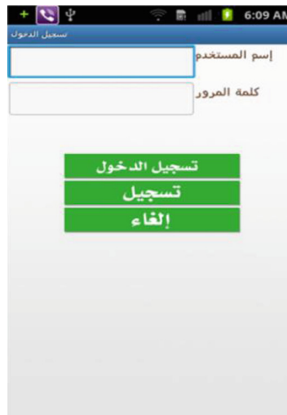


Fig. 7. Sign in screen

saved reports, sent reports, all reports, profile and logout with each button leading to a different screen.

The Send Report screen contains a field for typing a description of the problem, a list of hazard categories to select from, a camera icon to take a picture or upload a from gallery and a location flag to indicate that the current location of the user will be automatically sent with the report, as shown in Fig. 10. There are also two buttons, one for sending the report and the other for saving the report. The Saved Reports screen presents a list of saved reports (drafts) which have not been sent yet, as shown in Fig. 11, while the Sent Reports screen displays a list of already completed and sent reports, as shown in Fig. 12.

The All Reports screen, shown in Fig. 13, has two options: one is the live map option that displays all reports that have been sent by users for this specific location on



Fig. 8. Sign up screen

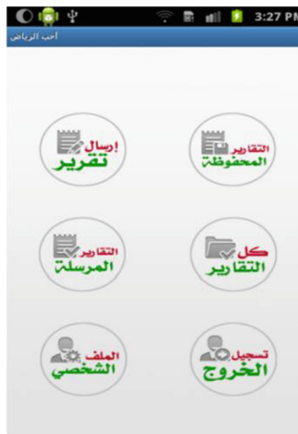


Fig. 9. Home screen

the map, the other is the list of reports option, which displays a list of all reports that have been sent by all users.

5 Evaluation and Testing

For testing ^{Love}Riyadh application, we developed a multi-level plan that starts by testing each unit separately. Then when the whole system is completed, we test the correct integration between units. Finally, we test the functionality of the entire system. After that, we carry out the usability testing by a questionnaire to insure that the application meets the end user's expectations.

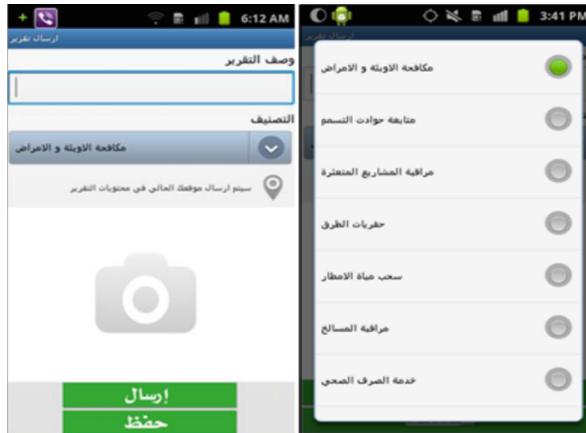


Fig. 10. Send report screens

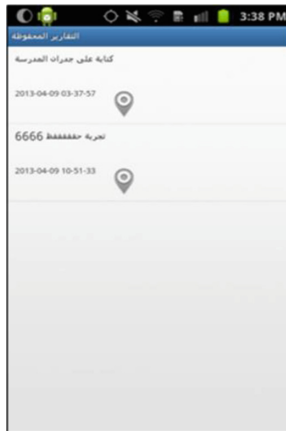


Fig. 11. Saved report screen

The work in unit testing considers each interface page in ^{Love}Riyadh application as a unit. So testing main functions for each unit was done separately, which is important in the incremental approach that followed in the software development. This test also verified that the mobile and web database are functioning as desired.

In Integration testing, we verified that all pages have correctly working links. Also, that the application is connected to the external and internal databases and able to communicate with them. After that, the entire system was tested and results were verified.

For usability testing, we developed a brief Arabic/English questionnaire to get the impression of real end users about the application. After receiving the feedback, we analyzed the results and modified the application accordingly.

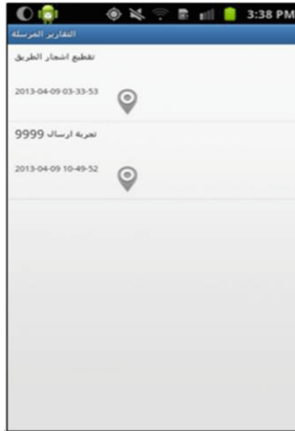


Fig. 12. Sent report screen

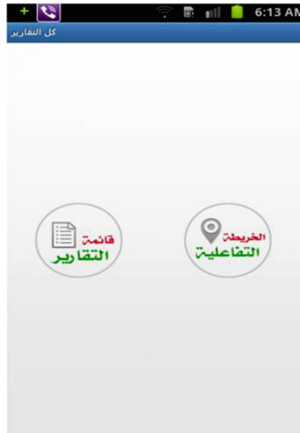


Fig. 13. All reports screen

6 Conclusion

Due to rapid technological development and population growth, Riyadh is a city that experiences many environmental problems. The objective of this paper was to develop a mobile application that helps in preventing environmental hazards. It provides citizens with an easy and efficient way to do their part in cleaning up their city and making it a more comfortable and safe place. In addition, it lets responsible people know about the problems and start solving them immediately.

The current version of the ^{Love}Riyadh mobile application supports many reporting functionalities. However, it is to be further improved in the near future to support SMS notifications, other mobile platforms and an English interface. It is also planned to generalize the application for other cities in Saudi Arabia, as well as other countries.

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References

1. Kaushik, A., Kaushik, C.P.: Environment and Ecology, in Basics of Environment and Ecology, pp. 1–13. New Age International, New Delhi (2010)
2. Pierre, Z., Fadeeva, F., Ogbuigwe, A. et al.: Visions For Change United Nations Environment Programme. Paris, France (2011)
3. Banik, S.D., Basu, S.K., Kri, A.: Environment Concerns and Perspectives. A.P.H. Publishing Corporation, New Delhi (2007)
4. Das, D., Sengupta, P.: Social cost of environmental pollution & application of counter measures through clean development mechanism with the effect of additionality & baseline — in the context of developing countries. In: Proceeding of the International Conference on Education and Management Technology (ICEMT), pp. 461–464, 2–4 Nov 2010
5. Fujita, H., Iijima, W., Koide, N. et al.: Mobile application development for environmental informatics and feedback on cooking oil use and disposal in Indonesia. In: Proceedings of the 2nd International Conference on Technology, Informatics, Management, Engineering, and Environment (TIME-E), pp. 29–33, 19–21 Aug 2014
6. Nie, Y., Zhang, J., Lei, Z., Xia, M.: Economic evaluation model and application of indoor environmental pollution. In: Proceedings of the International Conference on Computer Distributed Control and Intelligent Environmental Monitoring (CDCIEM), pp. 1478–1481, 19–20 Feb 2011
7. Digital trends. <http://www.digitaltrends.com/mobile/mobile-phone-world-population-2014/>
8. Love Clean London. <http://www.windowsphone.com/en-us/store/app/love-clean-london/81a64cda-9742-e011-854c-00237de2db9e>
9. The National Environment Agency (NEA). <http://www.nea.gov.sg>
10. Ministry of Municipality & Urban Planning. <http://www.baladiya.gov.qa/cui/index.dox>