Knowledge Transfer Existence for Flood Forecasting in Higher Education Community: Internet of Things Solution

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Abstract In today's age of new opportunities and emerging technologies, numerous studies have affirmed that the adoption of innovative technology has great impact on the society at large. Talk about the Internet of Things in today’s era which is becoming part of everybody nowadays. From the previous works, almost all the researchers have approved the importance of the IoT and in this case the “THINGS” are the Mobile Technologies which can be used in transferring the knowledge of flood forecasting during the pre-flood events to the community. Hence this study is about to know the awareness of the people the current usage of IoT that is Mobile Technology as a knowledge transfer tool to the community. And besides reading the previous researchers work, data was also collected using the questionnaire for as far as this research is concerned. And the results of this research are showing a positive impact from the usage of mobile technologies for knowledge transfer of flood forecast, it will be of a big positive impact on saving people's lives and property in the community.

Keywords: Flood forecast, Knowledge transfer, Internet of Things.

1. INTRODUCTION

Flood-related disasters account for about one-third of natural disasters, and liable for over half the deaths; with the trend, disturbingly upwards (Gichamo, Popescu et al. 2012). The HFDRR (Hyogo Framework for Disaster Risk Reduction) statistical data since 1980 to 2008 have recorded nearly 3000 flood events which led to almost 200,000 deaths with an economic loss of about $397 billion. Natural factors such as heavy rainfall, high floods and high tides, etc., and human factors such as blocking of waterways or aggravation of drainage channels, inadequate land use, and deforestation have been reported to be some major causes of floods (Hu, Han et al. 2015). However, recently, flooding worldwide has also been attributed to the negative effect of climate change (Griggs and Noguer 2002). The increasing occurrence and harshness of natural hazards like floods, Tsunami, earthquake, is great concern for stakeholders in disaster management; government and non-governmental authorities all over the world are committed to raising awareness and seeking efficient and effective approach towards disaster prevention, mitigation, management and recovery.

Climate changes over the past decade has exposed areas that were previously immune to such these disasters, particularly flooding largely due to rise to in the sea levels. The environmental incidents, economic losses from floods have greatly increased, principally driven by the expanding exposure of assets at risk (Kundzewicz, Kanae et al. 2014); this has led to the loss of lives and destroyed so many infrastructures and economies in the past couple of years'.

Significantly, current developments in Information and Communication Technologies (ICT), particularly with the emergent of the Internet of things (IoT), give a largely and huge untapped possibility for understanding the lifecycle of natural hazards management. Likewise, computational tools for tasks such as operational logistics, knowledge representation and environmental simulation are on the rise. The use of satellite imaging and communications, terrestrial wireless communication technologies as well as wireless sensor networks gives allowance to monitor the environmental parameters around the world in real-time (Bruns, Burgess et al. 2012). More so, increase access to broadband internet has made seamless access to these environmental data possible through the several digital personal devices, for instance the personal mobile phone (Bruns, Burgess et al. 2012).

Over the years, several disaster management tools and systems have been created and implemented, however,
they have majorly served as data, information repository and alerts. Whereas, access to a huge bank of disaster-related data and information is desired, knowledge repository of such magnitude will be more beneficial. In most countries, particularly the developing nations, flood and other disaster management activities are sole responsibility of government; programs and policies are exercised rather independently without proper coordination or integration, with little or no participation of non-governmental agencies, private sectors (Tingsanchali 2012) and the public.

In this work, we examined the awareness of high educated community in leveraging the affordance of IoT technologies for knowledge transfer in flood forecasting. We focused specifically on the use of the mobile phones; a relatively affordable and pervasive mobile device, as the gateway to the IoT ecosystem.

2. BACKGROUND

2.1 Flood

Floods are one of the most frequent natural hazards and occur in almost every country. A flood is generally defined as an excess of the amount of discharged water compared to the drainage capacity. At present, there is no systematic global detection of flood events as there is for cyclones and earthquakes. Floods are triggered by various phenomena and there are several types of floods. For example, one often differentiates among flash floods, river floods, and urban floods, all of which are caused by a combination of heavy precipitation and poor drainage. The severity of these flood types depends on rainfall intensity, spatial distribution of rainfall, topography and surface conditions.

2.2 Flood Forecasting

Flood forecasting systems are tools intended at reducing the doubt on the development of future events, hence allowing choice makers to take the most actual decisions under doubt (Arduino, Reggiani et al. 2005). Which to be operative, flood forecasting systems not only mandatory timely and adequately accurate within the implementation of effective protection measures or flood warning measures but also to give a usable quantification of the forecasting uncertainty. Flooding in Malaysia is regular natural disasters caused by the heavy monsoon rainfall and the concentration of runoff, which overpowers river and drainage systems. However, (Shafiaia and Khalidb 2016) reported that there is a misconception about flooding; the notion that it is due to climate change, more attention is put on rehabilitation and preservation of properties like housing properties so as not to worsen the monetary mysteries. An estimation of 0.5 billion rates of flood-related bloodshed and damages have documented (Khalid and Shafai 2015).

2.3 Knowledge

Knowledge can be defined as a justified belief that increases an individual's capacity to take effective action (Dalkir and Liebowitz 2011). According to (Dictionaries 2013), knowledge is viewed as residing within the individual, of which its primary benefit is in its application rather than creation or acquisition. Knowledge can be shared, multiplied, preserved and transferred through the different means.

Knowledge is a practical and specific information that actively guides in the execution of tasks, decision making and problem solving (Liebowitz and Beekman 1998). Essentially, knowledge is to know when, know why, and know which information is needed and how the info can be found and at the same time processed, to reach a desired objective.

2.4 Knowledge Transfer

Knowledge transfer is a formalized, focus-defined, and intended unidirectional communication of knowledge between or among individuals, teams, groups, or organizations, having a clearly identified objective (Schwartz 2005, Couturier, Kimber et al. 2014). It is the focus of learning which is critical to all advancements; it has been identified as a fundamental process of civilization without which every problem-solving approach or operating skill would have to be reinvented each time that the knowledge is needed (Schwartz 2005). Knowledge transfer could either be tacit (e.g. when a master craftsman works to develop the skill and knowledge of an apprentice), explicit (e.g. when a supervisor highlights a finding in a research paper and sends it to an associate), or a combination of both (such as when an ERP consultant shows a potential system user how to use tools and tables to implement a system) (Sun 2013, Couturier, Kimber et al. 2014).

2.5 Internet of Things

Internet of things (IoT) refers to the networked interconnection of everyday physical objects such as digital devices, cars, electrical appliances etc. which are often embedded with pervasive intelligence (Xia, Yang et al. 2012). According (Kopetz 2011), the interconnection of these physical objects is through the Internet, thereby making it possible to access remote sensor data as well as control the physical world remotely. IoT could also be said to be a global Internet-based information architecture facilitating the exchange of goods and services (Weber and Weber 2010). Two key technologies which have leverage on the IoT platform are the cloud computing and mobile technology. Both technologies combined have ushered new opportunities for information and knowledge exchange and have particularly deployed in disaster management domain. We shall discuss their peculiarities in the subsequent subsections.

2.6 Mobile Technology

Mobile technology in the context of this work refers to any moveable or portable technology that can be used to accomplish a wide variety of tasks. It facilitates the execution of different human activities enabling them to be performed via PDA, laptops, cellular phone
A pervasive mobile device in this 21st century is the smart phone. The standard smart phone is no longer a simple two-way pager but now built to support navigation, video gaming, instant messaging, cellular phone and many more. A standard mobile phone has a variety of broadcasting media like microwave, Bluetooth, GPS, infrared and radio wave which it uses in data transferring via text, voice, 2-dimensional barcodes, video among others. In summary, according to (Turowski and Pousttchi 2013) the following functionalities are crucial for a standard smart phone:

- Internet enabled
- Ability to execute applications
- Ability to receive and send short messages (SMS)
- Voice functionality.
- Photography.

3. METHODOLOGY

We adopted a survey quantitative research design and our instrument of the survey was questionnaire. A total of one hundred and fifty-eight (158) questionnaires were distributed to the educated community which included students, lecturers and non-lecturers at the Universiti Teknologi Malaysia. The survey instrument was designed to provide answers to insights into two research questions:

1. What is the awareness of highly educated community in using IoT in flood forecasting?
2. What is the knowledge transfer existence using IoT (Mobile Technology) for flood forecasting to the Community?

The questionnaire was designed using Google from and was distributed to the over five hundred participants through e-mail. However, responses were recovered from only one hundred fifty respondents. The results and discussions are given in details in section 4.

4. RESULTS AND DISCUSSIONS

In this section, we report the summary of the responses from the respondents and provide discussions on them.

Figures 1, 2 and 3 summarizes the demographic details of the respondents. The gender distribution shows that were more female respondents 59% (93) as against 41% (62) male. The respondents age distribution reveals that 48% (76) falls in the range 15 to 25 years, 38% (60) falls in the range 26-35 and 14% (22) falls in the range 36-45 years. Finally, the level of education of the respondents are such that 46% (71) have a first degree, 31% (49) masters’ and 17% (27) are PhD holders.

Table 1 Summarize responses for objective one

<table>
<thead>
<tr>
<th>Variables</th>
<th>Strongly disagree</th>
<th>disagree</th>
<th>fair</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondents received warning via mobile technology</td>
<td>20%</td>
<td>21%</td>
<td>31%</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>Respondents got a lot information from mobile technology</td>
<td>21%</td>
<td>17%</td>
<td>17%</td>
<td>28%</td>
<td>17%</td>
</tr>
<tr>
<td>Respondents searched for information before floods</td>
<td>17%</td>
<td>14%</td>
<td>21%</td>
<td>34%</td>
<td>14%</td>
</tr>
<tr>
<td>Respondents received any warning before flood</td>
<td>8%</td>
<td>22%</td>
<td>18%</td>
<td>48%</td>
<td>4%</td>
</tr>
</tbody>
</table>
Furthermore, Table 1 shows the summary of the responses to the objective one of this study, i.e to examine the awareness of the respondents in using IoT technologies for flood forecasting. The result shows that more respondents agreed to have received flood-related warnings from some sources and search for flood-related information on their own initiative. The reason for this result could be because of the education advantage, which arm the respondents with the information-seeking habit. This habit is crucial for effective knowledge transfer in disaster mitigation, forecast and management.

**Table 2 Respondents rating on Flood forecasting information through a mobile Application**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Fair</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trustworthy</td>
<td>6.9%</td>
<td>41.4%</td>
<td>44.8%</td>
<td>3.4%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Useful</td>
<td>31%</td>
<td>37.9%</td>
<td>24.1%</td>
<td>6.9%</td>
<td>0%</td>
</tr>
<tr>
<td>Up-to-date</td>
<td>17.2%</td>
<td>44.8%</td>
<td>34.5%</td>
<td>0%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Accuracy</td>
<td>17.2%</td>
<td>27.6%</td>
<td>34.5%</td>
<td>0%</td>
<td>3.4%</td>
</tr>
</tbody>
</table>

Table 2 summarizes the ratings of the respondents with regards to the knowledge transfer existence using IoT (Mobile Technology) for flood forecasting to the Community. There are weak positive reactions from the respondents to information from flood forecast through a mobile technology. 49% respondents will investigate the information first whether it came from an authenticated department, 46% will inform their families about the information immediately whereas, the other 5% will do nothing and just delete the information received. Another objective based on Table 2, is the rating on flood forecasting information through a mobile technology(IoT).

**REFERENCES:**


Bruns, A., Burgess, J. E., Crawford, K., & Shaw, F. (2012). # qldfloods and @ QPSMedia: Crisis communication on Twitter in the 2011 south east Queensland floods.


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