A Study of Virtual Reality Challenges & It's Applications in Emerging Trends

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Abstract- *Virtual reality (VR) is a technology which allows a user to interact with a computer-simulated environment, whether that environment is a simulation of the real world or an imaginary world. It is the key to experiencing, feeling and touching the past, present and the future. It is the medium of creating our own world, our own customized reality. It could range from creating a video game to having a virtual stroll around the universe, from walking through our own dream house to experiencing a walk on an alien planet. With virtual reality, we can experience the most intimidating and grueling situations by playing safe and with a learning perspective. Very few people, however, really know what VR is, what its basic principles and its open problems are. In this journal a historical overview of virtual reality is presented, basic terminology and classes of VR systems are listed. An insightful study of typical VR systems is done and finds the challenges of Virtual Reality. Virtual reality has bridged the gap between the computer display and the 3D world. This is the reason why it is a fast growing technology in every sector. It is also a new media to gain information and thus expand one's perception which previously was difficult. Indeed it has and is still providing simplified solutions to complex problems and optimizes its solutions. Virtual reality is providing promising applications with the use of high end input and output devices. This journal dealt with critical reviews and applications of virtual reality.*

Keywords- Virtual Reality, Virtual manufacturing, Virtual designing, Virtual environment, Levels of immersion, Immersive Virtual Reality, Telepresence.

I. INTRODUCTION

"Virtual Reality" the basic concept behind this term is illusion. The term" Virtual Reality" was first coined in 1987 by Jaron Lanier who had set up a company which pioneered research in it. Virtual Reality (VR) is nothing but a completely immersive computer replicated environment that gives the user the feeling of an entirely different environment instead of the one they are actually in. It gives the user a sense of reality. It is just an illusion with the help of very advanced technology. This synthetic environment created with the aid of Virtual Reality gives the user a feeling of being there thus allowing the user to interact accordingly. Thus due to this possible ease of interaction one can visualize, improvise and develop any new idea or concept as they actually desire.

Virtual Reality is a leap into the 3 dimensional world. Hence it cannot be termed as only 3 dimensional computer graphics but an extension to it using more advanced hardware's and software's. The most common way in which virtual reality is known to the world is media, entertainment and gaming, but its applications are spread to countless fields. Today Virtual Reality has ripen enough to prove its vitality in engineering, medical, psychological, entertainment, architectural, education and many more such domains. Virtual Reality has reached the training grounds of the soldiers to the cockpits of the pilots. In defence; it has been adopted by all the sectors for training soldiers for dangerous situations like war, where they are taught to react to real life situations in simulated environment. That's the way how virtual simulation allows them to enter in such a situation virtually without any risk to their life.

Healthcare is another important field where VR is extensively used. Virtual Robotic Surgery is a way in which a robot performs the surgery which is controlled by a human surgeon. This mainly reduces complications and the time of operation. Likewise, VR is also useful in treatment of phobias and for the people suffering from psychological diseases.

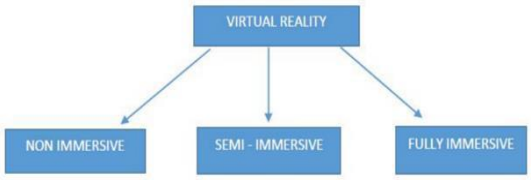
Another field of application of VR is education. It simplifies the teaching and learning experiences through the ways listed below:

- Audio and Video conferencing
- Virtual classrooms
- Computer Based Trainings (CBT)

It helps students to understand concepts in more simplified manner as they can feel the world virtually what they are actually learning about. It helps in quick refining and modifying the faults of newly modified processes and it's validation without physically running the process .Virtual Reality not only provides the ability to visualize in 3D environment but also lets the user to interact with the object

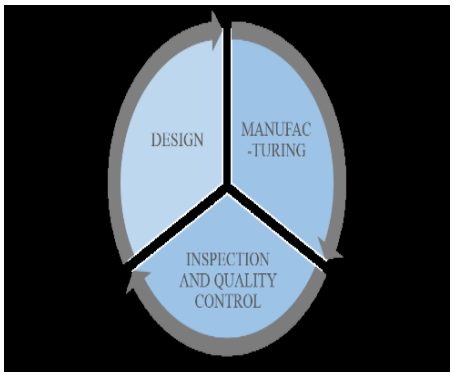
hence enhancing the qualitative and quantitative aspects associated with it.

There are Virtual reality software's available in the market that can be used to develop virtual environment in different sectors. In the field of creating virtual environment software's like SUPERSCOPE and SENSE8 are used. Similarly in the manufacturing application of virtual reality DELMIA package is widely used. It is difficult to classify the virtual reality but according to the sense of immersion and degree of presence it is categorised in three different ways viz. Non immersive (desktop) system, semi immersive (projection system) and fully immersive.



Classification of Virtual Reality

Applications of VR in manufacturing process and simulation: Mujber (2004), focused on manufacturing sector as it is one of the most important sectors of nation's economy. To enhance profitability of the company, a manufacturing organization is always in search of new technologies which can achieve the desired production qualities in minimum input and in short time period. Any new change in the manufacturing process to achieve the desired targets can't be made suddenly. So, VR is widely used in order to reduce wastage of material and rectify mistakes of a human being in the process before being practically implemented. Hence instead of doing practical iteration methods, which costs more and requires more time, use of VR helps in both qualitative and quantitative ways.



A typical product development cycle

Virtual manufacturing Tools for improving Design and Production:

Philippe (2007), focused on manufacturing sector using VR. Meeting the needs of the customers is the most important concern for any industry. Thus manufacturing department has to play a major and one of the most vital roles. Meeting such unpredictable demands require a tool to solve the problems thereby avoiding the waste of money and resources in practical applications. Thus VR can be used in Product design, manufacturing planning and manufacturing control strategies. All these Strategies can be simulated in the virtual environment and thus helps in reading and accordingly optimising the outcomes before practical applications.

One can make changes to the manufacturing systems in the virtual environment so as to know how the changes affect the system and thereby can make necessary changes to increase the productivity. This review journal explores some reviews on virtual reality and also the applications of VR in manufacturing.

Use of Virtual Reality in Design:

Giuseppe Di Gironimo (2009), focused on virtual reality in design.

Design: Classical way of designing was drawing on sheets. Next to it a revolutionary change happened, i.e. application of computers in design process, CAD/CAE software package. Though CAD systems are efficient, they have certain limitations.

VR helps in the design process in following manner:

- A designer is allowed to work in virtual environment.
- More than one person can work on a design simultaneously in the virtual environment.
- Using immersive design techniques, manipulations are easy.

Use of Virtual reality in product design process:-

At this stage, a model of product having all the technical information about the product like assembly details, tolerances, material properties etc. is used as the base of all further actions.

Similarly one can interact with the product ergonomics and aesthetics to forecast its functional behaviour virtually. With all above, computational simulation like FEA, kinematics, dynamics behaviour can be performed in order to optimize the system performance.

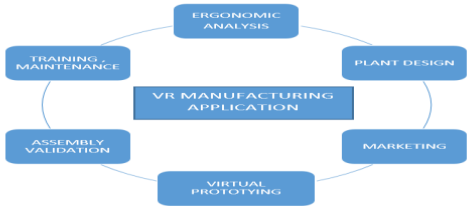
Virtual Prototyping: It is used to validate the design before making actual prototypes. Instead of making actual prototypes, this is more expensive, Virtual prototype is another way.

Virtual assembly: Assembly in virtual environment allows the designer to interact with the design very closely so that he/she can find it easier and also can detect defects while assembling. In a simple way, VA (Virtual

Assembly) can be defined as, "Taking assistance of computer tools for taking decisions related to assembly, visualization, simulation, etc. without physical existence of the model."

VR in manufacturing: Manufacturing is the most promising industry. The world has shrunken at an enormous rate. The various processes and aspects related to manufacturing are converged with the suitable simulation technology thus resulting in cost reduction and profitability of the industry. Not surprisingly Virtual Manufacturing plays a vital role in such type of manufacturing. Thus VM is considered to bring a revolutionary change in manufacturing sector. These days' companies use the simulation technology to optimize the various factors that affect the profitability of the products associated with that company. Simulation technology acts like an agent that draws out the factors resulting in cost reduction, less material usage etc.

Product design and manufacturing in virtual environment: Qingjin Peng (2011) has carried out a study and stated that, a product's efficiency and performance are simulated using a computer and also the processes involved in its fabrication are optimized. Not only this but also the manufacturability, the life cycle of the product, its final shape, stresses involved are optimized by using a non-linear FEA technique which provides the relevant information. Thus one can say this non-linear FEA technique forms the core of virtual manufacturing. This kind of approach has opened the doors to perform the work in more realistic manner. Indeed this has enabled reduction in tool cost,costs of prototypes and also the material waste. Because of this overall elevated performance, manufacturers are confident to provide products with best quality according to the demand to the market within the budget. This also reduces the overall product completion time.



VM Application

Virtual Reality applications in Manufacturing Industry: Jozef Novak Marcincin (2011), has stated that Virtual Manufacturing is the back bone of the most advanced form of CAM. Virtual manufacturing (VM) is possible because of Virtual Reality (VR). VR techniques that are used are developing rapidly. Customer expectations are the priority of any industry and thus fulfilling them has been made easy because of VM since VR forms the basis of it. The time required for production and the cost associated is reduced. No more drawing sheets are required for documentation of the product details as it utilises the Virtual Manufacturing technique which further uses desktop VR system for CAD of the parts and processes for manufacturing.

Applications of virtual reality modelling language in manufacturing: Jozef Novak-Marcincin (2011), has provided his insights on the virtual reality modelling language. When 3D partsare imported to virtual environment, after that movement of 3D part is a difficult task. So there are different scripts and coding of language like VRML, python, c ++ used for manipulations. VRML language comes in different versions VRML 1.0 (1995) which is a working proposal, VRML 2.0 (1997) is the recent new language which is not only the extension of VRML1.0 but has many new features so that one can work on this language easily. This has made end to end communication very efficient as it has improved the compatibility features.

Free open software technologies to build virtual reality manufacturing systems: Isidro Calvo, (2016) proposed a methodology in their journal regarding building of virtual Reality manufacturing systems which are based on open source technologies.

In this approach the guidelines are provided which are helpful to build a new virtual environment. This is divided into two parts. First one is how to create a virtual world. Following points shows that significantly:

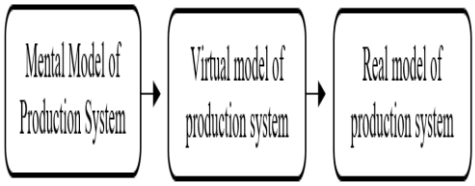
- Analysis of part in industrial process.
- Design of 3D model
- Creation of virtual region in open simulator

- Upload 3D model into virtual world
- Programming open simulation script
- Programming and industrial controller
- Compatibility of physical plant and virtual world
- Update of open simulation script
- Update of controller
- validate and test

Visualization support for the virtual redesign of manufacturing system: Erik Lindskoga (2013), proposed that factory redesign is not a simple process as it involves many processes like resource/material handling, product flow through the process and also different factory operations. So virtual models can be used to visualize the factory layouts as it eases the method of understanding the impact of different parameters on the factory layout without involving costly mistake.

Thus the 3D view of the layouts makes it better option to enhance the efficiency of the layout instead of conventional 2D methods.

Using 3D Scanning technique, the existing factory layout is scanned and then point cloud models are made from the scanned data. After point cloud models a simulated view of the factory is created consisting of every department and machineries. Then it is redesigned or reengineered according to the need before actually going for the changes. Thus virtual Models and layouts contribute a lot to the industry.



Virtual model and layout

Nestorordaza (2015), has focused on the use of VR in manufacturing process by providing the reader with an informative case study on how virtual training can be used to reduce the work of conventional hardware methods of training and hence bridging the gap between the manufacturing engineering and production process. The case study consisted of participation of 10 operators and performing different tasks. The virtual simulation and training (VISTRA) system was used to simulate such environment to train the operators. The test concluded indicating that the operators without the experience of VISTRA system took more time to complete the sequence compared to others who experienced VISTRA system. Same mistakes were made by both users and no users of VISTRA. Hence the usability of VR in manufacturing still remains a point of discussion.

Virtual reality simulation applied to a numerical control milling machine: Perez Acal and Sanz Lobera (2007), mainly dealt with the simulation of NC milling machine based on object oriented programming. The authors have enlightened the benefits of using virtual reality in machine processes. When there are certain changes in the manufacturing process or in an operation of a company's product the sequence of machining or operation is changed hence for this user handling machines are to be trained frequently. These training are costly to carry out every time on the real machines of materials. Here virtual reality plays an immensely important role with which training can be carried out in virtual environment.

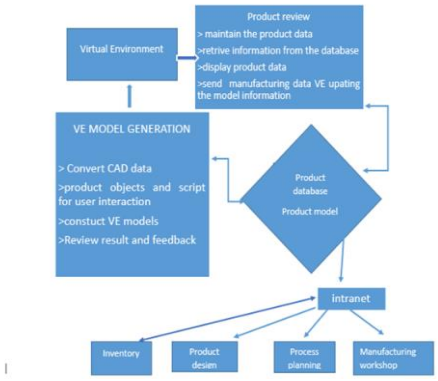
Virtual reality approach in immersive design: Weidlich (2009) emphasizes on virtual reality system. VR system is limited mostly in case of design review because different data format are using CAD system and virtual reality environment. There are different approaches to virtual reality system to work on an active development platform. Researchers have implemented three typical ways of immersive modelling: relating a VR system and CAD system, networking between VR system and a CAD system, and construction tool are used in combined modelling and verification phases. Thus VR interface can be used to integrate the process of modelling and detailing the products.

Virtual Manufacturing and Construction: Ritchie (2009) focused on Virtual manufacturing. Once the product is designed, it undergoes many changes as it proceeds through the development phase. Thus the cost associated with the change increases the overall cost of the product. Hence many industries make use of various VR software's and hardware's available to simulate environment and also to produce digital models. This reduces the cost effectively and also enhances productivity. Virtual Manufacturing (VM) provides solution from the very design approach to the finished product and its manufacturing associated activities. It makes concurrent simulation of all the activities possible which are part of the product life cycle.

The author has given very good case study of Simulation lab and Itia enlightening us with the usability of VR in manufacturing.

Virtual reality approach for hierarchical path planning: Simon Cailhol (2015), has provided insights on the interactive use of virtual reality in path planning of manufacturing process. The product development process is

getting faster day by day with more complex geometry. This needs the tool which can rapidly test the product throughout the PLM using VR. For such test using virtual prototypes makes design process easier and reduces cost. The path planning has been mainly divided into two parts i.e. automatic path planning and immersive path planning. Automatic path planning is fully associated with robots, and interaction between human operator and computer. Data exchange formats available in VE is shown in the below figure



Assembly in virtual environment: Sankar Jayaram (1997), highlights the concept behind virtual reality based virtual assembly system, is giving facts how to use design tool in assembly and disassembly in virtual environment and exploration of assembly with different point of view and there implantation and improvement with help of virtual technology, In this journal the author has provided on how can user exchange information with other design application such as CAD application, as well as how can user again transfer their virtual data into CAD system, related facts are provided. A benefit of virtual assembly is reducing total cost as well as cycle time. Improved product design and quality and reduced product development.

II. CONCLUSION

The main aim of this journal is to provide the information on virtual reality and its application in manufacturing sector. In industries the steps from product design to product completion can be done with the help of virtual reality. No doubt it reduces the cost of the plant as well the product cost and time required to complete it within the prescribed quality limits. The implementation of virtual reality in manufacturing can provide a very effective and promising solution to minimize the errors and maximize the efficiency. It uses a logical and sequential approach to the manufacturing process which has tremendously changed the way of looking at the manufacturing sector.

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