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May O. Lwin, Nanyang Technological University, tmaylwin@ntu.edu.sg
** Santosh Vijaykumar, Nanyang Technological University, tmaylwin@ntu.edu.sg*
Gentatsu Lim, Nanyang Technological University, gtxlim@ntu.edu.sg
Vajira Sampath Rathnayake, Nanyang Technological University, vajira@ntu.edu.sg
Owen Noel Newton Fernando, Nanyang Technological University, ofernando@ntu.edu.sg
Schubert Foo, Nanyang Technological University, sfoo@ntu.edu.sg

Abstract

Dengue affects scores of people in Sri Lanka and the rest of the Asia-Pacific region. This paper reports preliminary findings from the pilot test of a novel Android-based dengue prevention system called Mo-Buzz. Developed in collaboration with Sri Lanka's largest telecom company and the city municipal council, this system integrates three components: civic engagement, predictive surveillance and health education. The study was conducted among a sample of 80 potential consumers in Colombo, Sri Lanka. We evaluated potential user acceptance and obtained general feedback on the system adapting the Technology Acceptance Model and Expectation Confirmation Theory. While predictive surveillance and civic engagement modules were high on likability, perceived utility and future use, the construct scores for the health education module were low. Differences in perceived ease-of-use, usefulness and intention-to-use were observed by gender, age and income. Implications of consumer feedback on further design of the dengue prevention system are discussed.

Keywords: health; social media; consumer acceptance
Track: Consumer Behavior

1.0 Introduction

Dengue, an infectious disease caused by the *Aedes aegypti* mosquito, affects 2.5 billion people annually or nearly 40% of the world's population (WHO, 2014). The Asia-Pacific region alone bears a staggering 70% of this disease burden. Sri Lanka, a developing country in this region, faces a particularly stark challenge as regards to its dengue situation. The severity of dengue burden in Sri Lanka is enormous with two epidemics in 2004 and 2009, and most recently in 2012 when more than 44,000 (or 220 per 100,000) dengue cases were reported (Tam et al., 2013). Dengue related mortality has continued to rise since 2009. Moreover, the systemic infrastructure for prevention and treatment of dengue continues to be inhibited by traditional means of conducting epidemiological surveillance, disease reporting and health education.

For instance, Public Health Inspectors (PHIs) in Colombo – the capital city of Sri Lanka and the epicenter of the dengue epidemic in the country – are reportedly overburdened with the task of covering 40,000 people each (Peiris, 2009). Mapping of dengue cases is carried out after the outbreak has occurred using traditional methods such as pin maps, while monitoring of breeding sites is conducted using manual, time-consuming methods. Communication strategies to create awareness about dengue among community members and persuade them to undertake personal protective measures are implemented using media channels such as pamphlets and brochures with limited capabilities in terms of interactivity and message tailoring.

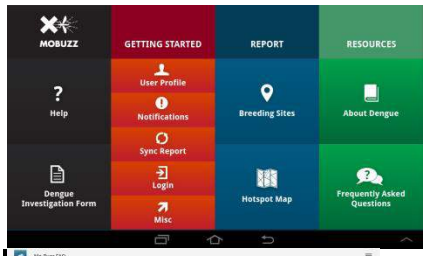
Strained by a severe dengue burden and constrained by resources to address the problem, Sri Lanka however boasts an unprecedented rate of cellular service penetration and among the lowest rates of cellular services in the world (ITU, 2013). Bolstered by evidence about mobile phone innovations transforming public health in developing countries (Chunara et al., 2012; Freifeld et al., 2010), researchers at the Center of Social Media Innovations for Communities (COSMIC), developed a mobile-based social media-driven, mobile-based system for dengue prevention in Sri Lanka (Lwin et al., 2014). This system is currently being used by all public health inspectors in Sri Lanka and the research team intends to create a similar version for use by the general public. This paper reports preliminary results from a pilot study conducted among potential consumers of this system to obtain their feedback as a means to assess potential adoption. We commence by describing the system, called Mo-Buzz, and present the theoretical framework that guides our objective. We then detail the methodology and present our results. This paper culminates with a discussion of findings as they pertain to consumer acceptance of civic engagement-driven mobile-based dengue prevention initiatives.

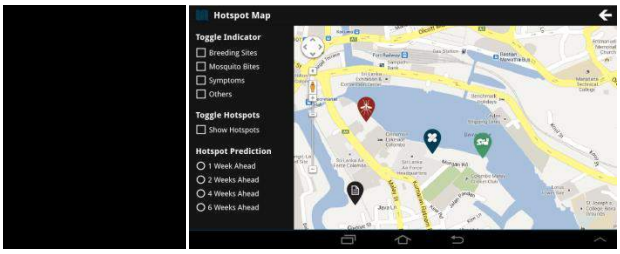
2.0 Description of the System

Existing dengue prevention suffers from reactive surveillance strategies, non-dynamic monitoring of disease spread and lack of engaging health messaging. Our project team collaborated with a large-scale telecom company, the Colombo Municipal Council and the local university to design a system that addresses these gaps directly through an integrated socially mediated system called Mo-Buzz. Mo-Buzz is delivered on an Android platform and comprises three components:

a) The predictive surveillance component offers a color-coded early warning system that displays dengue hotspots by generating predictive maps made available to health authorities and the public on mobile devices. The predictive maps are back-ended by algorithms and computer simulations based on historic and current dengue data.
b) The civic engagement component uses crowd-sourcing technologies to monitor breeding sites and dengue incidence in real-time. The app allows users to report breeding sites and symptoms using simple geo-tagged forms and image capturing technology. These reports can be sent to health authorities with the click of a button.
c) The health communication component uses a blend of geographically-targeted alerts and a detailed educational module on dengue. In addition, users receive customized information on protecting themselves from breeding sites or treating symptoms based on the type of report sent.

Figure 1: Screenshots of Mo-Buzz





3.0 Theoretical Framework

Our objective was to conduct a theoretically-grounded pilot study focused on obtaining feedback from potential users of the proposed system. Because we wished to gain insights from both, the technological and the user perspectives, our inquiry was guided by the Technology Acceptance Model (TAM; Davis, 1989) and the Expectation Confirmation Theory (ECT; Oliver, 1980). From the user standpoint, the ECT postulates that satisfaction about a product or an information system is a function of a consumer's expectations from the product, perceived performance of the product and disconfirmation of beliefs about the product. Although the ECT was originally conceived to measure post-adoption satisfaction, we adapt its use in a pre-adoption scenario because the theory offers a useful rubric to generate feedback about a system that the consumers might potentially use. Thus, we have considered consumer's expectations about Mo-Buzz in terms of the consumer's perceived utility of Mo-Buzz, perceived performance in terms of the extent to which they like the system (after using it for a week), and satisfaction in terms of whether they are likely to use Mo-Buzz in the future (after it would be launched). From the technology standpoint, the TAM postulates that perceived ease-of-use (PEOU) of an information system and its perceived usefulness (PU) determines the consumer's intention to use the said system. Applying TAM to Mo-Buzz, we are specifically interested to examine PEOU and PU with regards to each of the three components of Mo-Buzz and further evaluate whether these patterns differ by demographic segments. Specifically, we wanted to find out if the three components adequately address different aspects of dengue that concern the general public (PU); and whether their technological skills allow them to efficiently use the three components so their purpose can be best served (PEOU).

4.0 Methodology

4.1 Participant profile (Table 1)

A total of 80 adults (73.8% male and 25.3% female; at least 21 years old) participated in this study. About three quarters of them were single and almost all were Sinhalese. Nearly 60% of the respondents received university education and the median monthly household income of the group was Rs 50,001-75,000. A detailed participant profile is available in Table 1.

Table 1: Demographic profiles of respondents (N = 80)

Demographics	Frequency	Percentage
Gender		
Male	59	73.8%
Female	20	25.0%
Age		
21 – 30	61	76.3%
31 – 40	9	11.3%
41 and above	9	11.3%
Marital status		
Single	61	76.3%
Married	18	22.5%
Ethnicity		
Sinhalese	75	96.2%
Others	3	3.8%
Highest educational level		
Secondary or equivalent	11	13.8%
Diploma or certificate	21	26.3%
University and above	47	58.8%
Monthly household income		
Rs 25,000 and below	20	25.0%
Rs 25,001 – 50,000	18	22.5%
Rs 50,001 – 75,000	15	18.8%
Rs 75,001 and above	11	13.8%

4.2 Instrument

Likability and perceived utility were captured using a 3-item 5-point semantic differential scale (extremely dislike to extremely like; extremely useless to extremely useful, respectively). PEOU, PU and intention-to-use were captured using respondent agreement on 3-item 5-point Likert scales adapted to fit the three components of Mo-Buzz. Likelihood of use was captured in a binary (Yes/No) manner. Demographic variables included gender, age, household income, marital status, ethnicity and education.

4.3 Procedures

All participants downloaded the Mo-Buzz mobile application on their smartphones a week before their feedback was to be obtained. Participants were requested to use different functions in the application at least once a day. On the seventh day, a research engineer demonstrated the uses and functions of each component of the dengue application before administering the pen-and-paper survey questionnaire among the participant group. Before responding to the questionnaire, participants were briefed about the purpose of this study and written consent was sought. They were informed that participation was voluntary and that they could skip any questions or terminate their participation at any point of time. The Institution Review Board of Nanyang Technological University had reviewed the questionnaire and granted the researchers the permission for data collection prior to the beginning of the study. Data were analyzed on SPSS 21.0 using simple means analysis, ANOVA and exploratory graphs.

5.0 Results

5.1 Analysis of ECT constructs (Table 2)

The civic engagement component received the highest likability ratings compared to both predictive surveillance (*M* = 4.09, *SD* = .75) and health education (*M* = 3.91, *SD* = .93). All three components had relatively high ratings for their utilities: predictive surveillance (*M* = 4.25, *SD* = .65), civic engagement (*M* = 4.26, *SD* = .75), health education (*M* = 4.27, *SD* = .67). More than 91.3% and 87.5% of participants expressed interest in using the civic engagement and predictive surveillance components although only 76.3% reported that they would use the health education module after the application would be launched.

Table 2: Participants' responses on likeability, utility and likelihood of use of Mo-Buzz (*N* = 80)

	Likability	**Utility**	**Probability of Use**
Predictive surveillance	4.09 (.75)	4.25 (.65)	87.5%
Civic engagement	4.16 (.77)	4.26 (.75)	91.3%
Health education	3.91 (.93)	4.27 (.67)	76.3%
General feedback	4.14 (.61)	4.35 (.59)	93.8%

5.2 Analysis of TAM's constructs (Table 3)

Overall, the system was perceived to be easy-to-use (M = 4.30, SD = 0.62) and useful (M = 3.97, SD = .53) with a high intention to use (M = 3.97, SD = .63).

TAM by Gender: PEOU among female participants (*M* = 4.30, *SD* = .65) did not differ from male (*M* = 4.30, *SD* = .62) participants. Female participants (*M* = 4.08, *SD* = .64) perceived Mo-Buzz as more useful than their male counterparts (*M* = 3.91, *SD* = .47). Intention-to-use Mo-Buzz was equally high among both female (*M* = 3.95, *SD* = .74) and male (*M* = 3.97, *SD* = .60) groups.

TAM by Age: Our analysis by age revealed that PEOU (*M* = 4.44, *SD* = .29) and intention to use the mobile application (*M* = 4.22, *SD* = .29) and intention-to-use was highest among participants in the 31-40 age group as compared to the other groups. In contrast, participants in the oldest age group (41 and above) perceived Mo-Buzz as least easy to use (*M* = 4.22, *SD* = .91), least useful and were least likely to use it (*M* = 3.74, *SD* = 1.10).

TAM by Income: Means for PEOU, PU and intention to use Mo-Buzz had consistently upward trends from lower income group to higher income group, nevertheless these trend diminished in the highest income group (Rs 75,001 and above). Consistently, all ratings for perceived ease-of-use, perceived usefulness, and intention to use dengue application had upward trends from lower income group to higher income group, nevertheless these trend diminished in the highest income group (Rs 75,001 and above).

Table 3: Technology acceptance model's constructs (*N* = 80)

Demographics	**Perceived Ease-of-Use**	**Perceived Usefulness**	**Intention to Use Mo-Buzz**
Overall Mean (SD)	4.30 (.62)	3.97 (.53)	3.97 (.63)
Gender			
Male	4.30 (.62)	3.91 (.47)	3.97 (.60)
Female	4.30 (.65)	4.08 (.64)	3.95 (.74)

Age			
21 – 30	4.29 (.61)	4.02 (.52)	3.96 (.58)
31 – 40	4.44 (.29)	3.89 (.53)	4.22 (.29)
41 and above	4.22 (.91)	3.95 (.52)	3.74 (1.10)
Monthly household income			
Rs 25,000 and below	4.05 (.72)	3.80 (.52)	3.75 (.68)
Rs 25,001 – 50,000	4.44 (.69)	3.94 (.63)	4.00 (.83)
Rs 50,001 – 75,000	4.51 (.47)	3.96 (.56)	4.13 (.41)
Rs 75,001 and above	4.24 (.68)	4.03 (.48)	4.03 (.32)

6.0 Discussion

Pivoted on a trans-disciplinary, trans-sector collaboration, our pilot study examined the potential acceptance of a public system among its potential consumers. Overall, the general feedback to the system was positive, with greater than average (3.00) or high scores for most parameters across groups. Other specific findings from this study help us to further refine the system, and identify consumer segments for targeting promotional communications about the system prior to its launch.

For instance, we found that while the predictive surveillance and civic engagement components received positive feedback, the health education component received low scores in terms of likability and probability of use. The fact that its potential utility was rated as high denotes that participants recognized the value of an educational module that enhanced their awareness of dengue. We suggest that the low likability might have stemmed from the static messaging components which were possibly less attractive. We have since used this finding to redesign our educational module with more graphical elements and an animation video about dengue that creates awareness using an entertainment-education (EE) strategy popularly used in other health areas. The demographic analysis of TAM constructs was revealing. The gender-based analysis especially suggested the need for persuasive communications about the usefulness of the system to male consumers in Colombo, in order to ensure increased use. The findings also suggested a need to conduct community sessions or workshops targeted specifically at older adults (40 years of age and above), where we could create awareness about the utility of the system and train them in using the system. In terms of income, our experience suggests that low PEOU, PU and IU among the lowest income group could be a function of their lack of familiarity with smartphones and perceived lack of affordability. Because the fertile Sri Lankan telecom market is slated to offer low-cost smartphones in the future, we anticipate that this pattern might shift in the medium-to-long term. Low intention-to-use among the highest income group could potentially be caused by a generic lack of susceptibility to dengue (as reported in another paper by the authors, currently under review). We plan to address this issue through targeted health education sessions on the pervasive nature of dengue risk irrespective of real estate location or manicured surroundings. In conclusion, we found a strong acceptance of our participatory system among consumers in Colombo and identified potential gaps in adoption among specific consumer segments. In addition, our collaboration with telecom industry partners will ensure that the nuance provided by local market intelligence will bolster the performance and acceptance of our system when launched among the general public.

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