ISSN: 0974-8571 Vol.13 No. 2 December, 2021

International Journal of Computational Intelligence in Control

Conceptual framework for measuring the Acceptance of Smartwatch to check blood pressure and pulse transmission time

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Abstract

Innovative research and development in Information Communication and Technology have reshaped our daily life. Use of ICT tools in medicine has great impact on our daily life. Nowadays our life is at is at major risk of health diseases. Hypertension is becoming a chronic disease in our society. To avoid hypertension, use of Smartwatch is better option. Because most of the peoples are not aware of diseases which occurs due to the blood pressure. If these diseases are not diagnosed at early stage, then it is too difficult to control. So, by using Smartwatch they can get update of their health and will get proper treatment. But technology itself cannot guarantee the usage of technology so this research is to identify the motivating external factors that affect the students to use Smartwatch for check blood pressure and pulse transit time. Hyderabad and Jamshoro users of smartwatch was the target population of this research. Stratified random sampling techniques was used in this research. Technology acceptance model (TAM) was used with three external factors Self efficacy, Subjective norms and Trust. Quantitative research methodology has been used for this research. After data collection SPSS and SmartPLS was used for data analysis and hypothesis testing.

Keyword: Smartwatch, Hypertension, TAM, blood pressure,

Introduction

In earlier years, it has been difficult for common peoples to check their blood pressure and other physical health activities, so they had to visit hospitals and clinics. Elderly peoples are facing high levels of disabilities, due to the age-related diseases, so they need high level of greater care and assistance at their homes. Nowadays our way of life is at major risk of health diseases. Hypertension is becoming a chronic disease in our society (Ashraf Tahat,2011). Smartwatch to check blood pressure and pulse transit time is more useful and newer step for the benefit of the patient to care them, outside of the hospital to motivate safety of public and facilitate them for treatment and diagnosis (Ashraf Tahat,2011). The mobile development of digital technology has transferred the lives in the world of digital technology.

The desire of the people does not only to carry out digital products to let electronics and computers as a part of our bodies (Min Weng,2016). Healthcare professionals waste most of the time moving b/w patients and office, while the supportive technology stays stable. Innovation of mobile and electronic health care is reforming the involvements of both doctors and patients in modern health care system by enhancing the potential of physiological monitoring device (Ashraf Tahat,2011).

The first digital watch was developed in 1972, it was firstly called pebble watch and recognize as modern Smartwatch (Christopher M. Gaeta ,2016). The Smartwatches has good history in the field of pervasive computing. according to cechinato, cox, and bird (2015) the modern smartwatch, which can connect other devices by wireless by clock, range of sensors and stores them as integrated. Smartwatches are wearable mini computers in the form of wristwatches providing more features besides time keeping, display, email, messages and much more(Stephanie Hui-Wen Chuah et.al , 2016).Smartwatch give alarm when anything happens in health care, like high Blood pressure and increase or decrease heartbeat.

Smartwatches comprises of potential for supporting health in everyday life to empowering self-monitoring of individual activity to get input based on movement measures to allow for surveys and identifying patterns of behavior and to support bi-directional communication with those of health care providers and family members. Moreover, Smartwatches emerge technology and research with these devices at initial stage. According to WHO, raised blood pressure is major cause of 7.1 million deaths approximately 13% of the world, About1 billion people surviving from B.P and more than half billion will

survive due to silent killer in 2025(Ashraf Tahat,2011). To control the hypertension and to diagnose B.P is major challenge for these days (Ashraf Tahat,2011). Smartwatch is more useful and new approach for patient care outside of hospital. In this proposed model we must determine the factors for acceptance of intention to use Smartwatch for B.P and pulse transit time using technology acceptance model.

Fig.1 First pebble watch

Problem Statement

The hypertension is an age concern disease and extend life and situation that show advance age. The social process has altered many aspects of daily life, driving, public transit living in narrow cities done less exercise, and thus easy access of energy foods. According to WHO, it is called worldwide outbreak, which expect that 40% of world population's adults 25 years and older have been diagnose with high blood pressure.so many people have wanted to control and monitor to improve their health have bought home B.P monitor (Karen Ng,2017). AS we early notices that according to report of WHO 40% of world's population is influenced by hypertension, it is more shocking that half of this population is aware of this condition less than half (46.5%) out of 153,966 people across 17 countries they had high B.P(Karen Ng,2017). The rate of hypertension is increasing the state of awareness, but there is quite retardation in the control if B.P watch become as widely used doctor's as latest smartwatches and activity trackers, people who only check their B.P at doctor's office can be much more observant about the B.P, it is very common among young generation, who ignore blood pressure (Karen Ng,2017). There is no intentional use of smartwatch to check blood pressure, especially the young generation.

This is proven in various studies conclude that home B.P can more accurately find the risk for hypertension cause diseases better than office B.P(Karen Ng,2017). The significance of home B.P measurements is that it permits users to actively aware of B.P value by frequent measure, and this can be held again increased with B.P watches (Karen Ng,2017). A user would motivate be more aware and act to control B.P by the freedom of measure B.P anywhere. Hypertension is worldwide outbreak (epidemic) and one of the biggest contributors to heart disease and heath (Karen Ng,2017). The Tech industries have opportunity to make significant contributors to people's awareness and control of high B.P by development of wearable B.P watches (Karen Ng,2017).

This study is to identify external motivating factors for the intention to use Smartwatch to check blood pressure and pulse transit time and validate the proposed model for acceptance of smartwatch to check blood pressure through empirical study.

Technology Acceptance Model

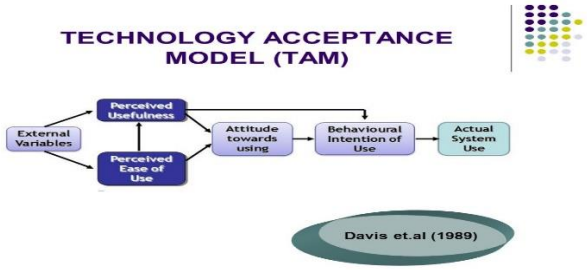
The acceptance theories and models such as DIT, TRA, TPB, TAM and UTAUT have various components that decide acceptance of technology. In (1989) Davis proposed TAM show which follow the effect of the outside variables on inside believe, states of mind and intension of the client. concurring to communication and data innovation TAM is one of the most commonly demonstrate to getit the person acknowledgment of emerged datahypothesis of contemplated activity (StephanieHui-WenChuahet.al,2016). TAM is an appropriation of hypothesis of contemplated Activity (TRA) by Fishbein and Ajzen (1975) and basically outlined for modeling client acceptance of data Information technology (Davis,1989). A well-studied theory rooted in behavioral psychology originates from TAM (Ajzen & Fishbein, 1980). TAM model explains the acceptance of IT and users' behavior. It is important to understand that the theory is about, what we believe or what we perceive the technology to be. In fact, TAM is too much popular so that it has been cited in most of the analyst, which deals with user acceptance of technology (Lee, Kozers & Corson,2000).

Today's research about technology acceptance is still running that is why the understanding of the presumptions, qualities and confinements of the technology acceptance model is necessary for anybody willing to study the user acceptance of technology to understand the Technology Acceptance Model. Therefore, to better understand the acceptance of students, this research extends the TAM in the Smartwatch acceptance perspective, specifically in the context of a developing economy of country (i.e., Pakistan). TAM suggests that user's motivation can be explained by three major factors accepting of technology are:

1. Perceived Ease of use (PEOU)
2. Perceived Usefulness (PU)
3. Behavioral Intention (BI)

Figure 2 shows (PU, PEOU, A, and BI) are utilized in TAM.

Fig.2: Technology Acceptance Model



Perceived Ease of use (PEOU)

The degree to which a user accepts that employing using a framework would be free from physical and mental exertion (Davis,1989). Perceived ease of use measures the technology should be easy to use and easy to learn to operate, so the user become skillful with system. It needs low mental effort and navigation is easy

Perceived Usefulness (PU)

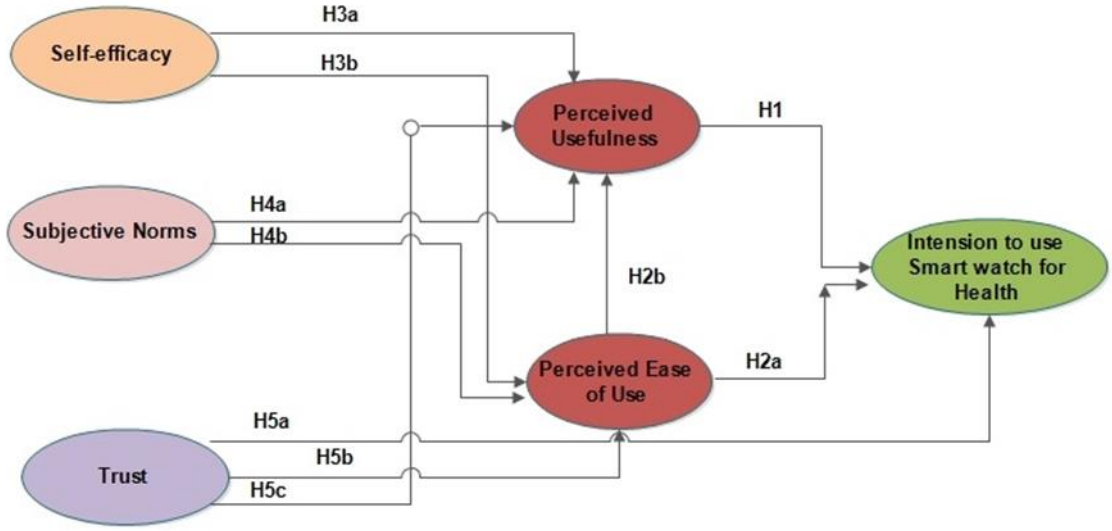
The degree to which a user accepts that using a framework would increase his or her job performance (Davis,1989). Job performance, productivity, and quality of work would be measured by perceived usefulness.

Behavioral Intention (BI)

Fishbein and Ajzen (Ajzen & Fishbein, 1980) define in TORA that behavioral intention as the agent's willing that he or she will perform the behavior. The behavioral intention as 'the degree to which a person has characterized cognizant plans to perform or not perform a few indicated future behavior' (Warshaw & Davis, 1985, p. 214).

Proposed Research Model Acceptance of Smartwatch in healthcare (SWAMH) and Hypothesis

Figure 3: Proposed Research Model



Hypothesis Formulation:

Perceived usefulness:

Hypotheses-1: Perceived Usefulness will have positive significant influence on Intention to use Smart watch for health.

Perceived Ease of use:

Hypotheses-2a: Perceived Ease of Use will have a positive significant influence on Intention to use Smart watch for health.

Hypotheses-2b: Perceived Ease of Use will have a positive significant influence on Perceived Usefulness.

Self-Efficacy

Judgment of one's capacity to utilize a technology to achieve a work. The self-efficacy is people believe in their capacity to utilize the technology to fullfills the work by which technology is applied.

Hypotheses-3a: Self Efficacy will have a positive significant influence on Perceived Usefulness.

Hypotheses-3b: Self Efficacy will have a positive significant influence on Perceived Ease of Use.

Subjective Norms

Subjective norm is "Person's recognition that most individuals who are imperative to him think that he or she should perform the behavior in question (Venkatesh et al,2003).

Hypotheses-4a: Subjective Norm will have a positive significant influence on Perceived Ease of Use.

Hypotheses-4b: Subjective Norm will have a positive significant influence on Perceived Usefulness.

Trust

Trust is defined as users' certainty in quality and reliability (Gefen et al,2003). This commitment of trust is to make sure of better rewards from financial activities so that people make efforts to diminish this social complexity and a strategic

distance from being risk from being misused (Wrightsman, 1972).

Hypotheses-5a: Trust will have a positive significant influence on intention to use Smart watch for health.

Hypotheses-5b: Trust will have a positive significant influence on Perceived Ease of Use.

Hypotheses-5c: Trust will have a positive significant influence on Perceived Usefulness.

Methodology

This study is based on positivism philosophy in which deductive approach is applied This is a cross-sectional, survey-based research so, the Quantitative methods have been applied. Data was collected by the questionnaire is based on conceptual model. A Seven-point Likert scale extending from (1) strongly disagree to (7) strongly agree have been used throughout the research questionnaire

Data Analysis and results

Demographics data results

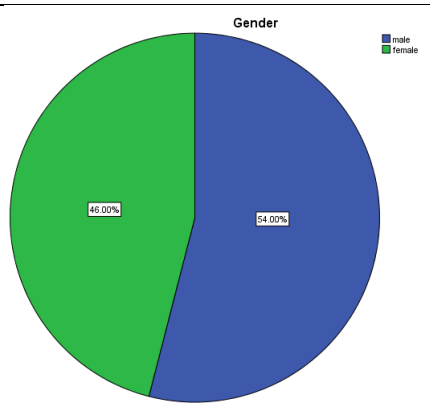
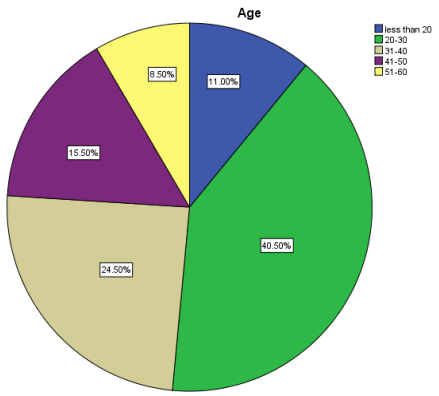
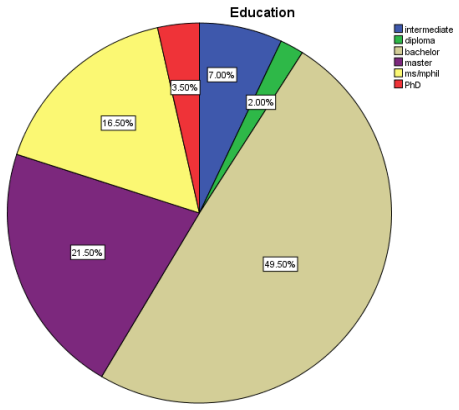
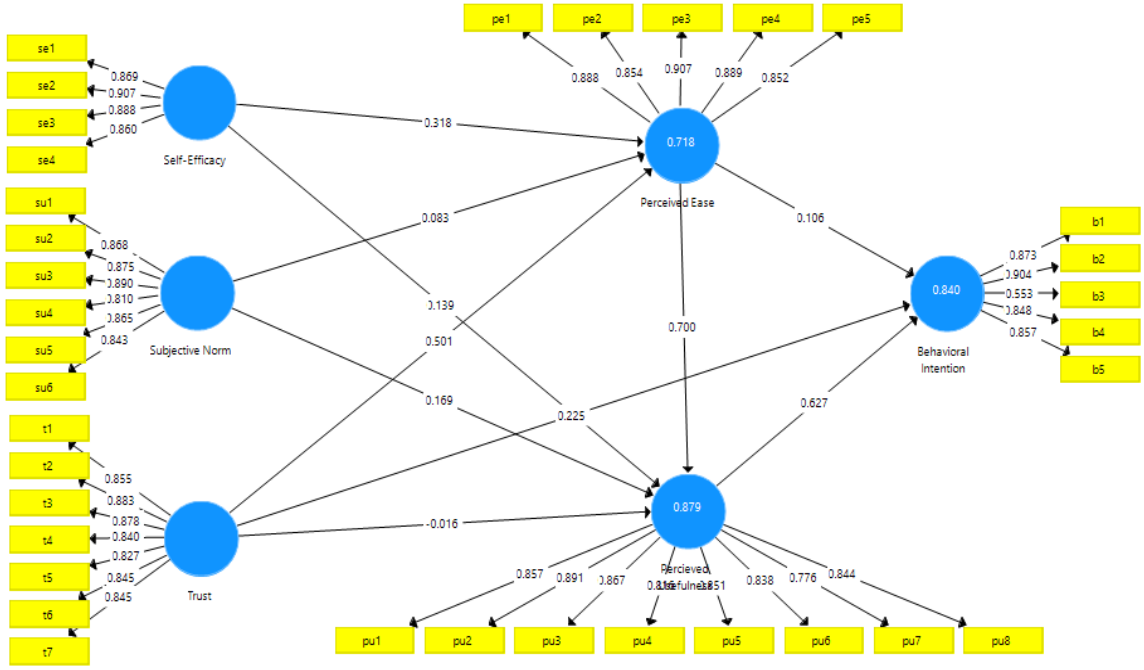
Variable(s)	Frequency (n)	Percentage (%)	
Gender			
Male	108	54	
Female	92	46	
Total	200	100	
Age			
Below 20	22	11	
20-30	81	40	
31-40	49	24.5	
41-50	31	15.5	
51-60	17	8.5	
Total	200	100	
Education			
Intermediate	14	7	
Diploma	4	2	
Bachelor	99	49.5	
Master	43	21.5	
MS/MPhil	33	16.5	
PhD	7	3.5	
Total	200	100	

Table 1: Profile of the Respondent

Measurement Model Analysis

The relationship between the latent variables and their indicators is defined in the measurement model.

Figure 3: Measurement Model



Assessment of construct reliability and validity

Construct	Indicator (s)	Indicator Reliability (Loadings)	Composite Reliability	AVE	Convergent Validity (AVE>0.5)	Discriminant Validity
Behavioral Intention	b1 b2 b3 b4 b5	0.872 0.905 0.552 0.849 0.856	0.907	0.668	Yes	Yes
Perceived Ease	pe1 pe2 pe3 pe4 pe5	0.889 0.854 0.907 0.888 0.851	0.944	0.771	Yes	Yes
Perceived Usefulness	pu1 pu2 pu3 pu4 pu5 pu6 pu7 pu8	0.858 0.892 0.868 0.816 0.851 0.837 0.774 0.844	0.952	0.711	Yes	Yes
Self-efficacy	se1 se2 se3 se4	0.870 0.908 0.888 0.860	0.933	0.777	Yes	Yes

subjective Norm	su1 su2 su3 su4 su5 su6	0.868 0.875 0.890 0.810 0.865 0.843	0.944	0.738	Yes	Yes
Trust	t1 t2 t3 t4 t5 t6 t7	0.853 0.883 0.877 0.840 0.827 0.847 0.846	0.949	0.729	Yes	Yes

Table 3: Reflective Measurement Model Assessment

2. Discriminant validity using Fornell and Larcker (1981)

The second approach of testing discriminant validity Using the Fornell and Larcker (1981)

	Behavior	PE	PU	SE	SU	Trust
Behavioral Intention	0.817					
Perceived Ease	0.867	0.878				
Perceived Usefulness	0.903	0.920	0.843			
Self-efficacy	0.869	0.784	0.819	0.882		
Social Norm	0.829	0.739	0.792	0.853	0.859	
Trust	0.808	0.815	0.794	0.789	0.770	0.854

Table 5: Fornell-Larcker Criterion Analysis for Discriminant Validity

3.HTMT for Assessing Discriminate validity

Third method for assessing Discriminant validity is suggested by Henseler et al., (2015) the Heterotrait-Monotrait criterion.

The HTMT scores in this study are below the threshold of 1 indicating that discriminant validity has been established.

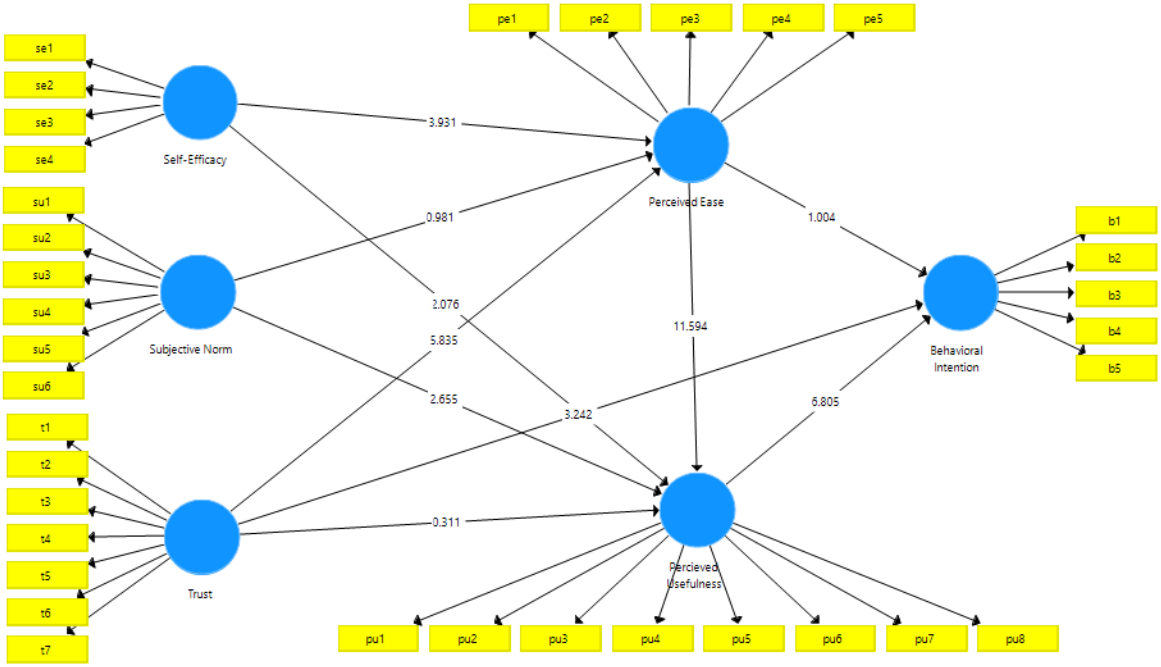
	Behavioral Intention	Perceived Ease	Perceived Usefulness	Self- efficacy	Social Norm	Trust
Behavioral Intention						
Perceived Ease	0.951					
Perceived Usefulness	0.983	0.986				
Self-efficacy	0.964	0.854	0.884			
Social Norm	0.905	0.791	0.841	0.928		
Trust	0.881	0.874	0.844	0.857	0.821	1.000

Table 6: Heterotrait-Monotrait Ratio of Correlations (HTMT) Criterion Analysis for Discriminant validity.

Assessment of Structural Model

Hair et al. (2017a) suggests that the structural model, or inner model, shows the relationships among the conductions being examined. There are five steps suggested by Hair et al (2017b).

Figure 4: Structural Model Analysis



Hypotheses	Direct Effect	S. D	T-value	P-value	Hypothesis Testing Result
Perceived Usefulness -> Behavioral Intention	0.625	0.090	6.965	0.000	Significant
Perceived Ease -> Behavioral Intention	0.110	0.102	1.081	0.280	Not Significant
Perceived Ease -> Perceived Usefulness	0.700	0.062	11.352	0.000	Significant
Self-Efficacy -> Perceived Usefulness	0.362	0.086	4.214	0.000	Significant
Self-Efficacy -> Perceived Ease	0.318	0.081	3.939	0.000	Significant
Subjective Norm -> Perceived Ease	0.082	0.080	1.031	0.303	Not Significant
Subjective Norm -> Perceived Usefulness	0.226	0.094	2.407	0.016	Significant
Trust -> Behavioral Intention	0.224	0.069	3.236	0.001	Significant
Trust -> Perceived Ease	0.501	0.079	6.336	0.000	Significant
Trust -> Perceived Usefulness	-0.016	0.055	0.297	0.767	Not Significant

Table 8: Path Coefficient Assessment (N = 200)

Conclusion

This study has investigated ten Hypothesis based on Six factors for the Acceptance of Smartwatch to check blood pressure and pulse transit time. The seven factors of them are supporting and three are not supporting the acceptance of Smartwatch to check blood pressure and pulse transit time. This research has explored to check blood pressure and pulse transit time by using Smartwatch through TAM model in Jamshoro and Hyderabad. There is less use of Smartwatch in the developing country like Pakistan. therefore, this research has provided information about perceived intention of using Smartwatch to check blood pressure and pulse transit time. The current study has contributed to Research Literature and extends the TAM model then checks in the context of Pakistan. Perceived Usefulness has extremely strong significant influence of intend to use Smartwatch to check blood pressure and pulse transit time. A very little work is available on the topic such as Smartwatch to check blood pressure and pulse transit time in Pakistan. The current study is the first approach for such type of problems in Pakistan.

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