A COMPARATIVE STUDY ON CONSOLIDATION OF DESIGN PRINCIPLES IN WEARABLE PERSUASIVE MULTIMEDIA

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INTRODUCTION

Persuasive Technology(PT)

- The domain of computer and persuasion form an acronym "Computer as Persuasive Technology" (PT) or better known as Captology (Fogg, 1998)
- Captoloy → persuasive technology as a means to change attitude and/or behavior

Multimedia Technology(MT)

- Multimedia does not only represent the combination of different types of media, but it is a means for communicating, cooperating and monitoring various aspects of everyday life (Boll, Meyer, & O'Connor, 2018)

Wearable Technology(WT)

- The emergence of wearable technology that is integrated with sensors has changed the function of multimedia
- In order to stay relevant, the media used to increase awareness should be in line with the current technology.
- To ensure the persuasive messages able to attract alpha generation in a more attractive and effective way

DESIGN PRINCIPLES

WEARABLE PRINCIPLES

- Evidently, there is a shortage of research outcomes that could assist designers in improving the wearables acceptability (Tharion, Buller, Karis, & Mullen, 2007).
- In consequence, a few researchers had put forward principles that can be considered when designing the wearable or the application in it.

Design Principle/Author	
• **Watch Design Principles (Samsung, 2020)**	Scannable, Easy to Follow, Responsive Desirable
• **A – Z Guide (Godfrey et al., 2018)**	Focuses on the key terms to provide a fundamental and wide understanding of recent wearable technology development in healthcare
• **Design Factors for Autism Spectrum Disorders (Koo, Gaul, Rivera, Pan, & Fong, 2018)**	Safety, Data accuracy, Comfort, Flexible material, Portability, Durability, Reasonable price, Ease of use, Lightweight, Small, Unnoticeable design, and Unique design
• **Health Wearable Design Principle (Jones, Gauge, & Crilley, 2017)**	Accessibility, Adaptability, and Iterability
• **Wearability Design Principle (Motti & Caine, 2014)**	20 general-purpose human factors that can be included in designing the wearable devices

DESIGN PRINCIPLES

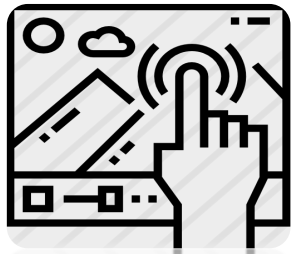
PERSUASIVE PRINCIPLES

- The most utilized conceptualization of PT is presented as design principle **(Fogg, 2003b)**
- **Oinas-Kukkonen & Harjumaa, (2009)** adopted and modified Fogg's model into the Persuasive Systems Design (PSD) that consider the persuasion principles as the main requirement for software qualities.
- **Lockton, Harrison, & Stanton, (2010)** introduced Design with Intent Method (DwI) that consists of inspiration mode and prescription mode.
- The intent in DwI field is usually linked to commercial benefit compared to other research of persuasive technology in which the concern is the persuasion with the intended social benefit, e.g: encouraging exercise and reducing energy use.

Computer as a tool	Computer as a media	Computer as a Social Actor
•Conditioning Principle •Tunneling Principle •Reduction Principle •Suggestion Principle •Tailoring Principle •Surveillance Principle •Self-Monitoring Principle	•Rehearsal Principle •Cause and Effect Principle •Simulation in Real-World Context Principle •Virtual Rewards Principle	•Attractiveness Principle, •Authority Principle •Similarity Principle •Praise Principle •Reciprocity Principle

Primary Task	System Credibility	Dialogue Support	Social Support
☐ Self-monitoring	☐ Authority	☐ Liking	☐ Cooperation
☐ Rehearsal	☐ Expertise	☐ Reminders	☐ Competition
☐ Tailoring	☐ Surface-credibility	☐ Rewards	☐ Normative influence
☐ Tunneling	☐ Third-party endorsements	☐ Suggestion	☐ Social learning
☐ Reduction	☐ Trustworthiness	☐ Similarity	☐ Social facilitation
☐ Simulation	☐ Real-world feel	☐ Social Role	☐ Social comparison
☐ Personalization	☐ Verifiability	☐ Praise	☐ Recognition

DESIGN PRINCIPLES



MULTIMEDIA PRINCIPLES

- An interactive media application that intends to persuade people toward behavior change and attitude can be an effective persuader if it is well-designed (Fogg, 2003b; Fogg, Cuellar, & Danielson, 2007).
- Accordingly, there are a few multimedia design principles as suggested by few a number of well-known researchers in multimedia

Mayer's Design Principle (Mayer, 2005)

- Coherence Principle
- Signaling Principle
- Redundancy Principle
- Spatial Contiguity Principle
- Temporal Contiguity Principle
- Segmenting Principle
- Pre-training Principle
- Modality Principle
- Multimedia Principle
- Personalization Principle
- Voice Principle
- Image Principle

Nielsen's Design Guidelines (Nielsen & Molich, 1990)

- Visibility Principle
- Feedback Principle
- Constraint Principle
- Mapping Principle
- Consistency Principle
- Affordances Principle

Don Norman's Principle (Norman, 1988)

- System status visibility
- Match between system and the real world
- User control and freedom,
- Consistency and standards
- Recognition rather than recall,
- Flexibility and efficiency of use
- Aesthetic and minimalist design
- Help user to recognize
- Diagnose and recover from errors
- Help and documentation

COMPARATIVE STUDY

Online databases

- Public Library of Science (PLOS), Elsevier, Sage, PubMed, BioMed Central, ScienceDirect and IEEE Xplore Digital Library

Keywords

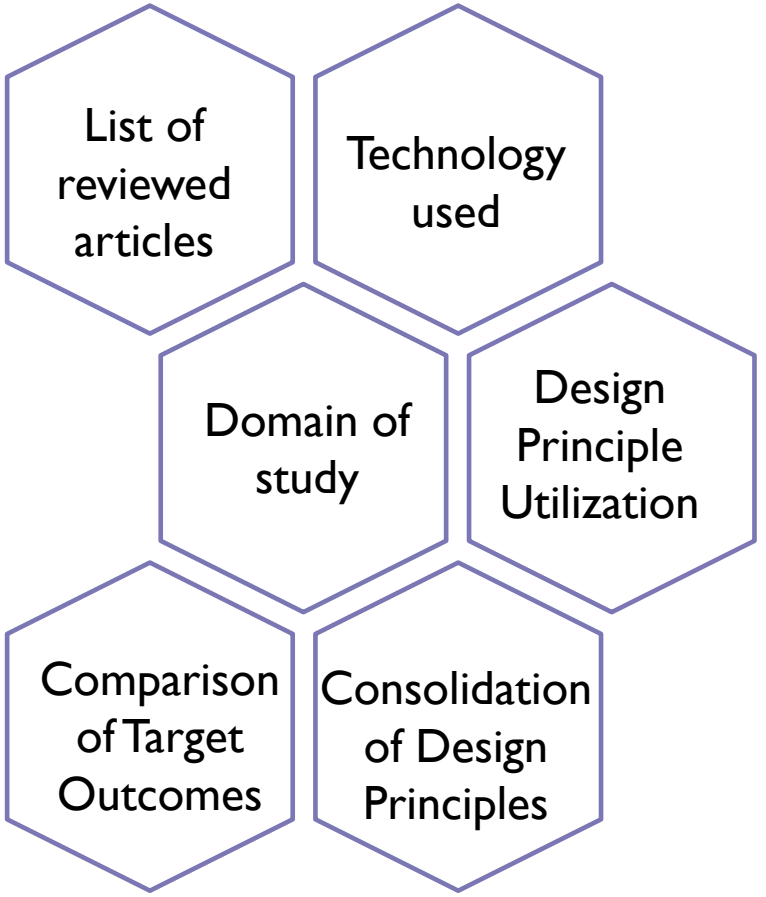
- Persuasive multimedia, wearable multimedia, persuasive wearable, wearable persuasive multimedia

Criteria

- The articles were published in between the year 2009 to 2020 from various countries
- The articles are related to persuasive technology, multimedia and wearable technology in various domains
- The articles are related to studies that utilize persuasive technology with multimedia or/and wearable technology

20 existing studies (2009 to 2019) related to persuasive system which adopt persuasive technology, multimedia and/or wearable technology were **selected**

FINDINGS AND DISCUSSION



LIST OF REVIEWED ARTICLES

Code	Author	Study
A1	(Yahaya & Hashim, 2018)	Persuasive Multimedia Application for enhancing primary school students' knowledge and awareness of obesity Risk (PerMOss)
A2	(Yahaya & Zaini, 2018)	Persuasive Multimedia application on the topic of Islamic funeral
A3	(Said, Musa, Sakamat, & Idris, 2018)	Persuasive Multimedia application for children readiness towards circumcision (BraveBoy)
A4	(Dohalit et al., 2018)	Persuasive Multimedia in Truancy Awareness (PMTA) (Kitakan Kawan)
A5	(Adlington, Shi, Chong, Soubutts, & Li, 2018)	Mobile application-based behavior change support system (HealthyMind)
A6	(Koo et al., 2018)	Wearable Glove for Autism Spectrum Disorders (Autisense)
A7	(Ferraro, Stepanivic, & Ferraris, 2018)(Ferraro, Stepanivic, & Ferraris, 2017)	Wearable Persuasive System to prevent Respiratory Disease (POD (Plurisensorial Device to Prevent Occupational Disease))
A8	(Shih & Jheng, 2017)	Persuasive game for encouraging energy saving behavior
A9	(Hussain, Cripwell, Berkovsky, & Freyne, 2016)	Wearable Persuasive to promote UV exposure awareness
A10	(Noor, Zulkifli, Yusoff, & Siraj, 2013)	Islamic Sex Education (ISE) Courseware in multimedia technology learning

Code	Author	Study
A11	(Zulkifli, Ahmad, Bakar, Mat, & Noor, 2015)	Interactive Persuasive Learning for the elderly
A12	(Sharma, Jagyasi, Raval, & Patil, 2015)	Agricultural activity training using multimedia and wearable sensing (AgriAcT)
A13	(Yahaya & Zain, 2014)	Persuasive multimedia to form a positive attitude toward disabled parking abuse
A14	(Othman & Yahaya, 2012)	Persuasive multimedia to raise children awareness of child sexual abuse
A15	(Ismail, Ahmad, Rosmani, & Shuib, 2012)	Interactive persuasive mobile game (Smoke shooter)
A16	(Yahaya et al., 2012)	Persuasive multimedia to raise stress awareness
A17	(Yusoff, Zulkifli, & Mohamed, 2011)	Persuasive Multimedia courseware for virtual Hajj learning (V-Hajj)
A18	(Rosmani & Wahab, 2011)	Persuasive multimedia application for Arabic characters learning (i-IQRA')
A19	(Salam & Yahaya, 2009)	Persuasive Multimedia Learning for reducing children dental anxiety
A20	(Soler, Zacarías, & Lucero, 2009)	Mobile Persuasive Game to raise oral health and dental hygiene awareness (Molarcropolis)

DOMAIN OF STUDY & TECHNOLOGY USED

DOMAIN OF STUDY

- All the studies were classified based on the intention of the study either to promote healthy lifestyle, educating and learning, or to encourage people in saving the environment

Domain	Study	Percentage
Health (promote healthy lifestyle)	A1, A5, A6, A7, A9, A15, A16, A19, A20	45%
Education/Learning (educating/learning)	A2, A3, A4, A10, A11, A12, A14, A17, A18, A19	50%
Environment	A8, A13	5%

TECNOLOGY USED

- The design principles has been implemented in various technologies
- Computer-based and mobile are the preferable technologies by many studies

Technology	Study	Total
Computer-based	A1, A3, A4, A10, A11, A13, A14, A17, A18, A19	10
Mobile (Smartphone)	A2, A5, A7, A9, A12, A15, A16, A20	8
Wearable	A6, A7, A9, A12	4

COMPARISON OF TARGET OUTCOMES & DESIGN PRINCIPLE UTILIZATION

COMPARISON OF TARGET OUTCOMES

- Almost half of the persuasive study was targeting awareness as their outcomes
- Many studies were also targeted many outcomes

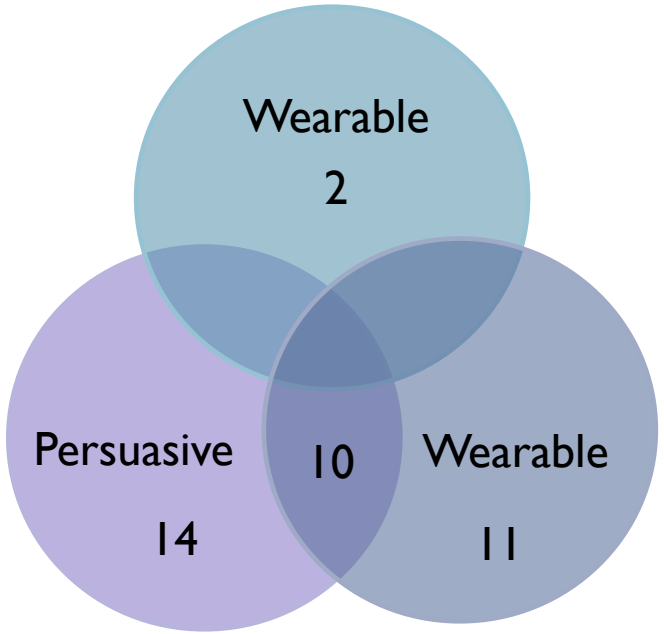
Behavioral/Psychological Outcomes	Study	Percentage
Behavior	A3, A5, A7, A15, A17	29.4%
Attitude	A13, A17	11.7%
Motivation	A3, A5, A7, A16, A19	29.4%
Awareness	A1, A4, A7, A8, A9, A14, A16, A20	47.1%
Self-efficacy	-	-
Adherence and Compliance	-	-
Habit	A20	5.88%
Knowledge	A1, A2	11.8%
Intention	-	-
Engagement and Acceptance	A5, A11, A17, A18	23.5%
Belief and Perception	A1, A3	11.76%
Others	-	-

DESIGN PRINCIPLE UTILIZATION

- Overall, 29 persuasive principles, 13 multimedia principles and 4 wearable principles have been identified from all studies.
- For each design principle, there are some principles that are commonly used in the studies.

Design Principle	Principle	Study	Total
Persuasive Design Principle	Cause and effect	A1,A4,A15,A16,A17,A20	6
	Similarity	A1,A4,A12,A14,A16,A18,A19	7
	Suggestion	A1,A8,A12,A14,A20	5
	Attractiveness	A3,A4,A12,A14,A15,A17,A20	7
	Praise	A3,A4,A15,A18,A19	5
Multimedia Design Principle	Coherence	A4,A10,A16,A17,A19	5
	Multimedia	A4,A10,A16,A17,A18,A19	6
Wearable Design Principle	Comfort	A6,A7	2

CONSOLIDATION OF DESIGN PRINCIPLES



- It is recommended to use paired principles that complement each other in strengthening the effect of persuasive (Wildeboer et al., 2016)
- 14 studies utilized persuasive design principle, 11 implemented multimedia design principle, 2 studies highlighted wearable design principle
- 10 of the studies were found to consolidate the persuasive and multimedia principles
- Nevertheless, two studies that working on wearable technology and persuasive technology are not highlighting the integration of wearable and persuasive design principles

CONCLUSION

Discovery	The design principles were leveraged in various domains especially in health and education.
	The design principles are also implemented in wearable technology besides computer and mobile technology
	Awareness was found to be the most targeted outcome
	Many studies had consolidated the design principles in their work
Proposal	The consolidation of design principles could enhance the effectiveness of a persuasive system to achieve the targeted outcome of a study
	It is crucial to further explore the integration of wearable, persuasive and multimedia principles as the information on it is still at infancy

THANK YOU

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This research is supported by the Ministry of Education (MOE) Malaysia
[FRGS/1/2019/ICT04/UUM/02/5].