The mHealth: A Review of Current Persuasive Technology Design Strategies

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Abstract: *Health services needs nowadays are rising and consumers are increasingly aware of the importance to know their health status quickly and effectively. However, the mobile health applications acceptance is still low even its development is growing due to the use of information technology among health providers and consumers. This indicates that the mobile health application less successful in persuading consumers for better health habits. The design of information in this mobile application should achieve the objective of improving consumer health habits. This paper reviews the findings of previous studies related to the design strategies used to exploit persuasive technology for behavior change. The results are presented in a table showing the frequency of each strategy being studied by the researchers. Hence, this study will assist mobile developers, designers and health providers in developing their future mobile health applications.*
Keywords: *Persuasive technology, captology, behavior change, mHealth, HCI*

I. Introduction

The mobile health application or simply known as mHealth refers to the subset of e-health area that is used in the public health and medicine practice using a mobile device [1]. The mobile devices defined here includes mobile phones, smart phones, personal digital assistants (PDA), portable media player, portable gaming console, tablet PC and portable mini computers. These devices are used in many ways such as to capture, transmit, analyze and process the data from sensors, biomedical devices or human operatorsto produce information that can be used for medical practitioners or users for their health [1, 2].

The mobile platform, especially the smartphones are suitable for health application because it has many features that are accommodating both to the users and practitioners. Apart from being a communication tool, it alsohas the features of data collection such as taking notes,photos, and videos, wide choices of connectivity and mobility because of its form factor. All these features can be used effectively for the purpose of an e-health application easily as anall-in-one tool [1-4]. Therefore, the role of thesmartphone as an enabler to health and medicine application in the digital era is a must.

While the smartphone as the hardware apparatus for e-health application is assumed as an essential element, the application itself must be designed in a way that it could help its own objective in helping the users. In this review, most of the mHealth application are oriented towards the non-practitioners of medicine and health, such as the patient or the general mass. These applications' objective are to help its users in behavior changing to improve their state of health. According to World Health Organization (WHO), in the near future, we will see an increase in mortality rate, due to health problems in which it causes are related to behavior. For example, the lack of physical activity, over consumed alcohol and unhealthy diet has a strong relation to health problems such as heart disease, diabetes, stroke, and cancer. Therefore, an intervention in the behavior of those who are susceptible to the diseases is needed [5]. Thus, it is clear that there is a need to incorporate behavior change techniques (BCT) into the mHealth app so that its objective to help those who want a better and healthier lifestyle.

Adesign tool has been developed for influencing user behavior to help designers in designing a system or an application for the purpose of behavior change. The tool, named Design with Intent Method (DwI) is developed to suggest asignificant approach that can influence behavior types and shows comparable problems that have been solved earlier. Among the perspectives presented in the designtoolsarearchitectural, errorproofing, persuasive, visual, cognitive, and security [6].

Persuasive technology itself has a broad meaning. The term captology is defined as the study of thecomputer for persuasive technology. Captology focuses more on the human-computer interaction (HCI) part rather than the computer-mediation communication (CMC). Captology field involved the study on user interface and the interaction design aspect of the computer programs or applications. For example, it focuses on the look and feels, the flow of information displayed, and navigational structure as well as the feedback from the programs or applications that constitute the interaction between a user and the computer. This interaction will have the potential to persuade, motivate, negotiate and incentivized the user in doing things according to the objectives of the programs and applications [7].

Persuasive technology would benefit to the user as it can act as an agent of behavior change to the user. It has three functional roles that would make behavior changing possible. The first one is the role of the social actor where it creates arelationship with the user and using that relationship to motivate behavior changing. This includes giving rewards, modeling user behavior, and providing social support. The second functional role is a medium that would contribute to the experience. People will be able to understand what the cause of a behavior is,providing with indirect experience that can help people in motivating the actof rehearsing a behavior. The last functional role that would benefit is acting as a tool. A tool would help the target behavior become easy to the user. It can be the guide and tell the user what to do to achieve the target. Not only that, it could also do some measurements and calculations that could project a prediction of the outcome of the user in achieving the target behavior. This prediction would help motivate themto change their behavior [7].

In this review, we choose to discuss the persuasive technology in the mHealth apps, in which, will persuade users into attitude and behavior change by using contextual information, guidance, and advice. The persuasive technology uses a computer to change what we think and does [7]. It has become prominence in BCT as nowadays we are closer to the computer, in the form of mobile gadgets and smart phones. That is why we need to know the persuasive technology strategies to be used in designing our BCT mHealth application so that it can attract more users to use it, thus helping more people to get a healthier life.

II. Persuasive TechnologyAnd Its Application

The persuasive technology works by using a computer to be the social actors to persuade users in doing things. This being said, a computer not only assumed the roles of tool and medium for users, it also act as a social actor in which can be persuasive. For example, in the late 90s and early 2000s, pocket pet games such as Tamagotchi and Nintendo's Pocket Pikachu requires their "masters" to feed them, play with them, and taking care of them in order to let them survived. If there are no "care" given, the pet will die. This would certainly affect its masters' feeling and affectionate. In Pocket Pikachu, the masters need to be physically active so that the digital pet also become healthy. For this reason, Nintendo has incorporated the use of pedometer that could track the owners' physical movement into the device. The owners' need to stay physically active consistently so that their pet will also be active and not die [7-8].

Pocket Pikachu has demonstrated how computing device can be a social actor in influencing behavior change. Through support, encouragement, feedback, and reward as positive reinforcement, entertainment technology such as games can benefit in behavior changing, especially into positive ones [8]. For this to happen, correct social cues need to be presented to the users so they can act just as intended by the applications or games. There are five types of social cues discussed by Fogg (2002), namely (with example): physical (face expression, eye contact, body movement), psychological (personality, feelings, empathy), language (interactive, recognition), social dynamics (cooperation, answering questions, reciprocity) and social roles (relationship – teammate, opponent, guide) [8].

To deliver the social cues for persuasive technology in behavior changing, the designer, and developer of the mHealth apps can use different strategies. Halko and Kientz (2010) has listed eight general strategies that can be used by a persuasive technology. These strategies have been categorized into four types: instruction style, social feedback, motivation type, and reinforcement type [9]. Authors in [10-13] havelisted other strategies and features that can be used such as tailoring or personalization, reminder, simulation, and information quality. Each of this strategies isdiscussed in Table 1.

Table 1: Persuasive Technology Design Strategies

Strategy	Description
Authoritative[7,9] / Tunneling[11]	Using an agent with authority like a strict instructor to discipline the user of achieving the targeted outcome. Example: A game named MOPET has a virtual agent that assumed the role of a drill sergeant. The agent will instruct the user in a strict manner to start playing the game for another amount of time.
Non-Authoritative [9, 12]	Using a neutral agent such as friends and colleagues to encourage the user to achieve the targeted outcome. Example: Using Facebook comments feature to encourage friends in achieving target such as the Three Good Things (3GT) Facebook app.
Cooperative [9]	Using the sentiment of a user working together with friends and colleagues to achieve the targeted outcome.
Competitive [9]	Using the competitive element when a user competing with friends and other users to win the competition in order to achieve the targeted outcome.
Extrinsic [9]	Using the external motivators, for example, giving atrophy and physical prizes as a reward for activities done to achieve the targeted outcome.
Intrinsic [9]	Using the internal motivators like feeling happy or feeling healthy as a self-motivation factor in order to achieve targeted outcome.
Negative Reinforcement [7,9]	Put away unpleasant stimulus such as the look of sick and as the user performs thehealthier behavior. Example: Tamagotchi virtual pet will become sick and eventually dies if its master did not feed him well.
Positive Reinforcement [7, 8,9]	Includes pleasant stimulusof good looking elements such as flowers blooming and a healthier character as the user performs thehealthier behavior. For example, Pikachu in the Pocket Pikachu will look healthier and stronger when its master did physical activities.
Tailoring /	Using customization techniques to provide functions or information that specifically matches the user

Personalization [7]	profiles and context in order to persuade a behavior change.
Reminder [13]	Using reminders to remind the user of their target in order to persuade them to do the activities to achieve their targeted outcome.
Reduction [13]	Using reduction techniques to reduce the complexity of the system or application in order to persuade the user to use the system or application in order to achieve their targeted outcome.
Information Quality [13]	Good and high-quality information that is credible and trustworthy are presented to the user in order to persuade them to do the activities to achieve their targeted outcome.

III.   Review Methodology

The study aims to identify and review previous research that focused on strategy been used in persuasive technology specifically in the mobile health industry. References to this study are searched for full-text of articles within Science Direct, IEEE Explorer, and Google Scholar databases. The articles are then filtered by further criteria so that only the articles related to the subject were taken for analysis. The criteria that we have used for further analysis relating to the above article is to assess the results of the study run by the researchers who brings a positive impact after strategies been used. The references were searched based on the combination of keywords "persuasive technology", "captology", "mHealth" and "mobile application". This study uses the articles that published from 2010 to 2016, a range of 7 years period of time. Figure 1 below illustrates the research process that these studies have been followed.
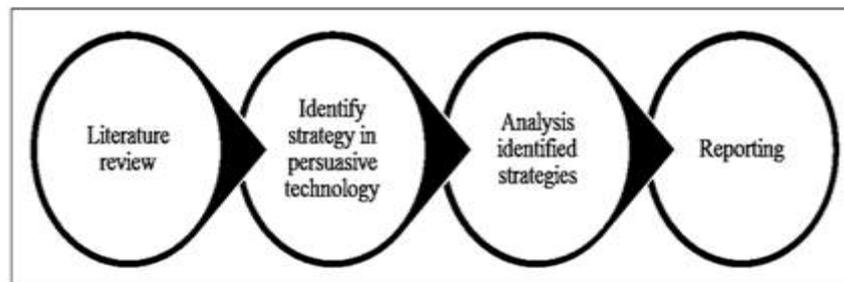
Fig.1 Research Methodology

IV.   Results

The results of this revieware represented by the following Table 2.

Table 2: Persuasive Technology Strategies used in mHealth Industry

Strategy	Authors																Total
	Bardram et al. (2013)[14]	Purpura et al. (2011)[15]	Pollak et al. (2010)[16]	Haut et al. (2014)[17]	Fritz et al. (2014)[18]	Foster et al. (2010)[19]	Grain H. et al. (2013)[20]	Azar et al. (2013)[21]	Arteaga et al. (2010)[22]	Krosa et al. (2013)[23]	Lim et al. (2011)[24]	Young (2010)[25]	Kaptein et al. (2015)[26]	Kangel al. (2015)[27]	Adams et al. (2015)[28]	Morvin(2015)[29]	
Authoritative / Tunneling	X	X	X									X	X	X			6
Non-Authoritative												X		X			2
Cooperative		X	X		X		X	X				X	X		X		8
Competitive		X	X			X	X										4
Extrinsic			X	X	X	X		X		X	X	X	X		X		10
Intrinsic	X	X		X	X		X			X	X	X	X		X	X	11
Negative Reinforcement													X				1
Positive Reinforcement										X	X				X		3
Tailoring / Personalization	X	X	X				X	X	X			X			X		8
Reminder		X	X				X			X		X		X			6
Information Quality	X		X				X			X		X		X	X	X	8
Reduction		X			X							X					3

As we can see from the result in this review, the most used strategies in persuasive technology design in the mHealth industry are the use of intrinsic motivation, followed by extrinsic motivational. This is followed by cooperative, tailoring or personalization, and information quality. Strategies such as authoritative instruction or tunneling and reminder also being moderately used in the persuasive technology design. Others such as competitive, positive reinforcement, reduction, non-authoritative instruction and negative reinforcement are seldom used in the persuasive technology design.

Based on the analysis, it was found that the motivational strategies, both extrinsic and intrinsic are the most important persuasive design strategy for a mobile health application.This was probably caused by theofferingof rewards, whether a physical one such as winning prizes that can be seen or a psychological one such as feeling good and healthy.

The use of cooperative strategy can be assumed as a strategy that appears because of the advancement of technology supports its existence. Social sites such as Facebook had a base framework in user networking thus an app that uses its API can use this for cooperative or competitive easily without having to create the user networking element from scratch. We also assumed that tailoring or personalization strategy is used because this will make the users feel easy and used to the app, thus increasing the usage. Other strategies may have lower usage as a strategy for persuasive design but we believe they have their own strength in persuasive technology for behavioral change. After all, this review has some limitation such as the papers used for review are strictly based on mobile health technology in a limited range of year of publishing.

V. Conclusion

For the conclusions, we can conclude that persuasive technology has the potential to provide a positive effect on consumers, especially in the health sector. This is because, in order to make people healthier and create awareness among them, the use of persuasive technology can be used as a tool to create self-motivated people to change for the better. Based on the reference articles that have been made, the strategies observed by researchers marked as shown in the above section. This review hopefully would benefit and assist the designers, developers, and health providers when they develop their mobile health application and increase the achievement of its objectives.

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