AUGMENTED REALITY VS VIRTUAL REALITY IN WORKPLACE

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Abstract - As Singapore continues to improve the quality and safety of the workplace and education, different technologies and their capabilities must be explored to meet this need. The ability of virtual reality (VR) and augmented reality (AR) to create an experience that combines virtual and physical environments with filtered data enables Nature to incorporate technology into the education process and workplace.This paper analyses recent studies, conclusions, and restrictions on the effects of virtual reality (VR) and augmented reality (AR) on human performance, with a focus on Singapore and our own experiences at the National University of Singapore (NUS).

1 Introduction

In this day and age, technologies like virtual reality (VR) and augmented reality (AR) have gained popularity. People can connect to the digital world thanks to these technologies. By enabling people to share or trade information, the capacity to connect the physical and digital worlds enhances creation and engagement.

Gamers can transport the virtual world from their computers to the real world, artists may integrate their virtual and real works, and offices can readily add fabric reinforcements. Singapore is exploring the use of this technology through participating in the global research and development processes.

Cinematographer Morton Heilig created VR for the first time in the 1950s to connect theatre with spectators. Virtual reality has been defined in a variety of ways up to this point [1, 2], but they all generally allude to the idea of a digitally simulated space with tools that enable real-time interaction. Head mounted displays (HMD), spatial projection, and handheld gadgets are the three primary categories of VR hardware. HMDs are the preferred VR displays because they can fully immerse the user in the environment. The degree of "reality" the user experiences in a digitally recreated environment is gauged by their sense of immersion.

However, unlike VR, AR allows users to see the real world and watch virtual objects above it. In contrast, VR does not allow users to see the real world, but instead transforms the virtual environment for them. This means that AR contributes to the real environment rather than completely replacing it. Therefore,

AR can be defined as the middle ground between purely virtual and purely real space [3,4]. Augmented objects must exist in a real environment and users must be able to interact with them using measured and programmed tools, similar to virtual objects in VR Round.

These measured and programmed devices are considered to fall under the Human Computer Interaction (HCI)

category; this comprises a variety of methods users can interact with virtual or augmented objects, such as speech detection and the modern keyboard, which range from physical keys to graphical user interfaces.

Innovating and researching VR/AR to enhance individual performance are topics covered in this document.

The ability to do any work with excellence is measured by the performance of humans, which typically involves three factors: quickness, precision, and competence [5].Significant enhancements in human performance result in the accomplishment of activities more quickly, accurately, and with fewer demands.But not all of our fields will change simultaneously.

2. VR/AR in Singapore

There are several areas of interest in the current global study on the effects of VR/AR on human performance. These involve giving users the ability to carry out particular tasks like using virtual keyboards [6] and altering keyboard controls to increase text input, or simulating various scenarios to hone firefighters' awareness of space and ability to think critically [7]. In addition to assisting and enhancing the mental health of patients who have undergone rehabilitation, human research in medicine also enables aspiring surgeons and medical students to acquire the eye-hand coordination required to carry out safe surgical and digital treatments [8–9].. Not all VR/AR technologies have been introduced to enhance the performance of humans. Singapore is aware of what VR and AR can do for people. One of the top VR users is Singapore Airlines Business. To train inexperienced aspirant pilots how to operate aeroplane, VR was implemented in an airline training school [10 12]. Another potential user is the medical sector [13]. In the part after this, this will be discussed. The impact of VR/AR on people's performance is now a topic of research in Singapore, specifically at the National University of Singapore.

This article will look at the current status of the field and suggest potential future directions.

For research investigations in Singapore, these three sources are recommended: Scopus, Engineering Village, and ScholarBank@NUS. 313 patents, 280 publications, and 207 papers from conferences addressing the usage of VR/AR and its effects on human performance were published between 1997 and 2020.
In Singapore,[11] research on the effects of VR/AR on people's performance has a particular focus on clinical education, treatment, and productivity.

The fact that the manufacturing process and medical/health services depend on human labour is one of the primary causes for its relevance. In rare circumstances, the operator may be able to respond while completing a crucial duty thanks to the information at hand. Additionally, a well-designed setting can ensure a secure experience and facilitate the transmission of knowledge during training.
The research and application examples of VR clinical simulations, AR surgery, and production are covered in Chapters 3-5.
Chapter 7 concludes and concludes the article. Chapter 382

3. VR medical simulation

Medical pupils and primary care clinicians are frequently taught and trained using medical simulations. Both surgical and procedural simulations are a part of it. Due of students' limited experience to surgery and live patient procedures, the training they give young surgeons is especially crucial. A few benefits of minimally invasive surgery (MIS) include reduced blood loss, less tissue damage, and a quicker recovery. MIS is an imaging technique where the surgeon uses the patient's body with the help of a needle photoprobe during the process as opposed to typical open surgical procedures when the surgeon defines the anatomical structure and executes it directly.[13]
Medical records and actual surgery must be connected, according to surgeons. Since the human body is so fragile, most surgeons find this to be a difficult undertaking with little room for error.

Eye synchronisation is one of the most crucial abilities for a MIS surgeon, along with the ability to think, act, and reacting to every change in the operating room. On computers with keyboards and standard mouse, medical pupils and young surgeons are frequently trained, but this is insufficient to teach practising surgeons the necessary skills [14].Thus, the purpose of the adoption of VR is to give surgeons a precise and secure virtual working environment [15].
MIS practises involving polymethylmethacrylate
Laparoscopic surgery, percutaneous coronary angioplasty, and (PMMA) injection can all be replicated as
for instruction. Because they're virtual, environments and items can be created and modified to suit the demands of the medical professional. This makes it possible to mimic many scenarios so that medical practitioners are ready for anything. By using tactile devices to operate virtual cameras and surgical equipment, VR surgical training aims to enhance the teaching experience. The system will manage the interaction of virtual items and give haptic feedback to the trainer thanks to the depth and integration of computers, creating an even more "immersive" experience overall.
Two components make up a standard [21 22]virtual reality (VR) clinical simulation: a virtual object (such a virtual organs) created from pre-operative medical imaging, and a miniature student navigating the virtual setting while using physical controllers and simulated tools.

However, during VR simulation training, modelling shouldn't be a one-way path. [18]Virtual objects and their behaviour when people interact with them have been modelled using a variety of techniques. For laparoscopic training, the simulated gallbladder serves as an example. When predicting behaviour during interactions, the gallbladder cannot be taken into consideration as a location. Instead, the muscles involved and the stimulation should be used to determine active and passive tension.

The bio-mechanical behaviour of the gallbladder has been studied using a variety of techniques, such as genetic algorithms and multi layer mass-spring models [23,24]. An idea for simulating how the bloodstream and vascular wall interact during virtual surgery [25]. Softened particle hydrodynamics and air spring models are combined to simulate blood flow and vessel deformation. We must also take into account tools and tools, which are interconnected textures, as well as to the virtual body. Designing tubular measuring catheters for use in electrical therapies is difficult.

The virtual equivalent of the catheter's shape needs to be altered in accordance with the control of the proximal end. Techniques for finite element analysis have been used to model catheter movement in human vascular systems [17,19]. During treatment, foreign fluids (such PMMA, a liquid cement used in bones) may also be used.
It's critical to accurately simulate how the virtual PMMA will interact with the virtual client and device since the mobility of the fluid cement affects the operator controlling the virtual device [16]. By carefully planning each virtual setting in the simulated environment, the operator's knowledge, or more accurately, the "realness" of the simulated experiment, can be increased.

During the session, VR/AR equipment can contain software add-ons like smart trainers [26]. These online teachers either provide pupils with information or correct them when they make mistakes. who are those folks.
In order to assemble mixed health care devices, [27] adopted the idea of a smart trainer, and they showed how employing VR as an instructional tool boosted knowledge transfer. This is due to the fact that VR/AR-related information experience and filtering for learners is a novel technology employed in the educational setting. To completely incorporate these software add-ons into VR simulations, more study is still needed. They are now in the basic research stage.

An overview of the VR simulation of medicine research is shown in Figure 1. There are numerous elements and features that must all be included for a VR medical simulation to be successful.
According to the current study, constructing complex tools improves general dexterity, particularly hand-eye coordination, in medical practitioners. The ability to acquire surgical techniques fast and safely is better suited to surgeons. However, accessories like tactile feedback and the ability to predict the outcomes of every move the user takes are still lacking in virtual simulations. The fundamental emotional process is not affected by the absence of additional senses like odours and noises that can diminish the "reality" of the simulated environment.

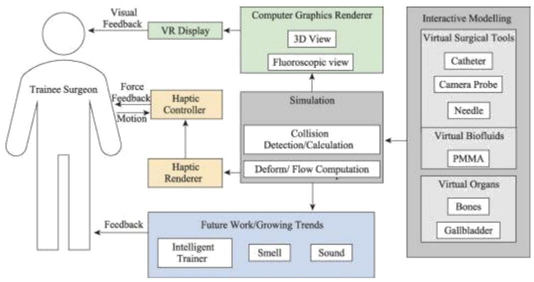

Figure 1 Overview of VR medical simulation

4 AR For Surgery

VR is mostly utilised to teach and simulations, taking into account its benefits and drawbacks. But for helping with medical procedures, notably surgery, AR is preferable. In comparison to other augmented reality gadgets like HMDs, spatial projection is now the most popular image method. This could impair the surgeon's vision. The increased strain of utilising surgical equipment while wearing glasses during surgery can also have an impact on the surgeon's performance. The present state of MIS [28] surgery necessitates the surgeon operating the instrument inside the patient's body while focusing continually on a 2D computer monitor. This restriction was lessened by Kockro et al.

introduced the notion of giving the patient a direct "X-ray" view of themselves by projecting the data gathered by the camera probe onto a 3-dimensional projected screen [28].This makes it easier for the surgeon to see the device in 3D and eliminates the need to measure depth of motion and directional relationships on a 2D computer screen. Although it has been demonstrated that the system may successfully map patients using a camera probe, real-time overlays can be unreliable due to processing times and the camera's capacity to capture a small, dark patch on the subject's body.

Medical imaging is frequently done today prior to surgery. During preprocessing, 3D views, measurements, and editing of the obtained images are all possible.
Today, the phrase "computer-assisted surgery" (CAS) is used to refer to a wide range of medical and architectural specialties in which computers are employed directly during surgery, involving electrical interference. Navigation, healthcare automation, and virtual and augmented reality are some of the several disciplines. This method for radiofrequency (RF) ablation of tumours was used by Yang et al. researchers from the National University of Singapore [29]. The surgeon might place previously acquired medical pictures on the patient to assist with positioning the appropriate radiograph.

Surgery precision will increase with picture overlapping, and patient problems and accidents will be reduced [30]. Additionally, guiding is introduced as a human-computer interface to manage the equipment if the surgeon is unable to touch and handle other operating room tools. The setup of the AR spatial display in the operating room is depicted in Figure 2. Additionally, a needle position overlay sample is displayed. Surgery performed with AR now has the same precision and efficiency as MIS, which is a step towards introducing new technology to the operating room.

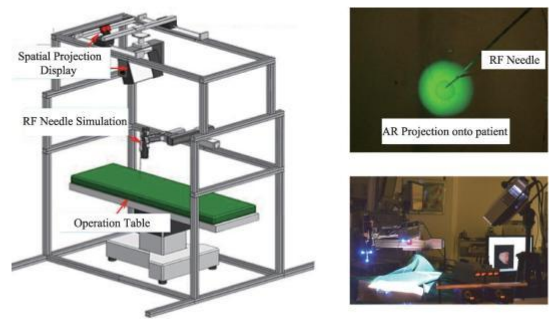

Figure 2 AR spatial display setup.

However, most studies that require the use of spatial maps have disadvantages such as clogged projections, requiring precise calibrating of lighting and the position of cameras and projectors. Tablet-based AR guidance, which can provide the surgeon with additional information at critical times, is the next best option. Thanks to the adjustability, the tablet can be set up according to the surgeon's comfort without interfering with the procedure. Alerts and reduced intelligence allow surgeons to focus on more important tasks. Usually, both images can be adjusted within a reasonable time without delaying the actual surgery. The installation also does not affect the work area in the room.

5. VR/AR In Manufacturing

Over the past few decades, production has played a significant role in Singapore's growth in economy. Businesses are always seeking for ways to be more efficient due to the rising competition in many business sectors. Singapore has recently placed a high priority on safety, which is now a significant factor in working conditions. Considering that the present sector of the economy in Singapore continues to be the biggest employer, implementing VR and AR in the office is intended to increase worker productivity and safety.
The production procedure requires computer-aided design (CAD).
pang and co. The concept of utilising augmented reality (AR) in this process to assist designers in visualising CAD parts on a computer screen and in the real world was developed by a different group at the National University of Singapore. This enhances the geometrical form of CAD objects and provides designers with a better 3D view. By lessening the user's cognitive load, this improved 3D visualisation improves the effectiveness of the design process. Developers will eventually be capable to manipulate virtual items with their hands free thanks to the development of VR/AR object tracking .

By enabling designers to move and control objects, this type of human-computer interface enhances interactivity and experience throughout the design process.
At the job level, computer and paper-based duties can be substituted by augmented reality (AR) jobs that enhance employee interaction and job expertise. A graphical user interface (GUI) can be used to add and filter the information the operator needs into the physical workspace, and the user will then be able to access this data from a straightforward specification.
The amount of information required to complete the operation is decreased by the operator's capacity to

filter the data they need in real time. With the emergence of intelligent machines, GUI may now be used to operate them as well, improving the effectiveness and efficiency of the entire process.
With AR, employees can replicate the process of assembling with digital components in a physical environment, similar to how design is done [27]. Virtual simulations give workers a chance to practise new skills and learn more about a specific task. This quickens the process, improves accuracy, and lessens assembly-related mishaps.Remotely operating robots, including live robots and robotic arms, can be made more enjoyable via virtual reality. by using the HMD at the operator's opposite end and mounting the camera on the robot's head.

While keeping an eye on the robot's surroundings, the person in charge will also be able to operate it [28]. The operator's sense of situation is enhanced as a result.Operator-controlled robot interactions will become more natural with the addition of hands-free remote control, eliminating the requirement for awkward-to-use devices like joysticks made expressly for the task.

Utilise VR and AR to improve users' understanding of three-dimensional field of geometry, machine control, and simulation and application.Devices improve user efficiency in terms of velocity, accuracy, and mental strain.
However, the lack of tactile sensation on virtual items limits the experience. Although there is technology that can[30] calculate feedback from force and transmit digital data to the user, haptic physical response is still being developed and is not yet widely used. For instance, utilising tactile gloves is costly, challenging, and somewhat constrained.

6. Discussion

As was shown in the preceding section, VR/AR promises to improve training's effectiveness and efficiency. This sparked investigation into these topics to see how well VR/AR may be applied in these circumstances. Despite extensive study on VR/AR in education, the current VR/AR production in the workplace is still quite young. The higher operational costs of VR/AR technologies are the main cause of this. The cost of electrical and other equipment will be high.
Additionally, purchasing and maintaining software licences is expensive. Additionally, a lot of the current VR/AR technology and software is difficult to use. impacting the usage of VR and AR in marketing and business. The impact is especially noticeable in Singapore, where a lack of indigenous labour has forced immigrant labourers to produce goods at lower labour rates. The use of VR/AR for safety training is becoming more popular as people become more aware of workplace safety.
Employees can learn about the consequences of risky behaviour and the reasons why it occurs through a VR/AR experience.
It can increase students' understanding of and awareness of their obligations with regard to workplace safety at building sites and elsewhere.

In particular for surgeons where actual surgery has become rare, virtual simulations of medical operations can provide a variety of virtual settings that will facilitate learning. The advantages of simulation training for teaching, however, only apply to staff or younger surgeons. The focus of virtual simulation at the moment is mechanics' hand-to-hand synchronisation.

Such digital simulations could also be deficient in terms of interacting with digital things. This is because it is challenging to model and forecast how virtual equipment will interact with a virtual body because the human body is complex and cannot be viewed as a single object during modelling. The possibilities for thought when modelling biomechanics are endless. To help with modelling and interaction, additional study is being carried out on algorithmic methods like machine learning. Medical simulation will give students additional experience to help them learn to think more effectively through various situations in the VR classroom, even though simulated instruments can be modeled. By giving doctors more helpful information during operation, introducing AR to the surgical suite will help them. However, this field of research and implementation is still in the early stages
& faces numerous challenges to growth. The surgeon's field of vision may be distorted by, for instance, a projection delay, calibration error, or imaging error, which could lead to mistakes in crucial judgements. The surgeon's effectiveness during the procedure will be hampered if the supplementary AR screen is not properly overlay because the human eye is extremely perceptive.

With the integration of several disciplines in business 4. 0, many fields, including AI and cyber-physical systems (CPS), will be accessible in VR and AR. This is excellent for introducing VR and AR into clinical trials and the operating room, respectively. Artificial intelligence use is one instance. Cognitive, emotional, and machine learning are all parts of machine learning. It is made to assist human workers in their planning, analysis, and decision-making.

Medical professionals, research papers, books, and records will all be used to construct the knowledge base. Based on the instruments in the operating theatre, an intelligent device can suggest a surgical technique prior to the procedure. Depending on the condition of the client, the doctor, and medical supplies at the time, machine intelligence can also help during surgery. You can browse a variety of knowledge bases to find data supporting the management of uncommon surgical situations. It is feasible to mimic surgery, give advice, or calculate the possible danger to the surgeon using virtual reality and augmented reality.

The robot entered the operating room. One such example is during the surgeon's radio frequency procedure, which can be powered by operating the radio frequency dose to eliminate body tremors. Smart devices can also be incorporated into robots to assist during surgery. Shared control systems can be designed to help surgeons use robots during surgeries to help them understand the process or detect potential complications. But the smart robot will remain legally an assistant in the operation, not getting ahead of the surgeon.

Today's production processes and workplaces are increasing with the use of high-efficiency technology. Combined with recent advances in software integration and network connectivity, both will be able to use CPS techniques in the future to facilitate data flow between physical and network equipment. As a result, there is improved collaboration and communication both at work and during production. This is particularly helpful for surgeries that employ big data. The impact of this knowledge-based architecture on enhancing surgical outcomes has been studied, and it further simplifies the surgical procedure.
To engage with the doctor, present information, or assist their skills throughout operation and production, virtual reality (VR) and augmented reality

(AR) are unique in CPS in this context. The flow of data in CPS is depicted in Figure 3, where VR and AR can be used to complement information delivered to the client in the business product. We test several virtual reality and augmented reality techniques while employing a CPS-based workflow.

A growing number of people have been forced to work from homes as a result of the COVID-19 outbreak.

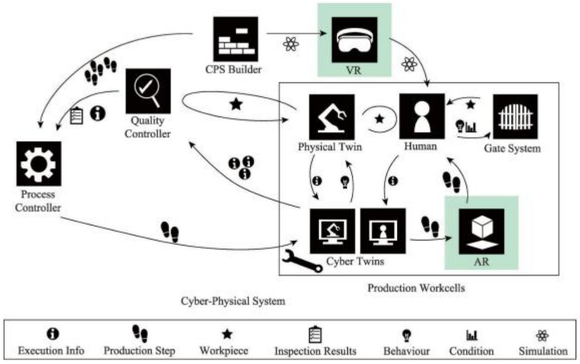

Figure3 Information process within a CPS.

As a result, more people are turning to online work. As businesses explore for more effective solutions for work and education, awareness of virtual reality and augmented reality technology is continuing to rise. Businesses are relocating online, where virtual versions of warehouses and goods are available. Customers can shop at the online store whenever they want, wherever they are.

VR/AR research will advance as companies and organizations in Singapore become more aware of the technology.

VR/AR technology is intended to help people perform better, which will benefit both people and businesses.

7 Conclusion

In conclusion, augmented and virtual reality has been demonstrated to enhance user efficiency in areas including hand-eye balance, knowledge of three-dimensional vision, exchange of data, and need. Due to the advancement of VR and AR-based experiences, users are now able to do activities more quickly and precisely with a reduction in cognitive capacities and an improvement in human performance. To meet the needs of the consumer, several scenarios and possibilities can be replicated in a virtual environment. Users are also kept in a secure environment.

The virtual setting conserves time, which is crucial for a small nation like Singapore. The majority of testing and studies are carried out in a clinical context, and research using virtual and augmented reality has produced numerous encouraging outcomes. It will take some time before AR/VR is extensively employed in business, despite the fact that recent developments have been positive and numerous business applications have been created. Despite the debate over how to define and gauge an improvement in human efficiency, interesting and developing research is being done on the brain using EEG.

The National University of Singapore is taken into consideration as this article covers the most recent study, current research, conclusions, and limitations on the impact of VR/AR on human performance in Singapore.

Shown are a few VR/AR apps in Singapore. This list of studies and papers is not all-inclusive. For instance, using audio in VR/AR experiences to enhance process knowledge and using VR/AR for physical and psychological rehabilitation

. Before clinical appointments, faculty at the National University of Singapore's Alice Lee Centre for Nursing Studies used online patients to train learners in nursing and hone their communication skills.Numerous VR and AR research projects are being conducted by scientists within the Keio-NUS CUTE Centre.

They developed an entertaining and engaging multi-sensor VR videogame. Real life is readily available through four streams. The technology, which is frequently recognised as a quick-moving platform for VR/AR, will be widely implemented in various business applications within the coming year, with Singapore becoming the first country to roll out 5G in Southeast Asia.

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