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Cite as: AIP Conference Proceedings **1891**, 020115 (2017); https://doi.org/10.1063/1.5005448
Published Online: 03 October 2017

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A Systematic Process for Persuasive Mobile Healthcare Applications

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Abstract. In recent years there has been an increased focus on persuasive design of mobile in the healthcare domain. However, most of the studies did not follow systematic processes while analysis and designing the persuasive technology applications, and they also failed to provide some of the relevant information needed to design the persuasive applications. Adding to this is a need for more guidance in order to set how the persuasive guidelines can be implemented, which also means that there is a need for a way to transform the persuasive components into software requirements and functionalities. Therefore, this paper proposes a general systematic process to be used independently of the problem domain in order to analyze the customers' significant requirements. Such domain is the obesity problem among Malaysian children, and the most significant treatment of this case is parents' involvement. To this end, this paper will apply a systematic process in monitoring the children's obesity status among parents.

INTRODUCTION

Notably, mobile healthcare (m-Healthcare) has witnessed a considerable interest and opened up new opportunities to develop applications that care on human health. One challenge of health's applications is the capability to establish long-lasting behavior change among patients and their respective health care provider, or both [1]. To tackle this challenge, there are several endeavors have been made by incorporating persuasive features [2]. The key reason behind this incorporation is that persuasive components have remarkable impacts on changing users' attitudes or behaviors [3], [4]. Stories of using persuasive components to change the users' behavior can be seen in various facets such as smoking cessation [5], weight loss [6], physical activity [7], treatment adherence [8], and disease management [9]. Thus, in mobile health application it is highly recommended to endow the software architecture of such applications with persuasive power. However, current studies pointed out that the incorporation of persuasive components in mobile healthcare is not detailed clearly [10].

Adding to this, most of the studies did not follow systematic processes while analyzing persuasive software applications [11]. With respect to mobile software architecture, it is yet to be integrated with persuasive components [12]. Clearly, these are one of the reasons of failure in most studies in providing the relevant information needed for the analysis of the compelling applications into the software architecture. Therefore, there is a need for more guidance on how the persuasive guidelines can be implemented. Software architecture (SA) is considered the essence of software systems, and it plays a vital role in the success or failure of any software system [13]. SA constitutes a model of how the system is structured, and how its components interact with each other to carry out the required behavior [14]. It also helps practitioners to clearly understand the components of the system and their relations without looking at the details of the implementation. Generally, one of the related studies for analyzing

The 2nd International Conference on Applied Science and Technology 2017 (ICAST'17)
AIP Conf. Proc. 1891, 020115-1–020115-6; https://doi.org/10.1063/1.5005448
Published by AIP Publishing. 978-0-7354-1573-7/$30.00

persuasive mobile in the domain of healthcare have been provided by [15] where they proposed an initial evaluation model as the basis for analyzing persuasive systems in the mobile healthcare. Their aim was to determine the consistency of the persuasive approaches in engaging users' acceptance. However, the current studies revealed that the incorporation of persuasive strategies in mobile healthcare is too general [16]. Adding to this is the scarcity of studies on persuasive mobile architecture [12], [9], [17] particularly on mobile healthcare to monitor the children's obesity status. Obesity among Malaysian children is the highest in Southeast Asia [18], and the best significant treatment to tackle this problem is parents' involvement [19], [20].

In this regard, the present studies lack in the architectural analysis of the persuasive mobile healthcare, especially those that can be used for persuading parents to monitor their children's obesity. Hence, this paper presents a novel systematic process for analyzing parents' requirements in monitoring their children's obesity status. Consequently, this systematic process can be generalized as a mean to analyze the requirements of software architecture in relation to the persuasive applications of other domains.

SYSTEMATIC PROCESS DESIGN

The design and implementation of a systematic process is the opportunity aimed to handling the errors and failures that have happened in the previous research due to the misunderstanding or negligence. This paper applies a systematic process in monitoring the children's obesity status among parents.

Requirements analysis activity has a great impact on software development process. It is an essential step to be implemented before developing any application. Pertinent to developing an application that can help parents to monitor their children obesity, requirements are gathered as stated in [21]. [22] mentioned that some parents have no willing or irresponsible in monitoring their children's obesity status due to time limitations, work constraints and not enough motivation or ability to do so. From the lines mentioned above, it would be a great challenge to investigate the key reasons that hinder parents of using what is good for their children and thereby persuasive components will be developed to help parents and their children through incorporating software architecture with persuasive components. Based on the results of previous literature reviews, it is quite obvious that the incorporation of persuasive strategies in mobile healthcare is clearly very general. Hence, most of the trials in the literatures adapt the concepts from [3] without showing how the incorporation and the implementation of the strategies have been made. [12] asserted that there is scarcity of studies on the persuasive mobile architecture, in particular, Mobile healthcare. Moreover, most of the current mobile healthcare architectures lack of persuasive features to persuade parents to monitor their children's obesity status [12], [9]. As well as, there is a need for more guidance in order to describe how the persuasive guidelines can be implemented, which also means that there is a highly need for a way to transform the persuasive components into software requirements and functionalities. Hence, in the stage of architecture analysis will use a systematic process design for analysis of persuasive software application before designing mobile software architecture. A systematic process design can take the advantages of concepts, models and processes that put forward [3], [23], [24], [25] to create products with the aim of persuasion, as well as some principles [26].

Initially, according to [24], many developers have little or no experience in creating persuasive products with its goal and yet to follow a systematic process in designing persuasive applications. He stressed that lack of well-established process to design persuasive technology leads people to adapt the methods of the other fields, such as usability engineering, or to make guesses to identify and develop their products. To meet this challenge relied on his expertise for fifteen years in this field and pointed out eight-steps for creating successful persuasive technologies. He also explained that the eight steps are not intended to be used as a rigid formula, but can be modified or cut sequence of steps to suit the conditions of design.

Given the importance of these steps in the design process of persuasive technology, this study decided to adopt three steps that are very appropriate to the design of persuasive mobile healthcare as part of persuasive architecture. These steps are; 1) defining simple behavior to target, 2) selected a receptive audience, and 3) find relevant examples of persuasive strategies (similar behavior, audience, mobile application). Similarly, one more step should be included in order to attain the designing of a persuasive mobile technology [25]. This step is selecting a target behavior. Moreover, all these steps (defining simple behavior, select receptive audience, select target behavior, select relevant example) must be implemented sequentially as a systematic process design as illustrated in Figure 1.

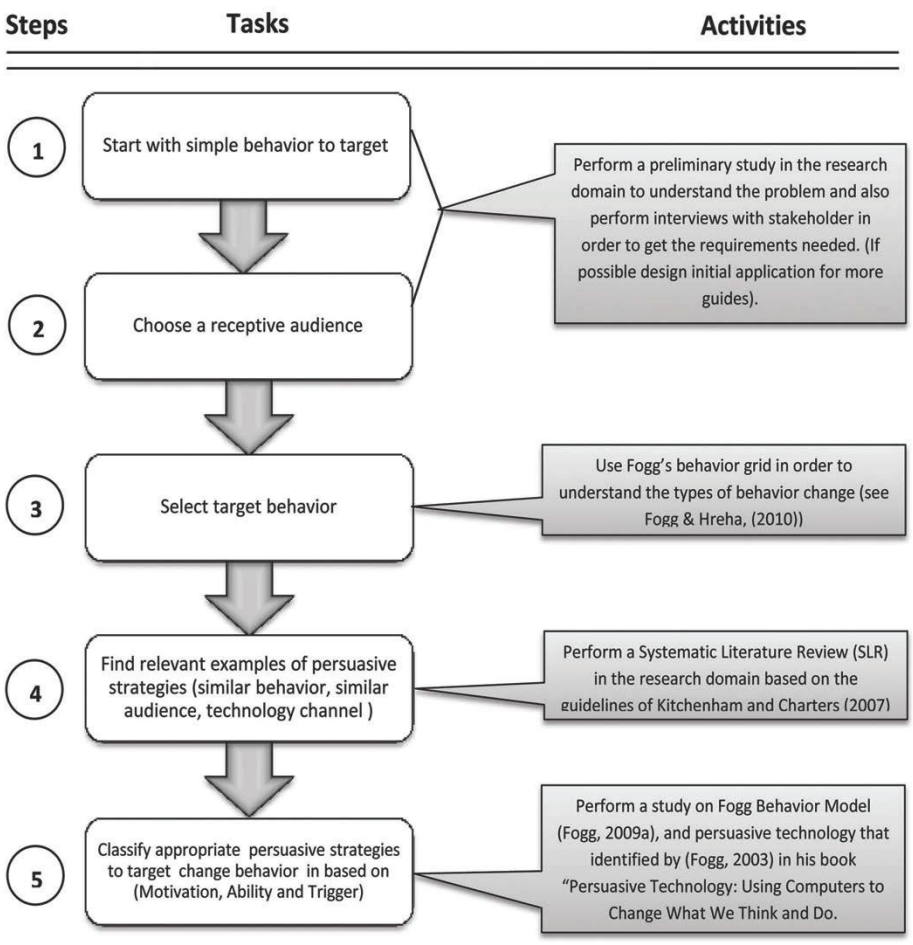

FIGURE 1. A systematic process for design persuasive systems

[24] pointed that the first step in the selection of a simple behavior is the most important aspect of designing successful persuasive technologies. He added that many projects are too ambitious, and thus are set up for failure. Moreover, many researchers [27], [28], [29], [30] have emphasized that simple behavior is an important first step to make a major change in health behavior. Therefore, this study considers choice of simple behavior is crucial matter. As a result, a systematic process design will begin with choosing a simple behavior to target like monitoring children obesity using smart phone. Consequently, this simple behavior will constitute a good starting point for reducing obesity among Malaysian children.

The second step of a systematic process design involves selecting the right audience to intervene and should identify the audience who has a desire to improve the desired behavior. Hence, the parents will be the target audience. [25] stressed that the persuasive design lacked in taxonomy and a terminology that allows precise discussions about different types of target behaviors. Therefore, the third step of this process aims to use Fogg's behavior grid which specifies fifteen types of behavior change as a method for matching target behaviors. Many former researchers indicated the importance of matching psychology to target behavior [31], [32]. Consequently, this step strives to apply behavior grid in framework of this study because it is considered a systematic way of design for successful behavior change. According to this grid the blue span behavior is familiar to target parents but for a period of time. This means that most parents have smart phones that can be used to monitor their children obesity amongst aged 7-12 year. In order to achieve a blue span behavior, three key factors must come together at once, namely; 1) trigger, 2) motivation, and 3) ability. The following steps are essential to attain the blue behavior;

- Focus on Triggers firstly, not Motivation.
- If a change with the trigger does not work, ability should be tackled secondly.

- If a change does not occur, in this case a person's motivation is too low; a motivation level must be triggered as a third step.

Many behavior theories and models stress the importance of motivation and ability in changing behavior [33], [34], [35], [36], [37], [38], [39], [40], [41], [42], [43], [44]. Nevertheless, [23], [24] has emphasized that three factors (motivation, ability and trigger) are important and necessary for behavior change. Therefore, this study adopts these three factors in changing the parents' behavior in monitoring their children obesity through the use of mobile technology as a channel to trigger the required behavior.

The fourth step of a systematic process design is finding the relevant examples of successful persuasive strategies which adapted from [24]. This phase of the persuasive design represents a successful step, according to Fogg's experience, because it enables the designer to look at successful strategies in order to be imitated. But, these relevant examples must match the target behavior, target audience and chosen technology channel (i.e., a mobile phone). Searching for relevant examples of successful persuasive techniques is a daunting task. Therefore, finding one example that matches to the precise behavior, target audience, and technology channel is accepted [24]. Otherwise, nine examples in total must be searched: three that achieve a similar behavior, three that reach a similar audience, and three that use the same technology channel to select the relevant examples. This step is more flexible in dealing with different persuasion strategies in all areas, which can be obtained from previous studies. Thus, this work is not confined only in persuasive technology that has been identified in [3]. After the completion of the previous four steps, choose simple behavior, identify the audience with matching target behavior, and identify the successful persuasive examples, a further step is needed which is, choosing appropriate persuasive strategies to target change behavior in order to classify it based on the Fogg Behavior Model [23], which are strategies to trigger lack of motivation, strategies to trigger lack of ability, and strategies to trigger lack of a well-timed trigger to perform the behavior.

In summary, understanding this systematic process enables software practitioners to be more confidence for generalization it on the other domains. It may even help them to design a more efficient or effective intervention in developing persuasive applications.

CONCLUSION

In conclusion, this paper focuses on a systematic process for designing persuasive systems which will enable the practitioners to analyze the significant requirements of the system and related problems. This process is the most effective in software development for practitioners in order to collect the required requirements from stakeholders in the right way. From this point of view, it becomes very important to apply systematic processes in architectural analysis stage. This means, if a practitioner knows each and every requirement of the customers before the actual process takes place, then the complexity of the design can be reduced in the later stage of the architectural synthesis. Finally, we hope that the benefits in providing such a systematic process can make the stage of architectural analysis clearer and more practical for persuasive systems development in the future.

ACKNOWLEDGEMENTS

This research was supported by the Fundamental Research Grant Scheme awarded to the Universiti Utara Malaysia by the Ministry of Education of Malaysia.

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