Mo-Buzz: Socially-Mediated Collaborative Platform for Ubiquitous Location Based Service

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Abstract. This paper describes a middleware platform for user-generated multimedia contents which facilitates visualization and communication of vector-borne diseases (dengue, malaria, etc.). It acts as a community platform, where diverse users from geographically distributed locations can collaborate to seek and contribute multimedia contents of such diseases and related issues (breeding sites, etc.). Some of the essential services supported by the system are display of live hotspots, timeline, multimedia and Twitter-feed visualization, and location based services for both users and authorities. As a proof-of-concept, dengue disease was selected to build services using this platform to observe its capabilities.

Keywords: Geographical information systems, information visualization, Mobile multimedia, interactive maps, middleware, user-generated contents.

1 Introduction

Dengue is a vector-borne infectious disease that has historically posed continued threats to populations living in both developed and developing countries. Dengue affects more than 50 million people in the world every year, in particular countries in the Asia-Pacific region that share more than 70% of the disease burden [1]. In Singapore, there were two serious outbreaks within the past 10 years, affecting 14,032 and 8,287 people in 2005 and 2007 respectively [2] [3]. Although various efforts were made to fight dengue in Singapore, the country remains vulnerable with an average number of 5, 000 dengue victims reported every year [4].

Unfortunately, there is no known vaccination or medicine that can prevent this infection. Hence preventing dengue, by destroying breading sites may be the best way to control this disease. Lack of information about breading site is one of the major problems in controlling these kinds of diseases. Authorities try to be aware about the real situation, but the resources are always a problem, especially in developing nations. Several applications have been developed to address this issue by introducing different information gathering and distribution mechanisms. However, one

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noticeable drawback of these systems is that they are more focusing on a selected subject, hence solutions have its own limitations related to that particular subject.

Our application stems from a recognition of the growing need to integrate epidemiological practices with health communication interventions – two processes that are traditionally thought to take place complimentary can now do so concurrently. In great measure, this innovation is attributed to the emergence of mobile phones and social media that are transforming the way public health is practiced. To reaffirm the preference for these technological preferences among our populations of interest, we surveyed middle-of-pyramid populations in three Asian countries – India, Singapore, and Vietnam – with a sample size of 1,000 from each country. Our survey found that mobile phones are among the top 3 preferred media for seeking health-related information, and that the demand for smartphones is poised to increase in India and Vietnam in the coming years. Similarly, social media are found to be of immense utility for keeping in touch with people, searching for information and sharing information. These findings, in concert with emerging needs in public health, lead us to identify the need for a system which enables citizens to track disease spread (search for information), contribute to surveillance efforts by engaging with health authorities (share information) and further disseminate health information through members of their social networks (keep in touch with people/share information) using simple mobile phones or smartphones.

Our solution is an attempt to create a platform that gives authorities awareness about ground situation. The system also creates an interactive channel between the general public and authorities. This also allows interactions with end-users in a structured-hierarchy or a flat structure depend on the situation. Hence this solution can be used to collect and distribute large range of data among diverse user groups. Instead of asking general public to engage, this platform gives opportunities for them to involve and solve problems themselves. Getting citizens more involved in the civic life and health of their communities is more effective in these kinds of situations, especially for resource limited environment. The bidirectional information floors are very important for such issues where it helps to have an equal and better understanding between the authorities and civilians, which will increase the civic engagement [5] in the long run.

2 Related Work

With the unprecedented growth of the internet and its increasing demand, diversity of standalone applications started to develop as web applications including, health [6] and geographical information systems [7]. In data visualization, map-based visualization is widely used to visualize geospatial data. Currently, Web-GISs are widely used due to its ability to obtain data from geographically distributed locations. Hence experiments are continuing to improve the usage of interfaces [8], and reduce the cost [9]. Further, visual health communication [10] is an emerging field because of its ability to help visualize the data in a friendly, interactive manner. Therefore, extensive studies have been done in order to create a health based communication platform and use of GIS when needed [9]. For fast spreading disease, GIS systems have been used to gather information to allow necessary actions to be taken quickly and decisively in a situation like SARS [11]. On the other hand, most of the current applications focus on centralized solutions [12].

On the other hand, most of the existing solutions focused on traditional methods, which has limited involvement of the social media or civic engagement [5]. Hence the focus of this project is to create a platform for such engagement that can be used for diverse of issues using different channels. Building social networks is one of the things that humans always fond of doing [13]. There are large numbers of information flows through social networks under different categories. Researchers have been analyzing these contents to have better understanding about the society under different aspects. For instance, Twitter is one of the famous social networking sites that can be used for above mentioned surveillance since it has a free and an open network. Use of such networks for various domains including heath purposes can be found in [14] [15] [16]. To facilitates the general public to contribute to surveillance efforts in the event of disease outbreaks [17], we have developed a platform, known as Mo-Buzz, which is focused on emergence of mobile phones and social media that will help to transform the way public health is practiced.

3 System Architecture and Its Features

The system is built upon open source technologies and mainly for mobile and web based application which can access through android platform or a browser. Android solution helps the main application by running as an agent on mobile devices. The users can report information in various forms (photo, audio, video, text, etc.) using mobile devices. The system also uses SMS technologies for feature phones. Web based solution is available for everyone; however, it has more features for authorities. The solution consists of two parts, which are interactive system for geospatial visualization and web forms for other details. The solution is developed with the aid of java related technologies, such as richfaces, jpa, javascript, and jquery. Server side of this system is supported by apache, tomcat, and mysql. Google map API is used for the interactive map while Google cloud is used to facilitate android based messaging solution. The overall system modules are shown in the Fig. 1.

The system can be divided in to three main modules based on their functionalities, which are content management, visualization, and personalized messages & alerts. Each of these modules has set of components that communicate to each other to facilitate attractive features.

3.1 Civic Engagement

This component provides the cutting-edge addition to existing PE efforts. The key idea here is to activate the general public to contribute to surveillance efforts in the

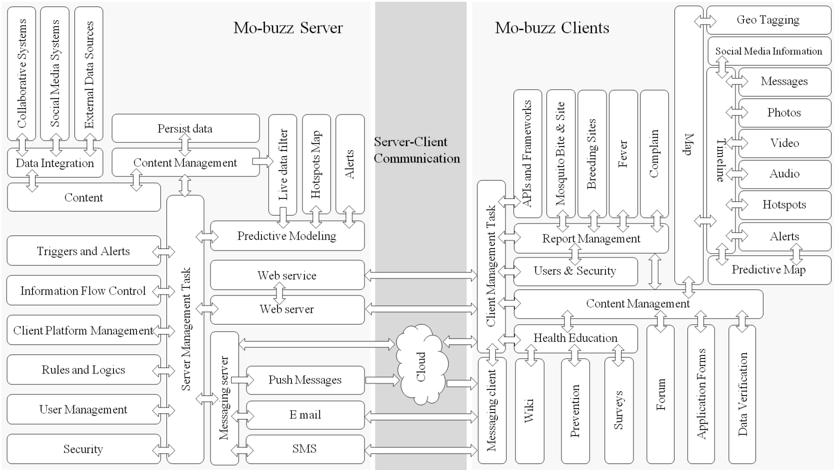


Fig. 1. System architecture

event of disease outbreaks. In this instance, citizens can report breeding sites, mosquito bites and Dengue symptoms using their smartphones in image (Fig. 2), video or text (Fig. 3) formats. These inputs are automatically reflected in the hotspot maps and can be accessed by health authorities for responding to citizen concerns as well as for initiating preventive actions in specific communities. The process is facilitated rapidly because of two reasons: a) mobile phone-based inputs from citizens are geo-tagged; and b) the Mo-Buzz system captures geo-spatial coordinates, time and date, and phone number of the contributor.

3.2 Content Management

The process of content validation comprises three categories, which are high, moderate, and low. These levels will define the reliability of the contents. Based on the reliability level of the data insertion mechanism, the filters are applied to the contents. If the category of the contents is high, then contents are directly available on the system. The content provided by authorities or registered users listed as high-reliable contents, which are fallen in to this category. The contents provided by the unregistered users are considered as low reliable data. Such data become available to users that listed as content validates. Users under authorities or registered users listed under “content validates” can access this content for verification. Based on the content's location, information is pushed to volunteers for verification. After the verification, contents can be fallen into the high or moderate category. If the content is verified by a user under the authority or reliable registered user, the content is ranked as “high” otherwise it will be ranked as “moderate” and will available to appropriate users for further verification. One or more users can verify the same content and all the ranks for the content are recorded in the system.

Users can voluntarily participate for the content verification and above verification is only applied to some selected categories of content such as photos, videos, and text messages. One main objective of the content ranking is to avoid unwanted, or fraud information reaches the authority. In reality, this will help to optimize the accuracy of the contents and will increase the civic engagement.

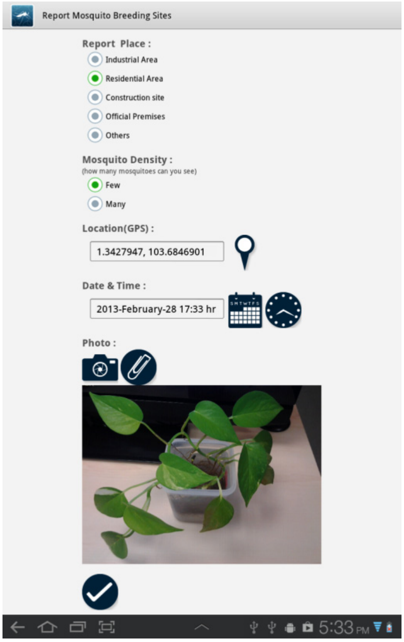


Fig. 2. Mobile app images report risk factors

Fig. 3. Report symptom using mobile app

3.3 Information Visualization

Visualization mainly consists with maps and forms. The main component of visualization is the interactive map. Most of the data in the system are geospatial data, which can be shown through the map. Visualization information can be divided into following categories:

Hotspots

Hotspots are real incidents (ex: reported disease). The interactive map highlights these incidents by circles, which show the incident's housing block (Fig.4). The color of the circle denote by the number of cases reported from each block as explained by the ledger. The visualization of the hotspots is based on the approved data by authorities. The centers of the circles are calculated by using each incident block's postal code.

The hotspots are used to provide exact location of the incident to the general public so they can arrange precautions based on their location. This visualization also gives a sense to different authorities about the next emerging incident clusters so they can plan and manage them accordingly.

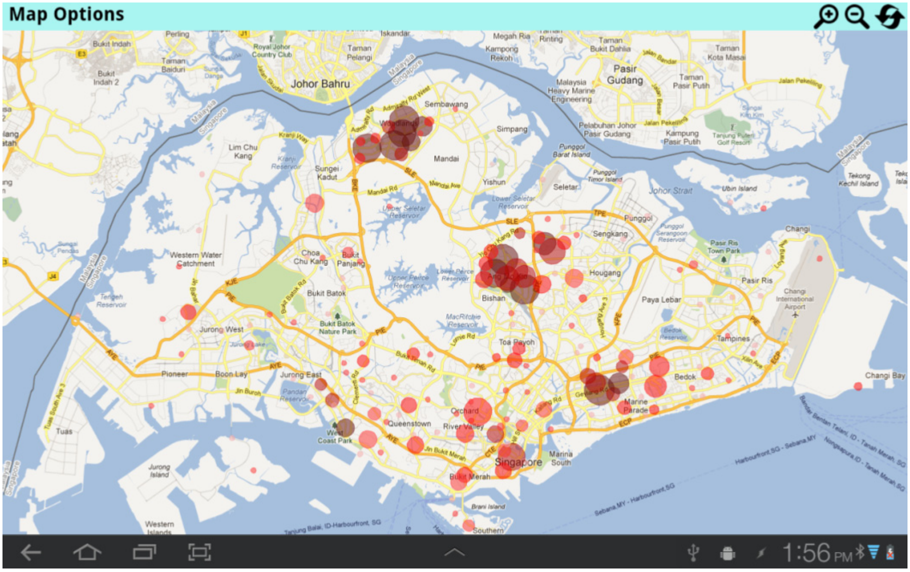


Fig. 4. Hotspots

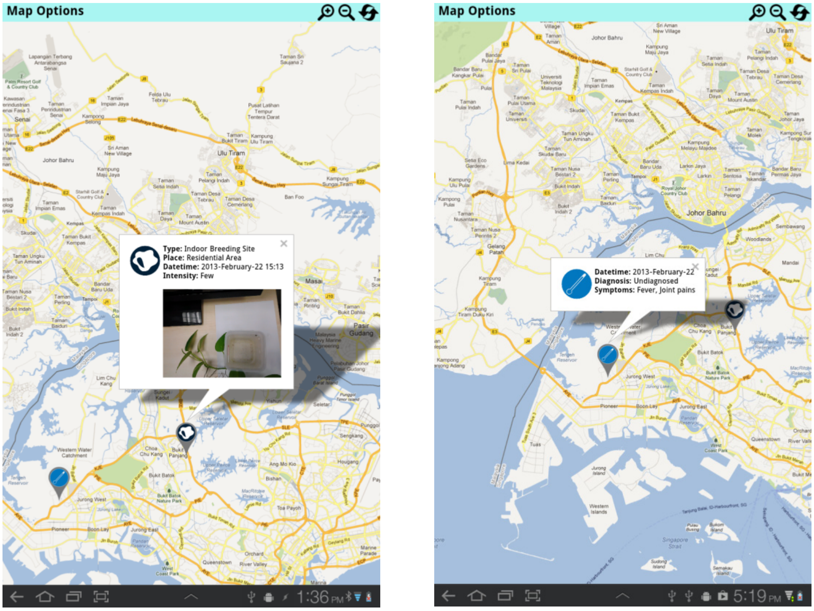
Multimedia Contents

Interactive map is encouraging its users (general public) to report about incidents or related information using several channels. Users can report this information by sending photos (a of Fig. 5), or messages (b of Fig. 5) as shown in Fig. 5. This will help authorities to identify possible important place that need to pay their attention. This will also simulate the reality about different places and trends of the society.

System will also allow its users to express their ideas through a forum. Application also allows selected user to act as ambassadors of the community or institute. They can also include messages to the system and these messages are considered as verified or reliable information.

Social Media

This system helps to create awareness by listening to the public conversations which are happening in the society. This is another way to get information about the real ground situation. The current version can listen to twitter feeds and filter information based on the user location and keywords. The system will display the associated conversations on the map according to their geographical location as shown in Figure 6. These feeds will offer suggestion to the authorities about the real situation on the ground.



a). Reported image of a breeding site **b).** Reported symptoms as text content

Fig. 5. User generated multimedia contents

Fig. 6. Twitter feeds related to dengue disease

3.4 Personalized Messages and Alerts

The repository of outbreak information based on weather and citizen data is used to disseminate health messages to both, individuals and communities. At the individual level, citizens receive tailored messages based on their input to the system. For instance, a citizen reporting malaria symptoms or mosquito breeding site to Mo-Buzz will instantly receive a complete information guide on, breeding site or symptoms, and cues to various preventive actions. At the community level, the system will automatically send health education messages to communities/zones (Fig. 7) that are highlighted on the maps as possible hotspots. Public health surveillance efforts are thus used to generate and deliver health communication messages. At a fundamental level, the system acts as a catalyst between the citizen and the public health system where the contributions of each stand to benefit the other. Overall, the intention is to use Mo-Buzz for efficient and effective risk prevention and outbreak management. In addition to communication modules, the system is capable of sending alerts to citizens living in areas identified as potential hotspots.

Fig. 7. Mo-buzz education messages

Messages can be alerts, reminders, or any useful information generated by the system or authorized users. Personalized messaging is used to disseminate messages to end users according to the message settings. Users can select various options in the message registration process which uses by the messaging system. Messaging system uses both push and pull techniques according to the selected options. The proposed system always tries to avoid messages broadcasting. Instead, it pushes messages to users based on their location, message's priority and other settings of messages and users. Also, the client application can pull the messages according its options and user settings. These massages are sending email boxes, to devices through the Google cloud or as SMSs.

4 Discussion

The developed solution works as a facilitator to manage the information flows between different types of user groups. Most important sections of the system are its content, and the validity of its content. Since the contents for this system are coming from the ground level and people who voluntarily contribute to the system, the content reflects the ground reality. Since dengue is a larger problem at the ground level, there is a better chance to have decent quality content maintained by its users. The civic engagement is one of the important aspects of the proposed system, which is essential when we need to collect large datasets. By going an extra mile, we hope that this engagement will solve some of the small problem that can be ended by themselves (or as a group), without the help of the authorities. System is also encouraging this by maintaining its content as open-content and by providing necessary functionalities. (Ex: through social ambassadors, forum, content validates etc.).

One of the major challenges of a technology-driven participatory health system enterprise is validating the quality of informational inputs from citizens. Selected content of the system must undergo through a verification and filtering (ex: photos and videos) in order to remove unrelated contents. Our validation process is consistent in keeping with the core idea of using participatory media and crowd sourcing technologies. In that, we use people (individuals and health systems personnel) as validation experts. If users are self disciplined to provide only related information, then the system can avoid this and get rid of the delay and effort that needs to verify the information.

5 Conclusion and Future Work

We have created a middleware platform to enable diverse users to collaborate and contribute multimedia contents for vector-borne diseases and related issues. The usage of familiar input channels (such as Twitter) for contents collection was made an immense improvement in the system. One of the key points that can observe in the systems is that, except for the hotspots, all other content is from end users. So except for administrative operations, the need of a specific assistant required for the system is minimal. The results obtained show the potential benefit in significantly alleviating the burden of laborious user intervention associated with conventional information gathering.

One of the future improvements of the system is to create a better content management system thath will reduce the drawbacks of the current system. The opportunities will consider building a system to prevent users based on various identifications in a misuse of the system. Visualization of twitter feeds are also can be enhanced by using an improved filtering mechanism. Building on an intelligent content analyzing mechanism will also help to have a better understanding on the ground. Another possible future enhancement will be the prediction of hotspot using different parameters. The development of a predictive module will help users to identify danger zones in advance and take the necessary precaution as early as early possible.

References

1. World Health Organization, Dengue and severe dengue (January 2012), http://www.who.int/mediacentre/factsheets/fs117/en/
2. Koh, B.K., Ng, L.C., Kita, Y., Tang, C.S., Ang, L.W., Wong, K.Y., James, L., Goh, K.T.: The 2005 dengue epidemic in Singapore: epidemiology, prevention and control. Annals of the Academy of Medicine 37(7), 538–545 (2008)
3. Lee, K.S., Lai, Y.L., Lo, S., Barkham, T., Aw, P., Ooi, P.L., Tai, J.C., Hibberd, M., Johansson, P., Khoo, S.P., Ng, L.C.: Dengue virus surveillance for early warning, Singapore. Emerging infectious diseases 16(5), 847–849 (2010), doi:10.3201/eid1605.091006
4. Channel News Asia, Singapore scientists find dengue killer in human antibody (2012), http://wwww.channelnewsasia.com/stories/singaporelocalnews/view/1208989/.html (retrieved November 27, 2012)
5. Gibson, M.: Citizens at the Center: A New Approach to Civic Engagement. The Case Foundation (2006)
6. Lazakidou, A.: Web-Based Applications in Healthcare. In: Web-Based Applications in Healthcare and Biomedicine, pp. 143–155. Springer, US (2010)
7. Jianya, G.: Design and implementation of an internet GIS. Geo-Spatial Information Science 4(2), 1–7 (2001)
8. Angelaccio, M., Krek, A., D'Ambrogio, A.: A Model-driven Approach for Designing Adaptive Web GIS Interfaces. In: Information Fusion and Geographic Information Systems, pp. 137–148. Springer, Berlin (2009)
9. Yi, Q., et al.: Integrating open-source technologies to build low-cost information systems for improved access to public health data. International Journal of Health Geographics 7(1) (2008)
10. Parrott, R., Hopfer, S., Ghetian, C.: Mapping as a Visual Health Communication Tool: Promises and Dilemmas. Health Communication 22(1), 13–24 (2007)
11. Lu, X.: A WEB-GIS Based Urgent Medical Rescue CSCW System for SARS Disease Prevention. In: Li, M., Sun, X.-H., Deng, Q.-n., Ni, J. (eds.) GCC 2003. LNCS, vol. 3032, pp. 91–98. Springer, Heidelberg (2004)
12. Lu, X.: A framework of web GIS based unified public health information visualization platform. In: Gervasi, O., Gavrilova, M.L., Kumar, V., Laganá, A., Lee, H.P., Mun, Y., Taniar, D., Tan, C.J.K. (eds.) ICCSA 2005. LNCS, vol. 3482, pp. 256–265. Springer, Heidelberg (2005)
13. Christakis, N.A., Fowler, J.H.: Connected: The Surprising Power of Our Social Networks and How They Shape Our Lives (2009)
14. Bakshy, E., Hofman, J.M., Mason, W.A., Watts, D.J.: Everyone's an Influencer: Quantifying Influence on Twitter. In: WSDM 2011, Hong Kong, China, pp. 65–74 (2011)
15. Marshall, C.C., Shipman, F.M.: Social media ownership: using twitter as a window onto current attitudes and beliefs. In: CHI 2011, pp. 1081–1090 (2011)
16. Stathopoulos, Z.: Not Just for Social Networking: How Brazil is Using Twitter to Better Monitor its Most Destructive Disease, http://threeladiesandalawyer.wordpress.com/sector-1/analysis/
17. Lazakidou, A.: Web-Based Applications in Healthcare. In: Web-Based Applications in Healthcare and Biomedicine, pp. 143–155. Springer, US (2010)