

Evaluating the Usage of Virtual Reality Technology in Healthcare Sector of Saudi

Arabia

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Abstract

All countries around the world seek to implement modern technologies in all areas of life including medicine where the kingdom of Saudi Arabia is one of those countries which aspire the medical efficiency that characterizes it around the world by applying technologies in medicine and healthcare field which in turn will contribute to achieve its 2030 vision as it chiefly depends on technology. There are too many technologies which serve healthcare sector one of them is the use of (VR) Virtual Reality which has contributed positively in several healthcare applications such as medical training, treatment and Disease Awareness. So, our paper aims to evaluate the usage of VR technology in healthcare Sector of Saudi Arabia. We conducted our study on sample of doctors of Saudi Arabia hospitals through interview and online survey in which some factors have been taken under consideration such as the motivations of use it, obstacles they faced, suitable field to use it and their opinions toward it. The preliminary finding of this study shows that more than fifty percent of physicians have already used VR technology and the majority of them were optimistic to use it. Moreover, we use a cause and effect diagram to illustrate the limitations of using VR technology and we proposed some solutions to overcome these limitations. We are going to discuss more about the results and further details.

Keywords: Virtual Reality (VR), Saudi Arabia (SA), Healthcare, Technology, Hospitals, Physicians.

I. Introduction

With the continuous improvement of technology, it has a significant impact on our daily life in various area. Medicine is one of the most important area in where the scientists have taken these technologies and harness them in the field of medicine and health, which helped in the achievement of positive outcomes. For instance, providing better health care, reducing medical errors, facilitating communication between doctors as well as Predicting the spread of diseases and more.

It has been argued that, the success of most healthcare organizations relays on how they implement effective technologies to improve their environment and achieve competitive advantages.

In this paper, we focus on the use of Virtual Reality technology especially in Saudi Arabia hospitals and demonstrate how it impacted their environment. Initially, Virtual Reality technology can be defined as “an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accepts it

as a real environment” [1]. According to the previous experiences of using VR technology in healthcare sectors indicated that the advantages of using it exceeded the disadvantages. Some of these advantages are as follow it makes training for medical student more attractive and entertainment, it helps to calm patients as well as get rid of stress and it facilitates for physicians to understand conditions of patients and diagnose them quickly. On other hand, there are some obstacles which were associated with the usage of VR technology summarized in the following. First, the staff don’t have enough experience to handle and interact with the technology. Also, the cost of implementing the VR is expensive, lack of technology support and it takes time to persuade the patients to use it.

As we mentioned earlier, a sample of SA physicians selected to conduct our study through interview and an online survey where the questions addressed multiple aspects will discuss in detail. Moreover, we are going to indicate an overview of VR technology and present some studies which were done in several areas around the world to clarify how they implement VR technology and what they derived from it. Also, we are going to illustrate objective, results and conclusion of our study.

A. Objective of the Study

This is an initial study which aims to assess the usage of virtual reality technology in hospitals of Saudi Arabia by demonstrating its effectiveness and the motivations that led them to use it. Also, to illustrate the obstacles encountered during the implementation of VR technology as well as trying to provide solutions to overcome these challenges and expand its usage among SA hospitals. Moreover, to encourage next generation of medical student to educate and better understanding of medical concepts.

II. Overview of Virtual Reality Technology

Virtual Reality can be defined as “a way for humans to visualize, manipulate and interact with computers and extremely complex data” as demonstrated by Isdale [2]. Tony Parisi [3] reported that, “Virtual Reality comprises a collection of technologies: 3D displays, motion tracking hardware, input devices, software frameworks, and development tools”.

From the definitions, we deduce that virtual reality technology aims to present a three-dimensional image of thing as it is actually. There are two components in order to build VR which are hardware and software components.

According to [4], “the hardware components are divided into five sub-components: computer workstation, sensory displays, process acceleration cards, tracking system and input devices. The software components are divided into four sub-components:

3D modeling software, 2D graphics software, digital sound editing software and VR simulation software”.

There are too many uses of VR technology in our life such as military training, education, entertainment, industry, engineering and medicine. Its applications are numerous and their fields wide, but medicine is the biggest beneficiary of this technique also games are more famous to use it.

III. Literature Review

The beginning of using VR in healthcare area was at the early 90's in helping the surgeries to plan by visualize the complex data [5]. Several studies discuss the implementing of the virtual reality on different fields of health care sector, such as: the pain management, mental health therapy and medicine training.

The first study is according to Debashish et al. [6], a random trail had been conducted to examine the usage of virtual reality games on nine children (5-18 years) who had burn injuries. Also, the researchers use the faces scale to let the children determine their pain. In addition, they interviewed the parents and the nurses to gain the data. The result of this study supports the usage of VR to manage the children pain by distracting mind during the treatment. However, the sample size of this study is small. As a result, it is difficult to generalize it. Moreover, the researchers used several methods to prove the efficacy and the effective of using the VR, such as: comparing the results of two groups. the following studies were applied in the treatment filed.

According to [7], in a controlled clinical trial, twenty-eight overweigh females are allocated to two groups which are the virtual reality group and psych nutritional group based on a cognitive-behavior approach. All the females had a restricted diet and physical training. Moreover, the females of virtual reality therapy group show more body satisfaction and motivation to change than the psych nutritional group. The study did not conduct a follow-up to check the groups status. So, there is no evidence for the constantly of the results

Also, Santos Mendes et al. in [8], represented a study on twenty-seven participants (16 patients with early-stage Parkinson's disease and 11 healthy elderly people). They found the ability of Parkinson's disease patients to gain a knowledge and the enhancement on their performance by using VR games (Nintendo Wii Fit™). The enhancement of their abilities is based on the game type selection.

As Saposnik et al. in [9] demonstrated that, in randomized clinical trial on the patients who had a stroke within two months, they divided the participants to two groups which are the virtual reality using the Nintendo Wii gaming and recreational therapy. Based on the results, they found the VR Wii gaming is a secure and effective way to a rehabilitation therapy after stroke.

The following studies were conducted on the surgical training field by using the VR technology.

In a randomized study, the participants were divided into two groups which are the virtual reality system and conventional video trainer. Furthermore, each group had twelve trainees and four experts. The result has shown that the participants in the VR group had more improvement in their surgical skills as in [10].

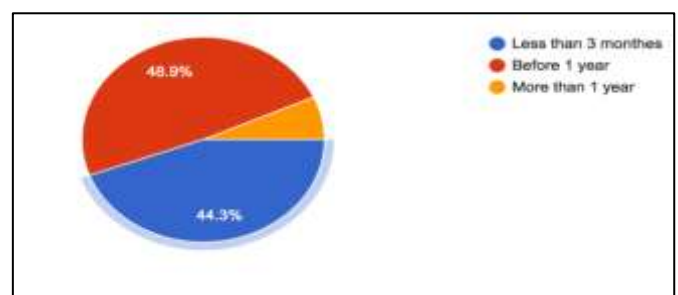
In addition, as indicated by Grantcharov et al. [11], sixteen surgical trainees were randomly selected to do a training about a laparoscopic cholecystectomy by using VR technology. This helped them to perform the procedure on the patients in the operating room (OR). The result of the participants, who took a VR training, showed improvement in their performance than those who didn't take it. It seems that, the comparison method is a good way to get more accurate and fast results.

IV. Methodology

In order to evaluate the usage of VR technology in hospitals of Saudi Arabia, an unstructured interview was conducted with few doctors in some health centers in Riyadh city of Saudi Arabia, to collect data about effectiveness of use the technology during vaccination of children and withdraw blood samples.

Moreover, an online survey was delivered to a sample of 150 physicians of both gender male and female from different hospitals of Saudi Arabia. The survey date was from October 6 ,2018, to November 13, 2018 where we suspended responses to view and discuss results. The questionnaire started by asking the doctors whether they had ever tried the VR technology or not, so if they answered yes, they have to complete the questionnaire otherwise they have to submit their responses. Questionnaire covered multiple aspects beginning with specified the last time the technology was used followed by indicated the suitable field to use VR technology whether in training, surgeries, treatment or diagnosis. The third question was to determine their satisfaction of using technology where the forth one specified the reasons that motivated them to use it whether making education more attractive, contributed to calm patients, develop service provided or other.

Furthermore, they illustrated obstacles they faced during implementation which could be lack of support, experiences, patients refuse to use it or other. Their opinions were specified toward their acceptance to be trained through technology among extent of their agreement, using VR technology in the future of healthcare sectors whether achieve



positive or negative outcomes, reasons of limited usage of technology in SA hospitals and their degree of expectations of expand the use of technology in SA hospitals toward 2030 vision was scaled from 1 to 5 where 5 considered as high. Finally, one question specified their experience of usage technology in treatment whether contributed positively or not.

V. Results and Discussion

By the interview, the results showed that the health centers in Riyadh city have been used VR technology since less than six months. They indicated that, the usage of virtual reality when vaccinating children and withdraw blood samples for the age group from 4 to 10 years, which achieved unexpected positive results to remove the fear of children. Moreover, they stated that right now they used it for vaccinating children in their schools helping to persuade them quickly and let them to enjoy during vaccination. In addition, an online survey of 150 responses illustrated that 58.7% of SA physicians have been used VR technology where 41.3% have not experienced it as shown in the following diagram.

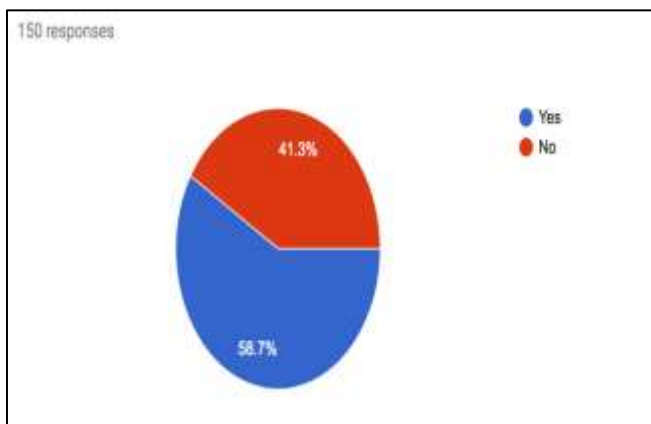


Fig. 1 Percentage of responses

According to the survey, it's clear that most of the physicians who have used VR technology was before 1 year and some of them recently less than 3 months where a few of them have used it before more than 1 year. (see Fig. 2)

Fig. 2 Last time period of using VR technology

The Previous studies have shown multiple uses of virtual reality technology in the field of healthcare and medicine. According to the responses, a high percentage indicated that they saw it more suitable in the treatment of patients about 59.1% while 37.5% of respondents saw it more appropriate to use it in training. A few percentage of respondents think it's suitable in surgeries and diagnosis field. (see Fig. 3)

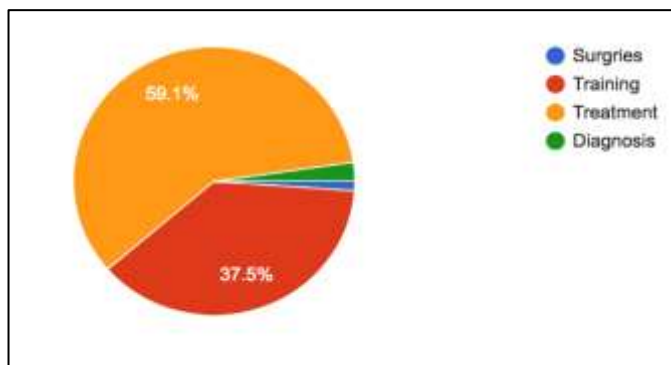


Fig. 3 Applications of VR in medicine

The following two figures demonstrate that the opinions of physicians toward VR technology. First, they showed their acceptance to

be trained through technology where more than a half of them strongly agree which was 88.6% percent followed by 10.2% of them indicated somewhat agree. No one selected strongly disagree where a few percentage stated that somewhat disagree. Second, their satisfaction during the use of this technology was scaled from 1 to 5, where 1 represented high satisfaction and 5 indicated dissatisfaction. As a result, most of them were satisfied by using it as they represented 56.8% of respondents. Then the percentage was dropped dramatically for scale 2,3 and 4 by 18.2%, 9.1% and 5.7% of respondents respectively. For scale 5, there was a little increase in percentage which indicated dissatisfaction as 10.2% of respondents.

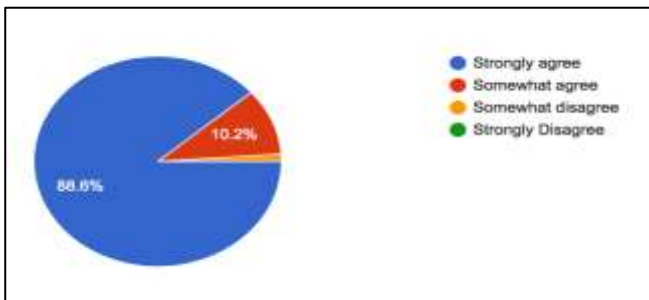


Fig. 4 Percentage of acceptance to be trained through technology

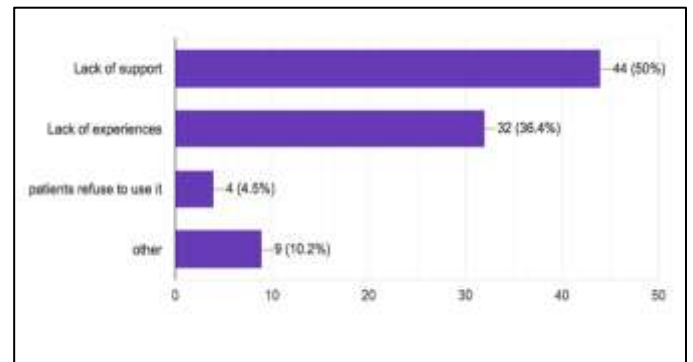
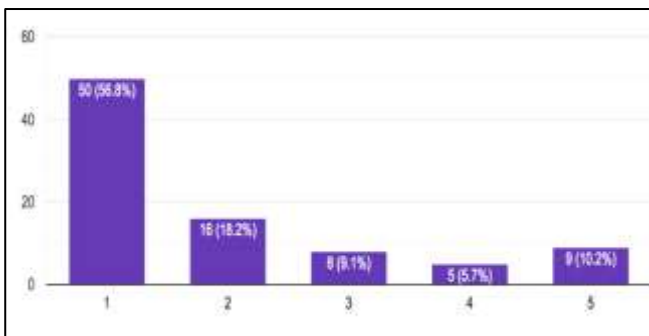


Fig. 5 The extent of satisfaction while using technology



Moreover, the results showed that 42% of respondents indicated that the motivation to use VR technology was to develop service provided where 35.2 % was in order to make education more attractive and 25% used it to calm patients as shown in the following figure.

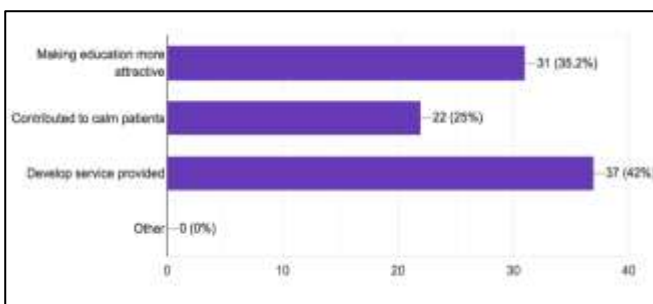


Fig. 6 Motivation to use VR technology

Also, “Implementation of new technology in health and social care can be problematic due to several inter-related factors” as demonstrated in [12].

According to [13], “Barriers can impede adoption and ongoing use of new technology”. It makes it clear that the physicians faced obstacles during implementation of VR technology where the most obvious one was lacking support which represented a half percentage followed by lack of experiences were represented 36.4%. Some respondents indicated that the patients refused to use it by 4.5% and 10.2% of them selected other obstacles.

Fig. 7 Obstacles encountered of using VR technology

In addition, the following figures demonstrate that the majority of respondent were very optimistic about the using of VR technology in the future of healthcare sectors and they expect that will achieve amazing results. Also, the next figure shows that the most of them about 45.3% highly expect that the technology will expand more in the future toward Saudi Arabia 2030 vision where 5 represented high expectation and 1 represented low one. So, most of them had high expectations and a slight percentage had low expectations. Furthermore, over 60% of respondents indicated that using VR during treatment of patients achieved positive results were less than 30% indicted sometime.

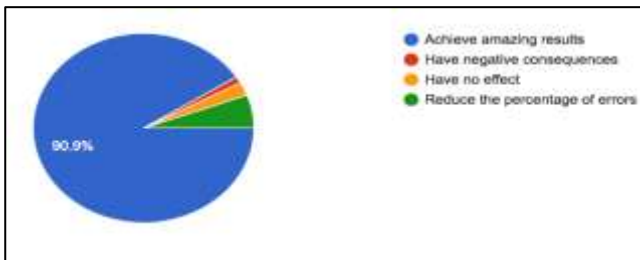
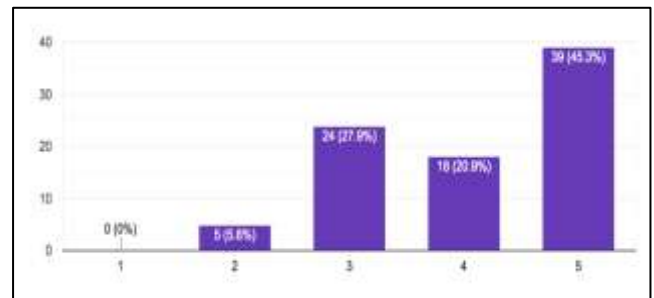


Fig. 9 Expectation toward expand technology

Fig. 8 Using VR in the future of healthcare



A. Reasons of limited usage of VR technology in Saudi Arabia hospitals

The limited usage of VR technology in SA hospitals due to several reasons which may include technical, financial or others. According to the survey, lack of technology provider was the most chosen reason by 59.1% responses which followed by an expensive of gaining technology by 23.9% responses and some of them about 18% respondents indicated the lack of both financial and technology support was the reason behind limited usage of it all of these percentages shown in the following figure.

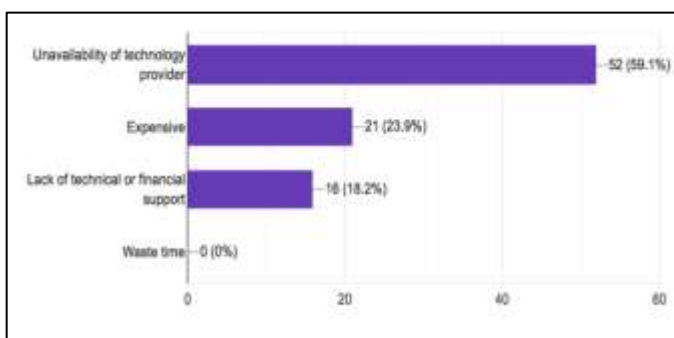


Fig. 10 Reasons of limited usage of VR in Saudi Arabia

After analyzing the results, a cause and effect diagram used to illustrate the reasons of limited usage of VR in

KSA hospitals as shown in the following figure also is called fishbone diagram because effect represent in the right side and the causes take the shape of fishbone. According to [14], “Every negative effect is caused by something, the trick is to find the right cause so it can be corrected”.

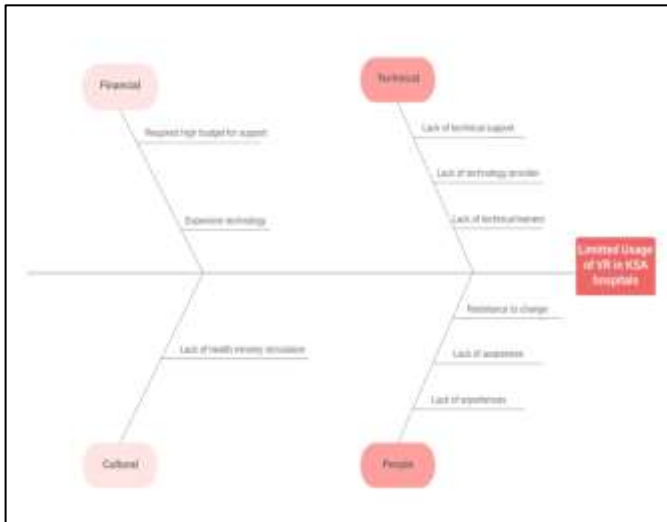


Fig. 11 Cause and effect diagram

B. Overcoming limited usage and obstacles of VR technology in Saudi Arabia Hospitals

To sum up, the results of the interview and the questionnaire indicated that most of physicians were satisfied with the use of VR technology, which has achieved positive results both in patients and in the field of training for doctors despite some of the obstacles encountered, but the usage of it is still limited to some hospitals in SA for several reasons. So, to overcome limited usage of it and obstacles encountered during implementation in order to expand its use in the future, we are coming with some solutions as follow. First, there is a need to spread awareness about the importance of virtual reality technology in medicine and how it is contributing to achieve positive outcomes. Also, provide trainers to train doctors on the use of technology and how they can overcome faults with the lowest cost and time. There is a need to have a sponsor of technology who is represented by the Ministry of Health in the Kingdom of Saudi Arabia, where they allocate budget to provide technologies in hospitals and health centers include VR and motivates them to use it, also they provide technical support. Moreover, need to permanent encouragement by the Ministry of Health for hospitals to use technology which will contribute to the achievement of SA Vision 2030. Finally, Its responsibility of the Ministry of Health to look for reliable and cost effective providers of technology and they should provide high quality products with warranties.

Conclusion

In conclusion, Virtual reality technology is still evolving and expanding its use in different field including medicine. In medicine field, it has a significant impact on the both physicians by improving their performance during training, assist them in diagnosis and treatment also, the patients by reducing their pain. As we mentioned earlier, our study considered as an initial one which presents the usage of VR in some hospitals of Saudi Arabia where more than fifty percent of physicians have already used it. It demonstrated some factors which include the advantages, obstacles of using VR and our contribution to overcome limited usage in SA hospitals. To conclude with, it's widely accepted that, using the VR technology in our healthcare sectors will help to improve the service and lead to achieve SA 2030 vision.

References

- [1] N. Chawla, N. Gupta and K. Choudhary, "Virtual Reality-Living the "CAVE" Again", *International Journal of Information and Computation Technology*, vol. 3, no. 0974-2239, pp. 555-560, 2013.
- [2] Knight and Claire , *Virtual reality for visualisation*. Department of Computer Science, University of Durham, 1998.
- [3] T. Parisi, *Learning Virtual Reality*, 1st ed. O'Reilly Media, Inc., 2015.
- [4] M. Okechukwu and F. Udoka Eze, "Understanding virtual reality technology: advances and applications", *Advances in computer Science and Engineering. InTech*, 2011.
- [5] C. Pensieri and M. Pennacchini, "Overview: Virtual Reality in Medicine", *Journal for Virtual Worlds Research*, vol. 7, no. 1, 2014.
- [6] D. Das, K. Grimmer, A. Sparnon, S. McRae and B. Thomas, "The efficacy of playing a virtual reality game in modulating pain for children with acute burn injuries: A randomized controlled trial [ISRCTN87413556]", *BMC Pediatrics*, vol. 5, no. 1, 2005.
- [7] L. Gregg and N. Tarrier, "Virtual reality in mental health", *Social Psychiatry and Psychiatric Epidemiology*, vol. 42, no. 5, pp. 343-354, 2007.
- [8] F. Mendes, J. Pompeu, A. Lobo, K. da Silva, T. Oliveira, A. Zomignani and M. Piemonte, "Motor learning, retention and transfer after virtual-reality-based training in Parkinson's disease – effect of motor and cognitive demands of games: a longitudinal, controlled clinical study", *Physiotherapy*, vol. 98, no. 3, pp. 217-223, 2012.

- [9] G. Saposnik, R. Teasell, M. Mamdani, J. Hall, W. McIlroy, D. Cheung, K. Thorpe, L. Cohen and M. Bayley, "Effectiveness of Virtual Reality Using Wii Gaming Technology in Stroke Rehabilitation", *Stroke*, vol. 41, no. 7, pp. 1477-1484, 2010.
- [10] K. Lehmann, J. Ritz, H. Maass, H. cakmak, U. Kuehnappel, C. Germer, G. Bretthauer and H. Buhr, "A Prospective Randomized Study to Test the Transfer of Basic Psychomotor Skills from Virtual Reality to Physical Reality in a Comparable Training Setting", *Annals of Surgery*, vol. 241, no. 3, pp. 442-449, 2005.
- [11] T. Grantcharov, V. Kristiansen, J. Bendix, L. Bardram, J. Rosenberg and P. Funch-Jensen, "Randomized clinical trial of virtual reality simulation for laparoscopic skills training", *British Journal of Surgery*, vol. 91, no. 2, pp. 146-150, 2004.
- [12] K. Cresswell and A. Sheikh, "Organizational issues in the implementation and adoption of health information technology innovations: an interpretative review," *Int. J. of Medical Informatics*, vol. 82, no. 5, pp. e73-e86, May 2013.
- [13] J. G. Anderson, "Social, ethical and legal barriers to E-health," *Int. J. of Medical Informatics*, vol. 76, no. 5-6, pp. 480-483, 2007.
- [14] H. Harrington and F. Voehl, *The innovation tools handbook*. New York: Productivity Press, 2016.
- [15] M. Reznek, P. Harter and T. Krummel, "Virtual Reality and Simulation: Training the Future Emergency Physician", *Academic Emergency Medicine*, vol. 9, no. 1, pp. 78-87, 2002.
- [16] J. Lee, J. Ku, W. Cho, W. Hahn, I. Kim, S. Lee, Y. Kang, D. Kim, T. Yu, B. Wiederhold, M. Wiederhold and S. Kim, "A Virtual Reality System for the Assessment and Rehabilitation of the Activities of Daily Living", *CyberPsychology & Behavior*, vol. 6, no. 4, pp. 383-388, 2003.
- [17] L. Li, F. Yu, D. Shi, J. Shi, Z. Tian, J. Yang, X. Wang and Q. Jiang, "Application of virtual reality technology in clinical medicine", *American journal of translational research*, vol. 9, no.9, PP. 3867-3880, 2017.

