International Journal of Engineering & Technology, 7 (4.29) (2018) 45-49

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper



Dissemination Model for Critical Governments Information

Najd Al Osaimi[1]*, Sharifa Alghowinem[2]

[1,2]Prince Sultan University
**Corresponding author E-mail: najd.alosaimi@gmail.com*

Abstract

Sharing information would not only raise awareness and increase knowledge, but could also save lives. Occasionally, governments need to provide critical information to citizens accurately and in a timely manner. There are different information dissemination channels such as: Television, Radio, SMS and Social Media. However, these channels have several limitations. A dissemination approach is needed that intelligently target specific citizens with critical information that concern them from trusted sources on time. In this research, we propose a dissemination model that addresses these issues and utilizes the needed features. Comparing several dissemination architectures, the proposed model is an enhanced architecture designed based on publish/subscribe. The study proposed a novel idea of information dissemination by integrating many trusted sources in a unified source that can be accessed by the stakeholders at any time. The study would be a building block for an official information dissemination system in Saudi Arabia.

Keywords: *Information dissemination, Publish/subscribe, Smart application.*

1. Introduction

Sharing information would raise awareness, educate individuals and increase knowledge [1]. Individuals need information for different purposes such as: avoiding potential danger, learning about certain disease, and determining emergency arrangements. Therefore, governments aim to provide accurate information to citizens in a timely manner especially during emergencies [2].

There are different dissemination channels such as: Television, Radio, SMS and Social Media. Those channel show success in information dissemination. However, there are some limitation identified on those channels [3]. The Saudi government have done extreme efforts to reach as much citizens as possible and make the information easily available and accessible to the population. However, a great majority of population cannot receive any information from government due to various reasons. For example, failure to disseminate instantaneous messages, failure to reach a target number of individuals, trust of information source and information accuracy. In particular, even though newspaper, as an example, is a well-known dissemination channel, population could not get information about a warning in the right time because the content of the newspapers is prepared beforehand [3].

Individuals try to find information from different channels. Unfortunately, finding an accurate information at the right time and in the correct form might be difficult. Therefore, there is a need for a dissemination system that publishes critical government information to the right people at the right time. Critical government information is any information that should be received by all or by certain group of citizens in a timely manner, which could effect their safety. Such information includes warning of spread of virus in a certain area, a natural disaster in a region, etc.

To address the limitation on the existing channels, the research looks into a way to publish critical, timely and accurate information to population wherever they are. Therefore, there is a need to build a model that disseminate trusted information to public in a reasonable time frame. To design this model, the underlying components, technologies and functions to build an information dissemination application will be examined to identify a suitable architecture to design this model

2. Background

Dissemination plays a major role in improving the knowledge and level of awareness of population by informing them about the critical information. For example, health information must be communicated and disseminated effectively in order to provide with instantaneous and accurate information [4]. This information can raise awareness about the risks for health issues and provide solutions [5]. The hajj ministry as well disseminate highly critical information to pilgrims in each hajj season.

However, the above examples used traditional methods such as newspapers, TV, radio and short message service (SMS), where many people received the information, but many did not. However, even with the intensive efforts to improve the existing dissemination methods, these methods still face significant problems such as the failure in warning people at risk on time and the difficulty of getting accurate information from trusted sources. Therefore, there is a need to utilize the new technologies (e.g. social networks and smart applications) in parallel with traditional methods to ensure complete coverage [6].

Internet-based approaches have emerged over the past decade and become very well-known in information dissemination [7]. These approaches are desirable because they reach millions of people concurrently. Besides that, they offer solutions to dissemination challenges such as cost and timeliness [8]. One of the benefits of using the internet for dissemination is the flexible nature of the media and the ability to make it interactive [9]. For example, Website is an efficient and powerful tool in disseminating infor-

Copyright © 2018 Authors. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

mation. However, the effect of using some websites are less than desirable [10].

Another example is the social media, which have shown a huge success in information dissemination in the healthcare sector. For example, using support groups, people can share experiences and important disease information [11]. Important information that published in social media has the opportunity to reach many more people than traditional dissemination channels [8]. Moreover, it enables delivering information to users with the most potential interest in that information. However, it allows people to publish outdated, inaccurate or false information especially during disasters.

There are different smart applications that are built with the purpose of disseminating information to people. These applications showed a huge success and satisfied users [12]. They allow people to share and find information in a timely manner [13]. However, there is no app that send critical information from different trusted sources to target population based on their location and interests.

Smart information dissemination had been explored in different context such as smart cities, smart health, traffic, emergency, surveillance, education and weather. For example, Variable Message Signs (VMS) on the road have been used in different cities to inform drivers about traffic congestion, accidents and speed limits [14, 15]. In education, smart apps have been developed to pushes notifications of the lecture time and messages from the faculty members to students [16, 17].

3. Smart Dissemination Model Architectures

There are many architectures that provide a communication paradigm. However, not all could be suitable architecture for fulfilling the requirements of a critical government information dissemination model.

For instance, in client/server architecture, clients send directly explicit calls to the server which in turns responses to these calls. A client does not share resources with the server, but it requests contents and services from the server. The large number of requests could overload, cause congestion and break down the server. Client/server does not serve the objective of this study as client must initiate the connection [18].

Similarly, Peer-to-Peer architecture focuses on the communication between clients rather than communication via a central service. This architecture does not suite the proposed information dissemination model since the proposed model requires a central trusted source for service (e.g. government ministry).

Service Oriented Architecture (SOA) is another communication architecture that contains service provider and service users. The service providers offer services to the users, and users send requests to service providers. Enterprise service bus is an auxiliary component that works as a mediator between the users and providers. SOA allows adding new service after the deployment without stopping the whole system [19, 20].

Publish/subscribe architecture is based on the implicit invocation style where publishers and subscribers communicate through an intermediary [18]. Publish/subscribe adapts well with distributed environments such as mobile platform since the communication is asynchronous [21]. The publishers disseminate only events of interests to the subscribers through one operation. Publishers and subscribers are connected through a set of channels through which subscribers are notified for the events of their interest. Subscribers have to specify their interests by issuing a subscription and therefore, there are different subscription models such as topic and content based.

Among the discussed architectures, Publish/Subscribe would satisfy the requirements of the proposed model as the government ministries would work as publishers and the individuals as subscribers. Moreover, Publish/subscribe architecture satisfies the availability, performance, scalability, privacy requirement of the information dissemination model, as discussed in the following subsection.

3.1. Publish/Subscribe Architecture

Publish /subscribe delivers messages from sources (publishers) to interested users (subscribers). When a new event is created and published to the system, the publish/subscribe infrastructure is responsible for checking the event against all current subscriptions and delivering it efficiently and reliably to all users whose subscriptions match the event [22].

Application that are designed based on publish/ subscribe requires publishers to distribute messages without expressly determining recipients or having information of planned recipients. This decoupling is typically fulfilled by a mediating element, which serves as a level of indirection and ensure privacy [23].

In publish/ subscribe, subscribers subscribe to events of their interests and the notification service issues a subscription and registers it. There are different types of subscription models: subject based, content based and type based.

In publish/ subscribe, there are two strategies to get information: push and pull. In pull strategy, the subscriber initiates the server to send him/her the required information. In the push strategy, information is pushed from the server to the users. The users receive information whenever the server pushed it. Pushing data to users is not directly supported by the transport protocols such as TCP and HTTP which implies that all such push services are implemented in an extended pull style. For example, a piece of software is running at the client side in the background permanently polling for new information, so demonstrating a pushing server to the user which is called smart pull or pull. Moreover, there is another strategy to demonstrate push which is server-initiated pull. The server sends a short notification to the user to report that there is a new document ready for delivery. The user then downloads this document by a pull operation [24].

Users receive notifications either periodically after a specified amount of time or are initiated due to a data driven event on publish/subscribe. In the case of data driven event, subscribers get notification when a certain event occurs. For instance, receiving notification from the weather app when a temperature reaches a high degree. In our proposed model, data driven event is the appropriate technique since information would be disseminated to subscribers whenever new events been published [24].

Location-based publish/subscribe (LPS) allows for communication depending on the location [25]. In LPS, the message delivery to subscriber undergoes three conditions. First, the content match between the message and the query of the subscriber. Second, the location match between the publisher and the subscriber. Third, the lifetime of the message as defined by the publisher condition message delivery.

4. Dissemination Models - Related Work

Few existing information dissemination model that built based on publish/subscribe architecture have been proposed.

Ivan [26] developed a framework to disseminate information over wireless networks, where an architecture that allows system components to independently propagate data synchrony has been proposed. The study analyses different patterns of RESTful Web services within Publish/Subscribe to disseminate data to consumers. However, the framework adapts a topic-based persistent event

channels which only disseminate information to consumers under a specific channel.

Moreover, [27] proposed an ecosystem for mobile crowd sensing, which relies on the Cloud based Publish/Subscribe middleware (CUPUS) to acquire sensor data from mobile devices. CUPUS is an open-source publish/subscribe middleware that is designed for mobile IoT environments.

5. The Proposed Dissemination Model

The main purpose of this study is to propose a dissemination model that publish accurate and critical information on time to specific citizens by intelligently targeting only the concerned ones. The model is designed based on publish/subscribe where the main actors are: the government ministries, who would be publishers and the individuals, who would be subscribers.

People who can be affected by any situation that occurs have the right to get accurate information about that situation from trusted sources on time. For example, when the Middle East Respiratory Syndrome (MERS-CoV) spreads in Saudi Arabia, the health ministry sent awareness messages to the population. Many people were able to receive these messages from the health ministry, but many did not.

Figure 1 show the overall design of the proposed model. As can be seen, the model consists of several integrated systems to ensure maximum performance.

Subscribers: The model requires subscribers to use their smart phones, to create a profile and subscribe into publishers. In their profiles, subscribers should include their demographic information (e.g. age, gender, spoken language) as well as their interest (e.g. pregnancy, education). Moreover, GPS signal from the phone will be used for location-based information dissemination [28]. Subscribers will receive the information through a push paradigm from the mediator only if they fit the selection criteria based on their demographic and location information.

Publishers: Only trusted sources are authorized and registered as publishers, which are substantial component of the model. These trusted sources guarantee that information received by subscribers are effective. The publisher in this proposed model are the trusted ministries, where they assure publishing critical, timely and accurate information. The publishers send the critical information associated with subscriber's selection criteria (e.g. based on GPS location) to the cloud broker.

The Cloud Broke: The cloud broker is responsible for efficient and matching and load balance of disseminating data to subscriptions.

- The cloud broker uses a Message Receiver component that accepts and validates subscriptions and publications from publisher.
- In contrast, the Delivery Service component outputs multiple data streams, where each data stream is pushed to mobile broker.
- The cloud broker receives sensed data (GPS data) from mobile broker and outputs publications received from publishers to mobile broker.
- The Cloud Broker uses a central processing unit within the cloud to receive and manage publications and subscriptions received from publishers and mobile broker [27].
- The cloud broker performs matching of active subscriptions to publications and delivers matching publications to subscribers.

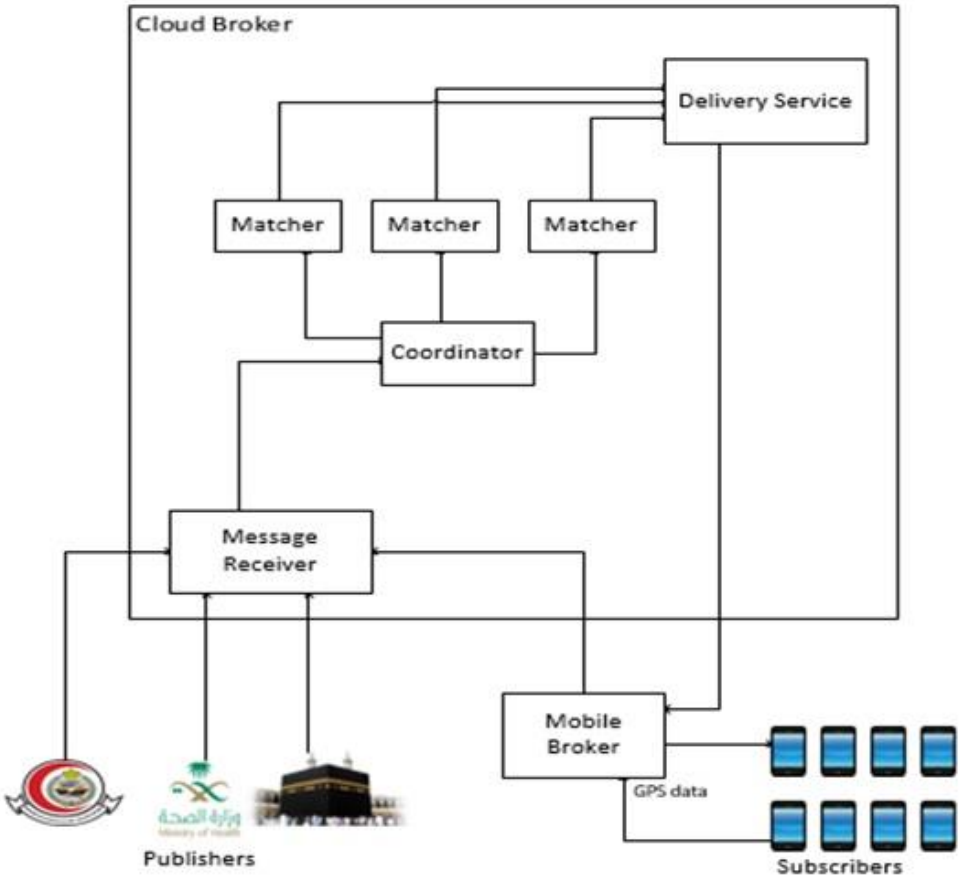


Figure 1: Our Proposed Information Dissemination Model

- The coordinator is responsible for distributing the processing load among matchers.

Mobile broker: The Mobile Broker runs on smart phones and serves as a gateway for local sensors. The mobile broker compares the received sensor reading with a set of subscriptions in case of matching the obtained data is sent to the cloud broker [27].

The model incorporates an intelligent Decision Support System (IDSS) to help in the decision-making process. The IDSS has to decide before a message is delivered to subscribers whether they met the criteria of receiving the message. The model disseminates information to subscribers based on their location, demographics and other factors. IDSS incorporates Heuristic optimization to find optimal subscribers who match a certain message. Moreover, it employs the personalization concept to deliver more personalized messages to subscribers. The conjunction of heuristic search and optimization would provide an optimal solution in a reasonable time. For example, the hajj ministry would publish a message to pilgrims to inform them about a stampede and give them the necessary precautions to avoid deaths and injuries. Such types of messages must be disseminated immediately to subscribers prioritized based on their location to save their lives and avoid any disasters. One of the major issues in publish subscribe system is security. A system is secured if it ensures confidentiality, integrity and authentication of messages as they deliver from publishers to subscribers. The malicious adversaries for example can create fake messages and subscription to tarnish the reputation of a publisher or mislead subscribers with false information [29].

This proposed model will use Khurana technique [29] to ensure the message confidentiality. The technique encrypts the message title with and allow publish/subscribe infrastructure to route the event using other fields such as age. This technique is selected because it does not require any security associations such as shared keys between the publishers and the subscribers and because of its speed performance [29].

6. Validation

There are different techniques for validation such as inspections, desk-checks, walkthroughs and prototypes [30]. To validate the proposed model, this research used the prototype technique because of its benefit in validation. The prototype has been developed to run on Android devices (see figure 2).



Figure 2: A screen shot from the developed prototype

User satisfaction survey was conduced for 100 participants after using the prototype. The results showed high acceptance from the participants and positive satisfaction. The participants indicated that this model would overcome the gaps in the traditional dissemination channels, which are the trust and accuracy of information since the information would be published from trusted sources such as ministries.

7. Conclusion and Future Work

This study introduces a dissemination method for critical government information that can be used along with the traditional channels to disseminate information to public. The study addresses the issues of the information dissemination such as trust of information, timely receiving and difficulty of getting information. The study would be a building block for information dissemination system as it proposes a novel idea of information dissemination by integrating many trusted information sources (ministries) as a unified source that can be accessed by the user at any time. Existing information dissemination systems do not use comprehensive models that disseminate information from different trusted sources and publishes them to users based on their demographics, interests and location. Therefore, this proposed model could be incorporated in different contexts.

Acknowledgement

This work was supported by the Human Computer Interaction Research Group; Prince Sultan University, Riyadh, Saudi Arabia. [RGCCIS-2017-06-01].

References

[1] S. Harmsworth and S. Turpin, "Creating an effective dissemination strategy," Tech. Rep., 2000.
[2] L. Wenjing, "Government information sharing: Principles, practice, and problems — an international perspective," Government Information Quarterly, vol. 28, pp. 363–373, 2011.
[3] J. Carvell, J. Balke, J. Ullman, K. Fitzpatrick, L. Nowlin, and C. Brehmer, MODULE 7. INFORMATION DISSEMINATION, 1999.
[4] L. Suggs, "A 10-year retrospective of research in new technologies for health communication," Journal of Health Communication, vol. 11, pp. 61–74, 2006.
[5] "Health communication," Tech. Rep., 2010.
[6] K. Mickey, "mGovernment: How government agencies can use SMS," Tech. Rep., 2010.
[7] D. Wantland, C. Porilo, W. Holzemer, R. Slaughter, and E. McGhee, "The effectiveness of web-based vs. non-web-based interventions: A meta-analysis of behavioral change outcomes," Tech. Rep., 2004.
[8] S. Stroever, "The use of social media to communicate child health information to low-income parents: A formative study (January 1, 2011)," Tech. Rep., 2011.
[9] M. Duffy, "The internet as a research and dissemination resource," Health Promotion International, vol. 15, pp. 349–353, 2000.
[10] L. W. Jeffres and C. Lin, "Metropolitan websites as urban communication," Journal of Computer-Mediated Communication, vol. 11, pp. 957–98, 2006.
[11] J. Sarasohn-Kahn, "The wisdom of patients: Health care meets online social media. :," Oakland, 2008.
[12] J. Cho, "The impact of post-adoption beliefs on the continued use of health apps," International Journal of Medical Informatics, vol. 87, pp. 75–83, 2016.
[13] H. L. Khoo and K. Asitha, "User requirements and route choice response to smart phone traffic apps," Travel Behaviour and Society, vol. 3, pp. 59–70, 2016.
[14] N. Ratrout and Y. Issa, "Effectiveness of newly introduced variable message signs in Al-Khobar, Saudi Arabia." Promet – Traffic & Transportation, vol. 26, pp. 169–177, 2014.
[15] S. CHIA, "Engineering Singapore's land transport system," Tech. Rep., 2014.
[16] "University of Regina student app," Regina, Tech. Rep., 2016.
[17] "King Abdul Aziz university introduces application through smart phones," Jeddah, Saudi Arabia, Tech. Rep., 2014.

[18] O. Vogel, I. Arnold, A. Chughtai, and T. Kehrer, Chapter 6: Architecture means. Springer, 2009.
[19] P. Bianco, R. Kotermanski, and P. Merson, "Evaluating a service oriented architecture," Tech. Rep., 2007.
[20] C. Cheong, C. Chatwin, and R. Young, "An soa-based diseases notification system," Tech. Rep., 2009.
[21] C. Liu, Y. Liu, X. Ma, and j. Gao, "An application scheme of publish/subscribe system over clustering mobile ad hoc networks," Tech. Rep., 2010.
[22] Y. Huang, "Enhanced publish/subscribe systems," Tech. Rep., 2003.
[23] R. Chand, "Large scale diffusion of information in publish-subscribe systems," Tech. Rep., 2005.
[24] W. Lehner and W. Hummer, "The revolution ahead: Publish/subscribe¨ meets database systems."
[25] P. Eugster, B. Garbinato, and A. Holzer, "Location-based publish/subscribe," Cambridge, MA, 2005.
[26] C. Ivan, "A web based publish-subscribe framework for mobile computing," (IJACSA) International Journal of Advanced Computer Science and Applications, vol. 5, 2014.
[27] A. Antonic, M. Marjanovi´ C, K. Pripu´ Zi˘ C, and I.´Zarko, "A mobile crowd˘ sensing ecosystem enabled by cupus: Cloud-based publish/subscribe middleware for the internet of things," Future Generation Computer Systems, vol. 56, pp. 607–622, 2016.
[28] X. Tong, "A publish/subscribe platform supporting mobile brokers for hybrid sensor networks," Tech. Rep., 2011.
[29] H. Khurana, "Scalable security and accounting services for content based publish/subscribe systems," Tech. Rep., 2005.
[30] K. Pohl, Requirements Engineering: Fundamentals, Principles, and Techniques. Springer, 2010.