A GLIMPSE OF VIRTUAL REALITY PUBLICATIONS IN ENGINEERING DISCIPLINES

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ABSTRCT

In recent times, Information and Communication Technology (ICT) has been developed and widely spread around world. ICT is used in various sectors and considered a basis in the emergence of some important technologies such as virtual reality technology. Virtual Reality (VR) is a special technology as an advanced technology connected to several fields, e.g. training, learning, science, engineering, medicine, military, etc. VR has great potentials which enabled to perform several phenomena and experiments. Hence, several scenarios have become available.   The purpose of this study is to shed light on virtual reality technology and list a glimpse of common publications and studies involved.

I.   INTRODUCTION

The spread and growth of ICT are becoming a noteworthy trend. Advances in technology and ICT revolution are considered a full power and the backbone of many areas and sectors. By ICT, the world has become an interconnected boundless world as a small village due to the ability of ICT to reduce boundaries over continents. ICT could be used through the majority segments of society and human life.

Virtual Reality (VR) is one of the most popular trends in the last decades, which depends on ICT. VR could be used in various fields such as training, learning, science, engineering, medicine, nursing healthcare, military, etc. Now, it is it is worth mentioning that the description of ICT can be stated as follows:

ICT is predominantly concerned with the infrastructure, equipment and gadgets which enable the transmission and delivery of information via digital means. Furthermore, ICT refers to the technologies and tools including computers and communication equipment used by individuals, communities and organizations for several purposes.

According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), ICT is defined as "the combination of informatics technology with other, related technologies, specifically communication technology".

In recent years, the spread of ICT elements has become a noteworthy trend. Fig.1, shows the developments of various ICT elements from

International Telecommunication Union (ITU) through the period (2001- 2019) [1].

With no doubt, the Internet is a major kernel of ICT and it has been rapidly spreading around the world, especially in recent years. Fig.2, shows the percentage of individuals for the Internet usage according to ITU statistics [2]. The ITU is a specialized organization which considered a segment of the United Nations [3].
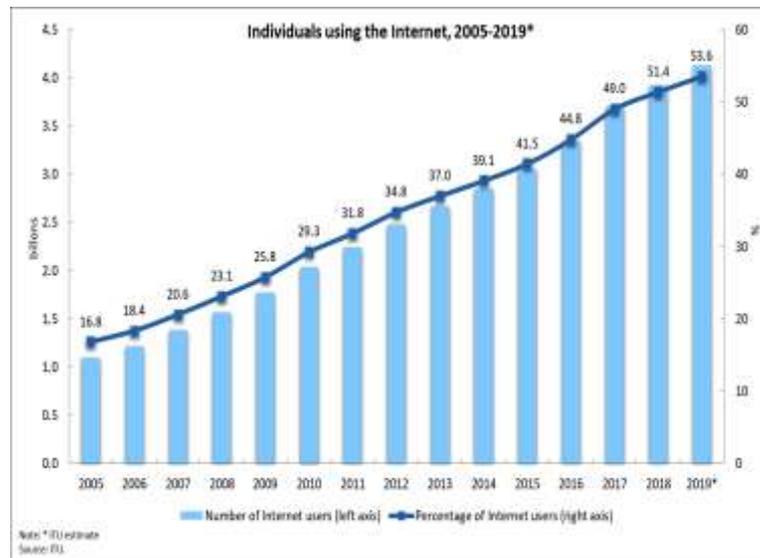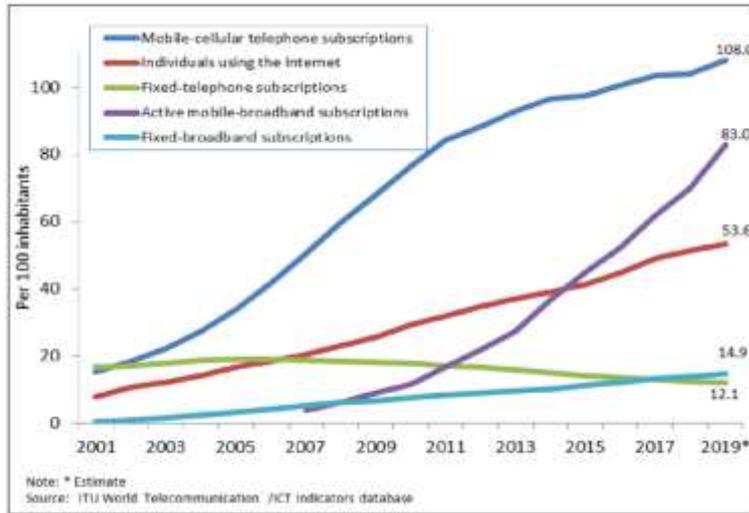

Fig. (2): Internet usage by Individuals [2]

II.   Virtual Reality Technology(VR)

Virtual Reality (or VR) is a very influential technology in various scenarios. It is used in different areas, not only in physics, chemistry, engineering, medicine, dentistry, etc., but in industrial design and development simulation, visualization, scientific domain, media industry, military training, learning and medical learning as well [4]. The term of Virtual Reality (VR) was established in 1987 by Jaron Lanier [5]. According to a previous study [6], Fig.3 indicates the concept of VR as follows:
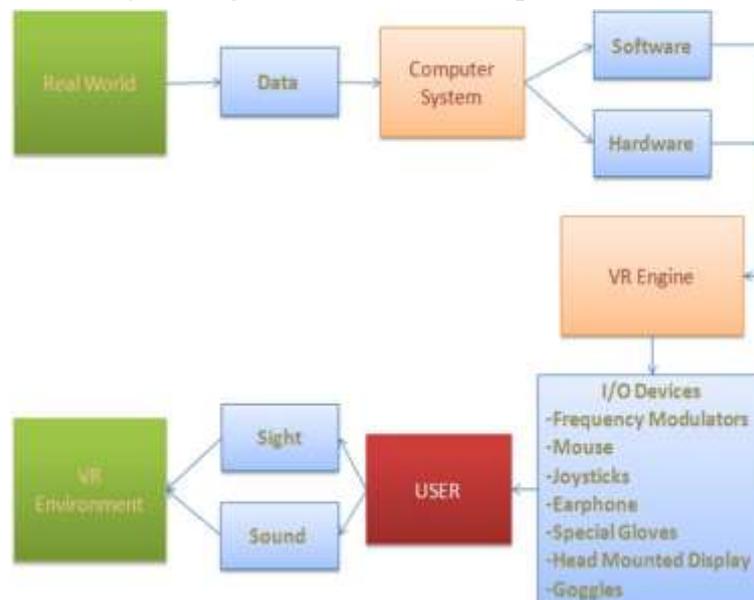

Fig. (3): VR technology concept [6]

- VR approach by computer is a method to mimic, create and generate a world of the human senses at realistic duration. Besides VR is a vital method that connected to several technologies, for instance stereo display, multimedia, network, computer emulation and graphics. Persons can monitor and interact with the generated virtual environment which is close to reality through computer and listening to live sound[7].
- VR approach could create presence emulation as an interactive interface. It is remotely enables users to perform scenarios on real environments. Therefore, VR approach can be invested in several sectors, activities and scenarios.
- VR approach could be described as an effective technological method to simulate phenomena, scenarios, activities and natural environment via ICT.
- VR approach can be performed in order to save physical environment. Moreover, VR is considered an alternative safe solution for actual environment, for example hazardous and expensive experiences.

- The aim of VR approach is to provide persons in real time simulation situation in addition to immersion in a certain environment where persons can be interactively and autonomous performs with its scenarios[8],[9]. Over recent years, the overwhelming technological evolution of VR approach has inserted a new paradigm into learning, training and teaching methods.

In this regard, there are several institutions has established the platform of virtual experiment that is appropriate for many purposes, e.g. Zhejiang University, Huazhong University of Science and Technology[10]. According to a previous study [11], for example in Iran, virtual higher education has rapidly increased in last years as an initiative for digital transformation. Table 1 presents virtual educational centers in Iran, a degree level and an enrollment size.

Table (1): Virtual Universities and virtual educational centers in Iran [11]

Higher Education Institutions	Educational level			
	Bachelors	Masters	Ph.D	Total
Isfahan University	14	320		334
Tarbiat Modarres University		168		168
Azarbayjan Tarbiat Moallem University	266			266
Tehran University	382	1300		1682
Sistan & Baloochestan University		43		43
Shahid Beheshti University		232	7	232
Shiraz University	3453	861		4314
Isfahan University Of Thechnology	204			204
Amir Kabir University Of Technology		2019		2019
Khaje Nasir Toosi University Of Technology	781	27		808
Tabriz Sahand University Of Technology	721			721
Iran University Of Science & Technology	1002	612		1614
Ghom University	1	290		291
Isfahan University Of Medical Sciences		52		52
Tabriz University Of Medical Sciences		13		13
Tehran University Of Medical Sciences		107		107
Shahid Beheshti University Of Medical Sciences		158		165
Shiraz University Of Medical Sciences		26		26
Kerman University Of Medical Sciences		4		4
Payame Noor University	275	30		305
University Of Hadith Sciences	2115	350		2465
Virtual Electronic Higher Education Institute	444			444
Faran Virtual Electronic Higher Education Institute	949			949
Noortooba Virtual Electronic Higher Education Institute	1177	104		1281
Karaj Farabi Higher Education Institute		165		165
Tehran Mehr Alborz Higher Education Institute		285		285
Total	11784	7166	7	18957

▪   VR could be used in several domains such as follows:

-        Energy industry [12].   -   Aerospace industry[13].
-        Automotive industry [14] .   -   Entertainment[15].
-        Medical[16].   -   Nursing[17].
-        Learning, health, production, machinery and transport [18].

In addition, VR could be used in engineering area. The next section presents some major publications in engineering area.

III.   Virtual Reality Publications in Engineering

The glimpse of various studies and publications of VR technology related to engineering fields is stated in Table 2.

Table (2): Studies and publications for VR related to engineering fields

No.	Study
1	3D virtual reality experiments to promote electrical engineering education
2	Electrical engineering teaching and distance learning using a desktop virtual reality system
3	VRCEMIG: A virtual reality system for real time control of electric substations
4	PEMCWebLab-Distance and virtual laboratories in electrical engineering: Development and trends
5	Consolidating learning in power systems: Virtual reality applied to the study of the operation of electric power transformers
6	Maintenance of complex machines in electric power systems using virtual reality techniques
7	3DVRLab: A virtual reality learning tool for electrical teaching experiments
8	SRV: a virtual reality application to electrical substations operation training
9	Virtual reality applied to the study of the integration of transformers in substations of power systems
10	Application of virtual reality teaching in power plant electrical Part courses
11	Virtual reality as a new trend in mechanical and electrical engineering education
12	Virtual reality-based rapid prototyping design for micro-electro-mechanical system
13	Virtual reality and learning by design: Tools for integrating mechanical engineering concepts
14	Towards the development of a virtual environment-based training system for mechanical assembly operations
15	Virtual reality technology and its application in agricultural machinery design
16	Virtual reality system for training in automotive mechanics
17	Virtual reality as a tool for verification of assembly and maintenance processes
18	Virtual Reality of Mechanical Product Design Base on AutoCAD and 3DS MAX
19	Virtual reality-a new technology for the mechanical engineer
20	Establishment of Virtual Reality Model Library of Mechanical Drawing
21	Virtual reality based marine engineering English learning environment simulation research
22	Development research of marine engine room simulator for offshore supply vessel based on virtual reality technology
23	Study on virtual maintenance training technology for the marine power plant
24	Application of virtual reality in marine search and rescue simulator.
25	Research on simulation system based on virtual reality technology for handling underwater vehicle in deep sea

Table (2): Cont.

26	Design and implementation of a 3D ocean virtual reality and visualization engine
27	Multi-level virtual reality system for marine education and training
28	Research and Realization of Visual System in Virtual Ocean Battlefield
29	Marine Nature Geographic Environment Reappearance by Using Virtual Reality Techniques
30	Development of virtual maintenance training software for marine power plant
31	Method and apparatus for virtual reality presentation of civil engineering, land planning and infrastructure
32	Visual simulation of Civil Engineering activities: Didactic virtual models
33	Virtual reality technology applied in teaching and research in civil engineering education
34	Virtual redlining for civil engineering in real environments
35	Applications of virtual reality to civil and architectural engineering projects
36	Virtual reality for the built environment: a critical review of recent advances
37	Virtual reality applications in civil engineering
38	A collaborative virtual environment for problem solving in civil engineering
39	Virtual reality studies of concrete
40	Disseminating Civil Engineering through Virtual Reality: An Immersive Interface
41	The application of virtual reality to chemical engineering and education
42	Vicher: a virtual reality based educational module for chemical reaction engineering
43	The status and prospects of virtual reality in chemical engineering
44	Low-cost virtual reality and its application to chemical engineering-part two
45	Mass effect: A chemical engineering education application of virtual reality simulator technology
46	Improving chemical plant safety training using virtual reality
47	Virtual applications using a web platform to teach chemical engineering: the distillation case
48	A Unity3D- based interactive three- dimensional virtual practice platform for chemical engineering
49	Integrated simulation platform of chemical processes based on virtual reality and dynamic model
50	Virtual Reality-based Chemical Process Simulation of Pipeline System.
51	A critical review of the use of virtual reality in construction engineering education and training
52	Construction safety training using immersive virtual reality
53	Low-cost virtual reality environment for engineering and construction
54	Innovation and users: virtual reality in the construction sector
55	Virtual reality in construction: tools, methods and processes
56	Adoption of virtual reality within construction processes: a factor analysis approach
57	Virtual reality in construction: a review
58	Credibility and applicability of virtual reality models in design and construction
59	State-of-the-art review of virtual reality environment applications in construction safety
60	Framework for integrating safety into construction methods education through interactive virtual reality
61	Design and Implementation of Virtual Reality Simulation System for Petrochemical Enterprise
62	Virtual Reality and Its Application in Petroleum Exploration and Development
63	Active Student Engagement in Learning-Using Virtual Reality Technology to Develop Professional Skills for Petroleum Engineering Education

Table (2): Cont.

64	**Experiences in introducing 3D visualization in petroleum engineering education**
65	**Virtual outcrop models of petroleum reservoir outcrop analogues–a review of the current state-of-the-art**
66	**Virtual reality technology and its application in prevention of coal and gas outburst**
67	**Virtual outcrop models of petroleum reservoir outcrop analogues–a review of the current state-of-the-art**
68	**Implement technique of virtual reality model of continual mining working surface**
69	**Application of virtual reality technology in mining engineering**
70	**A Collaborative Virtual Reality Oil and Gas Workflow**
71	**Human-machine collaboration in virtual reality for adaptive production engineering**
73	**Virtual reality production training system in the scope of intelligent factory**
74	**Production engineering-oriented virtual factory: a planning cell-based approach to manufacturing systems design**
75	**Virtual reality simulation of a mechanical assembly production line**
76	**Virtual Reality Technology in Computer-Aided Production Engineering**
77	**The Research of Oil Extraction Engineering Based on Virtual Reality**
78	**Three-view architecture for production-engineering-oriented virtual manufacturing and its application**
79	**Virtual engineering approaches in product and process design**
80	**Modeling production systems using virtual reality techniques**
81	**Chances and Limitations of a Virtual Reality-supported Tool for Decision Making in Industrial Engineering**
82	**Virtual reality and augmented-virtual reality as tools to train industrial operators**
83	**Virtual reality for industrial applications**
84	**Evaluating virtual reality and augmented reality training for industrial maintenance and assembly tasks**
85	**The development of intelligent virtual reality-based industrial training systems**
86	**Virtual hands and virtual reality multimodal platform to design safer industrial systems**
87	**Increased concurrency between industrial and engineering design using CAT technology combined with virtual reality**
88	**Using virtual reality for industrial design learning: a methodological proposal**
89	**Virtual reality technology and its industrial applications**
90	**Virtual reality for large-scale industrial applications**
91	**Ten steps to developing virtual reality applications for engineering education**
92	**Virtual Reality in Engineering Education: A CIM Case Study.**
93	**Teaching methodology for virtual reality practical course in engineering education**
94	**Virtual reality in science and engineering education**
95	**Virtual reality-a role in environmental engineering education?**
96	**Virtual reality in engineering education: The future of creative learning**
97	**Assessment of VR technology and its applications to engineering problems**
98	**Virtual reality in science and engineering education**
99	**Virtual engineering laboratories: Design and experiments**
100	**Introducing virtual reality into the engineering curriculum**

IV. CONCLUSION

Over recent years, Information and Communication Technology (ICT) has enriched several sectors. ICT is considered as a main reason for advent of Virtual Reality (VR) technology. VR is a fast-growing trend related to ICT development. VR as an advanced technology is a robust and effective tool in different fields such as energy, industry, aerospace industry, automotive, industry, medical and nursing, especially in the engineering area. It is an alternative safe approach for the real environment through dangerous experiments scenarios. This technology offers a worthwhile means for engineering use and research. VR technology has popularly increased around world and drawn the attention to the research audience as a precious technology on its own. There are many researches about VR in engineering disciplines since its first establishment, in addition to the virtual engineering as a new trend in the engineering field. Ultimately, VR is irreplaceable, and has become a significant technique for the engineers of tomorrow.

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استعراض لمنشورات الواقع الافتراضي في التخصصات الهندسية

احمد عبدالحميد، احمد سلامه، شيماء حسن ، نبيل عياد

في الآونة الأخيرة ، تم تطوير تكنولوجيا المعلومات والاتصالات وانتشارها على نطاق واسع في جميع أنحاء العالم. تُستخدم تكنولوجيا المعلومات والاتصالات في قطاعات مختلفة وتعتبر أساسًا في ظهور بعض التقنيات المهمة مثل تقنية الواقع الافتراضي. الواقع الافتراضي (VR) هي تقنية خاصة كتقنية متقدمة متصلة بعدة مجالات ، على سبيل المثال التدريب ، التعلم ، العلوم ، الهندسة ، الطب ، الجيش ، إلخ. للواقع الافتراضي إمكانات كبيرة تمكن من أداء العديد من الظواهر والتجارب. ومن ثم ، أصبحت عدة سيناريوهات متاحة. الغرض من هذه الدراسة هو إلقاء الضوء على تقنية الواقع الافتراضي وإدراج لمحة عن المنشورات والدراسات المشتركة ذات الصلة.