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Virtual Reality in the Healthcare Industry and its Essentiality in Medical Education

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***Abstract*—Virtual Reality (VR) applications in the healthcare industry have the potential to improve health while also creating opportunities for clinical education. Healthcare officials supported the incorporation of modern technology by raising budget allocations and organizing access to advanced devices and professional expertise. In this research, we are going to study VR in the healthcare industry and its essentiality in medical education. Businesses in the healthcare sector offer medical assistance and produce diagnostic products or drugs, facilitate medical coverage, and finally facilitate the delivery of healthcare to patients. VR is an atmosphere with a specific computer-generated with realistic-looking both objects and scenes that immerse the user in their environment. VR plays a vital role in making decisions for specific case studies and distance learning, the ability of VR simulation tools to share information obtained through communications infrastructure and electronic health records makes it more appealing.**

Keywords—Artificial Intelligence (AI), Virtual Reality (VR), healthcare industry, Medical based Education.

I. INTRODUCTION

In the field of medicine, developments occur at a dizzying rate. Twenty years ago, healthcare looked quite different from how it does now, with an older population with more complex demands, fewer treatment choices, less emphasis on collaboration between healthcare professionals, and more complicated healthcare systems. We've got to adjust our methods for preparing aspiring doctors for the field of medicine. Nowadays, it's not about whether or not a healthcare provider can remember or find information; it's about how well they can process, analyse, and apply that information to the treatment of individual patients. Virtual reality (VR) is a computer-generated simulated setting with realistic graphics and a large number of interactive elements that fully immerses the viewer. A virtual reality (VR) helmet is used to experience the surroundings. With VR, we may put ourselves in the shoes of fictional characters, learn how to do heart surgery, and improve the quality of our training to reach our full athletic potential.

Through the use of virtual reality (VR), we are able to experience video games as if we were one of the characters, learn how to perform heart surgery, and enhance the quality of sports training to achieve maximum performance. The most recent standard, 5G, can also provide very interesting potential futures for virtual reality's development. Because of this standard, more devices and larger user communities will be able to connect with one another. In addition, because its latency is so low, customers will be able to receive images in real time, almost as if it were the same as if they were looking at them with their very own eyes. A computer can act as a gatekeeper to a new world if it simulates as many of the human senses as it can, including vision, hearing, and even touch on occasion. The availability of content and the amount of computing power are the only restrictions placed on a VR experience. Virtual reality is the solution for any situation in which doing something in the real world would be too risky, expensive, or impractical. Virtual reality enables us to take virtual risks in order to gain real-world experience. This is useful for training purposes in a variety of fields, including medical applications and fighter pilot training [1]. It is reasonable to anticipate that more serious applications, like those for education or productivity, will come to the forefront as the price of virtual reality drops and the technology becomes more widespread. The way in which we interact with our digital technologies may be fundamentally transformed by virtual reality and its close relative, augmented reality [2]. Keeping with the current trend of humanising our technology.

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II. Literature Review

Baniasadi et al. (2020) conducted a review to identify the difficulties associated with the use of virtual reality in the medical field. VR challenges will have various impacts, so recognizing each of them aids in determining remedies for each challenge.

Dyer et al. (2018) and Latchoumi T.P. et al (2022) used software that generates an immersive VR life experience for workforce training in aging services [3]. The project was successful in introducing a novel new method for teaching medical assistants, physiotherapy, and also nursing syllabuses. According to the findings, virtual reality improved students' understanding of health issues according to their ages and rises their compassion for adults with hearing, sight loss, or affected by Alzheimer's disease. Jack Pottle. (2019) and Monica.M et. al. (2022) discussed how the future of Virtual Reality is in continued inclusion with the curricula and various technological advancements which allow for simulation of the practical experience. This automatically enables the quality of the teamwork at an average scale, regardless of geography, and will transform how we educate future clinicians. Winkler-Schwartz, Alexander, et al. (2019) and Karnan. B et. al. (2022) set out to create a checklist that would serve as a general framework for reporting or analyzing experiments conducted by VR surgical simulation and ML algorithms. Researchers and critics can easily evaluate the current quality and specific inadequacies of a manuscript by including overall points as well as clear subtopics of the checklist [4]. An Experiment based study on the Efficacy of VR 360° In UG Medicalfield was conducted by Lama, et al. (2019) and Vemuri et al (2021). VR creates a rich, immersive, engaging field of study environment that encourages hands-on understanding. It increases student interest and motivation while also effectively supporting the retention of knowledge and skill acquisition.

Ammanuel, Simon, et. al. (2019) and Sivakumar P (2015) The study's goal is to demonstrate the application of converting 2D radiographic images into 3D models using a threshold method and similar to the importing segmenting them in a Virtual Reality with an interface at a low cost. Understanding anatomical structure in 3-Dimensional space improves understanding med citizens, students, and patients [5-6]. Caroline Fertleman et al. (2018) and Sridaran K et. al. (2018) held a panel discussion titled "The Reactions of Medical Professionals to Minimal Antibiotic Patient Demand. Medical Ethics Study with the help of Immersive VR." Finally, VR was discovered to be a beneficial training device, one that may succeed where other proposals have failed to change behavior. Pantelidis, Panteleimon, et al. discussed “VR and AR in the medical field of study" from the perspective of the past, present, and future [7]. Tabatabai and Shima (2020) and Buvana M et al (2021) emphasized the value of VR learning and the repercussions of incorporating VR simulation techniques into the medical training for the upcoming clinical skill teaching and development. Tang, Kevin S., et al. (2020) analyzed the status of AR Applications (ARAs) and established an analytical model to guide the study in assessing the system as an instructional tool in medical training [8].

III. Proposed Work

The use of technology such as virtual reality has the potential to propel the field of medical education forward by offering students a more immersive educational experience. Because this technology is more realistic, it has the potential to more successfully engage students in medical education than the more conventional educational system does. It is straightforward for instructors to keep an eye on, and straightforward for pupils to use as well. The term "virtual reality technology" refers to an intelligent kind of immersive technology that provides the user with a vision that encompasses the whole surrounding environment [9]. To do this, specialist cameras such as 360-degree cameras and omni-directional cameras are used. A fully immersive video watching experience will be made available to the user through the usage of VR videos. The experience is much improved when watched using a virtual reality headset. On the other hand, it may also be seen on devices such as smartphones, laptops, and desktop computers without the need for VR goggles. Not only will the incorporation of AI make interactions with virtual patients more realistic, but it will also make it possible to conduct further research on therapeutic effectiveness [10-11]. AI is utilised to elicit particular difficulties from huge groups of learners and generate dynamic, customised settings to satisfy the unique learning demands of individual students.

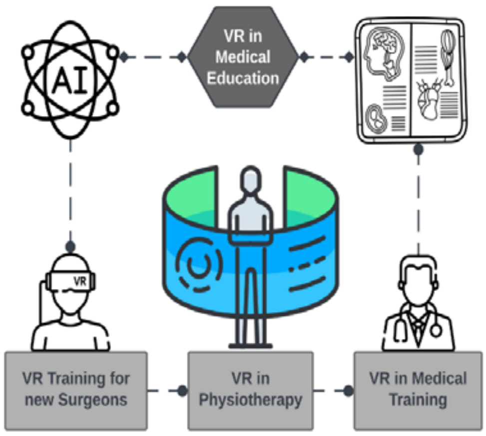

Fig 1. VR in Medical Education

Fig.1 illustrates Virtual Reality in medical education.

VR is a new technical concept that can instruct surgeons on innovative techniques and assess their degree of proficiency before performing surgery on patients. In addition, VR enables medical students to resume the same process or task multiple times as a training module [12]. VR simulation could recreate the operative field, improving training and reducing the need for costly animal training models. Our preliminary findings indicate that we have the advanced technologies to simulate tissues and laparoscopic devices and to create a VR educational environment for surgeons in real-time [13-14]. VR technology instructs surgeons with innovative techniques and evaluates their level of proficiency before performing real-time surgery on patients. In addition, VR enables the learners to return to the same methodology or task multiple times as a refresher course [15-16]. VR is used in patient-facing rehabilitation to create games that allow members to exercise movements in a safe, engaging, and challenging environment. In stroke rehabilitation, for example, VR is being used to dramatically increase the number of movements performed during a treatment session, with anticipated benefits in function and overall results.

Some of the hardest things while determining the entire testing methods with a medical education there are some similarities which may differ according to the results.

$$T_{ni} = dig_{t22}^{min}\, U\left(l_p;\, S_v : T,\, s^*\right), T_{map} = dig_{t22}^{min}\, Q(T : l_p; S, s^*) \quad (1)$$

In Equation (1), both the terms of constant values are represented in the term of representing the most regarding access points that are managed with the help of time. According to omit times for matrix multiplication clarity.

$$T_{map} = dig_{t22}^{min}\, S(T : I_p; S_u, s^*) = dig_{t23}^{max} \frac{S(I_p;\, S_v : T,\, q^*)S(T,\, s^*)}{S(I_p; S_u, s^*)} \quad (2)$$

Therefore, the model and $S(I_p;\, S_v : T,\, s)$ is the actual kind of probability realisations I_p and S_u occur in the given data type v, and a protective q*if S (Ts*) can be homogeneous for the identification of detection probability is represented Equation (2).

$$S(I_p; S_s; s) = \sum_{\sigma \in \Omega(T,\, q^*,\, I_p;\, Q_u)} S(\sigma | T,\, s) \quad (3)$$

Therefore in Equation (3), the Ω (v, s*, I_R, S_U) is the collection of all possible categories for distribution given I_P; T_u. Then, below Equation (4) represents the consistent G.

$$T_{map} = dig_{t \in I_p}^{min} K\left(T,\, s, I_p, S_U\right).Q(T,\, s^*) \quad (4)$$

Finally, the actual term that is displayed according to the Equation (5).

$$K(T,\, s, I_p, S_U) = |\Omega(T, s*, I_p, S_U)| = O(U+P)! \prod_{\mu \in I_p \cup Q_U} |S_\mu^v| - 1 \quad (5)$$

Therefore, the above Equation (5) represents the actual and sequential nodes that are being contexted with the time analysis and its management [17-18].

IV. EXPERIMENTAL RESULTS

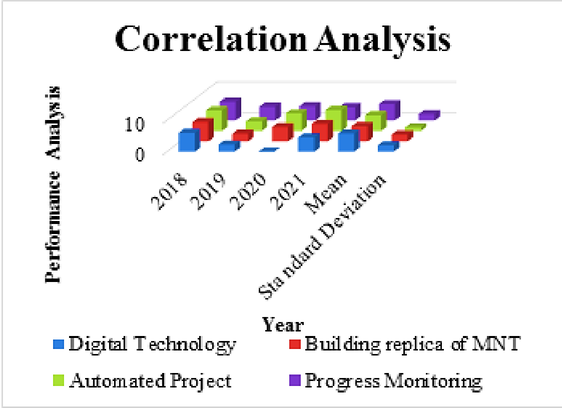

Fig.2. Building the human tissue for Artificial Intelligence based technology

Fig.2 depicts a Virtual Reality assessment AI technique for analyzing and simulating the result of built surroundings building reshaping strategies on building energy use, solar power generation, and the changes that follow all have an impact on energy usage [19-20]. In this analysis, the implementation of different digital based technologies were considered from the period of 2018 to 2021.

TABLE 1. BUILDING THE TECHNICAL ANALYSIS BASED ON THE VR AND ARTIFICIAL INTELLIGENCE

Year	Digital Technology	Building replica of MNT	Automated Project	Progress Monitoring
2018	6	6.1	6.5	5.9
2019	2.2	2.4	3	4.4
2020	0	4.5	5.5	4.5
2021	4.5	5.5	6.6	4.2
Mean	5.76	4.79	4.99	5.19
Standard Deviation	1.98	2.09	1.09	1.98

A significant percent of previous technical studies have been classified as implying that most of the preceding application fields of medicinal industry sectors in building replicas start with body cells for artificial organs with the application.

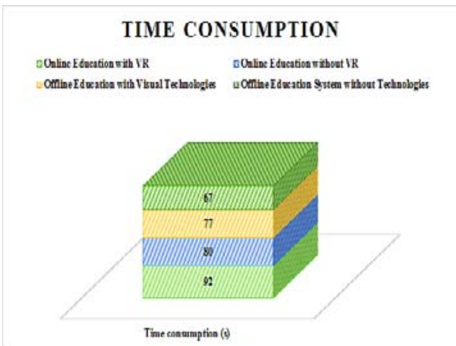

Fig.3. Time Consumption for information communication

Fig.3 represents the time consumed by different teaching and learning mechanisms in the healthcare industry with the utilization of different technological advancement. Fig.4 represents the comparison of the proposed online healthcare education with Virtual Reality (VR) along with other models such as model without VR, offline education with virtual technology and without any technologies. This

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time consumption defines the time consumed to provide visual effect on the medical concepts. From the results, online education with VR consumes less time than other models by making a minimum difference of 10%.

Analysis based on the energy consumption in the implementation of the models is presented in the Fig.5. Energy Consumption is measured in Joules (J). This analysis defines the minimum level of energy required to complete teaching and learning of the healthcare terms through technologies. From the results it can be seen that the technologies aid in the reduced energy consumption whereas the model without technology involves manual drawing of the medical images by the teachers. Manual drawing will consume more time and space for the works to get completed and hence the energy too. From the results, it can be seen that the online virtual reality will consume a much reduced energy of 53% which makes a difference of 42% to the highest.

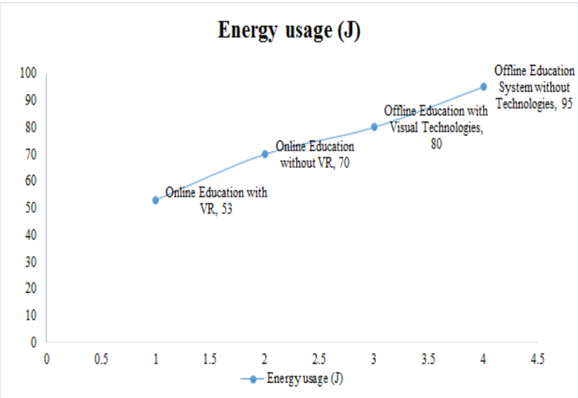

Fig.4. Energy consumed by the models

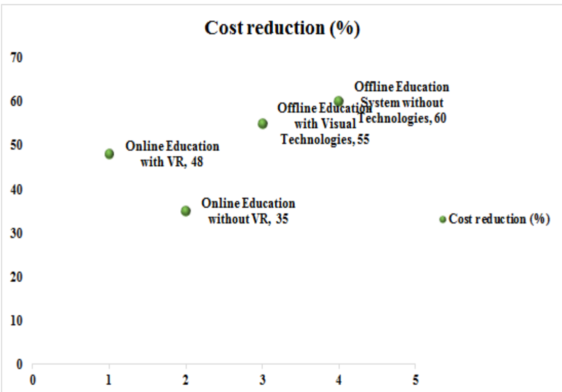

Fig.5. Cost Analysis of the proposed system

Next to the time and energy, cost plays a vital role in implementing a new technology for any given domain. In this research, cost analysis is performed to analyze the cost required from the designing of the model, implementation of the system, and completion of the education on the medical system.

V. Conclusion

When compared to traditional teaching resources, the researchers note that this method promoted further knowledge improvement for pupils and fostered significantly higher learning. Virtual reality is already transforming medical training. It facilitates removing lessons from the classroom by allowing students to put their knowledge into practice and learn from their mistakes. VR plays a vital role in making decisions for specific case studies and distance learning, the ability of VR simulation tools to share information obtained through communications infrastructure and electronic health records makes it more appealing. It aims to improve competencies and emphasizes the autonomous, blended learning that today's learners expect.

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