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Analysis of Virtual Reality and Traditional Methods in Metal Arc Welding Education

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Abstract: *Through the use of computer-generated environments, virtual reality (VR) enables interdisciplinary collaborative engineering. For the common user, computer visuals become quite pleasant. It enables individuals to experience things that are not possible in a real-world setting and to perceive the world in new dimensions. Rather of just staring at an image on a display, virtual reality brings the user into an environment where they may engage with computer-based simulation. The foundation of a virtual reality environment is a computer screen or stereoscopic display. Users may interact with equipment like a keyboard, mouse, wired glove, goggles, etc. in a virtual world. A creative and practical answer might be offered by virtual reality technology, which also offers a variety of sophisticated, high-tech VR teaching solutions. The review of virtual reality, virtual reality welding, virtual reality systems, virtual reality applications, and virtual reality modeling language (VRML) is the main goal of this study. The conceptual design of the virtual welding platform is also emphasized in the article.*

Keywords: virtual reality modeling language

I. INTRODUCTION

Virtual reality (VR) is a world that has been simulated by a computer. It mimics human gestures in both the virtual and physical realms. By use of computer-human interface technology, an interactive experience is created wherein an individual feels completely submerged in a virtual environment. In virtual reality, users may interact with virtual 3D objects in a natural and comfortable way, allowing them to explore, analyze, and simulate these things as if they were real [1].

There are three main types of virtual reality: neural-direct, sensory-immersive, and non-immersive. In the non-immersive level, which is mostly played on a desktop computer, no technology is required to create the virtual environment. In the neural-direct technique, the observer's current position and orientation are linked to a database directly via the human brain. [2]. Review and Design of Sensory-Virtual Reality in Metal Arc Welding Two examples of virtual reality applications that significantly depend on the idea of immersive approach and modeling of the real environment are robot navigation and aviation simulation. One well-known example of an actual example is the Cave Automatic Virtual world (CAVE) cube, which surrounds the user with projected graphics to create a virtual world [3].

II. VIRTUAL REALITY SYSTEMS AND ITS APPLICATIONS

Virtual reality technology may be used to imitate surroundings and more general behaviors like exploration and interaction. Between the user's input and output devices and the simulation, graphics, and virtual world engines, the user interface component acts as a go-between [4]. Morton Heilig invented the Sensorama, a device that later became known as the Head-Mounted Display (HMD), in 1956 [5]. The projectors and speakers around the room, which cover the walls with stereoscopic projections, require the user of Cave Automatic Virtual Environment to wear glasses that are synchronized with them [6]. Data input techniques for virtual reality systems often include wired gloves, wands, and computer vision [7]. The Nintendo Wii was the first device to integrate motion-sensor controllers, sometimes known as "wands," to virtual reality. This motion sensor locates the controller by measuring the distance between a fixed point and infrared radiation [8]. Another way to enable movement interaction is to use cameras to recognize models and detect motion. The main purpose of computer vision is to distinguish faces using an RGB (Red Green Blue) camera [9].

Virtual reality is often used by the military as a training tool [10]. The entertainment sector uses virtual reality to imitate modern computer games with haptic feedback [11]. The Science Space application, which focuses on Pauling World, Newton World, and Maxwell World and mostly utilizes HMD, is one example of how VR is utilized in teaching [12]. In the engineering field, engineers work in teams to create and build products, forming virtual workbenches, even when they are located in distant parts of the globe. Virtual reality technology in architecture saves time and money by enabling design changes to be made at any point before the actual building is finished [13]. Medical professionals employ virtual reality technology to reduce surgical procedure complications. Surgeons can view critical body parts more quickly, safely, and conveniently because to the clear head-mounted display (HMD) [14].Since they will reduce the time required to construct virtual locations, the primary problems confronting the virtual reality business are developing more precise tracking systems and finding out how to allow users to interact in a virtual environment [15].

III. INTRODUCTION TO VIRTUAL REALITY FOR WELDING

For technical and economical reasons, manual welding is still required even with the advancement of automated welding techniques [16]. For the majority of welders, tactile learning approaches are safer and more effective than hand welding, which requires highly skilled welders. Thus, the best way for welders to get real-world welding experience is via welding simulation [17, 18].Since the 1970s, several welding simulation tools and approaches have been created to instruct welders. These include electric arc, spark, and television-style displays; moreover, the introduction of microprocessors [24] and welding method simulations [19] are included. Three basic abilities were designed to be learned using a microcomputer controlled welder training simulator [25]: maintaining a better arc, preserving an electrode angle, and keeping an eye on the bead. A Charge Coupled Device (CCD)-based optical system is used to determine the height of the welding flame [26]. Experienced welders may already use a metal arc welding simulator with haptic display to feel the force of an electrode being driven into base metals [27]. Issues like compatibility, finding experienced teachers, cutting down on the quantity of information required, and time-saving are all addressed by virtual reality (VR) technology [28–31]. To improve realism, one may use stereoscopic display, mixed reality, or force display. A skilled welder will inform you that force and stereoscopic displays are not required for training. Rather of requiring complex force display apparatus, stereoscopic

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When a straightforward and less costly training system can be put in place, display devices and mixed reality are employed [32–35]. By employing a computer simulation, the virtual reality welding technique eliminates the requirement for experimental trials and makes it simple to forecast weld parameters including weld depth, microstructure, residual stress, and distortion [36].

IV. VIRTUALIZED WELDING SYSTEM PLATFORM & VIRTUAL REALITYMODELLING LANGUAGE (VRML)

The actual welding workstation and the virtual welding workstation make up the virtualized welding system platform. The main goal of a virtual welding workstation is to carry out the welding process, while the main goal of a real welding workstation is to observe the work piece in a virtual environment [37]. The virtual welding system, which uses EndeaVR software to handle the simulation, displays the bead deposition, the weld puddle, and the cooling effects as the bead solidifies.

A descriptive language included in the Window on World System domain is called VRML. VRML is based on Open GL. The goal of VRML 1.1, which attempts to develop a new VRML format, is to map user needs [38]. VRML 2.0 evolved into VRML 97, an international standard with additional features that may be used to create complex 3D representations of a variety of locations and objects, after it was accepted by the ISO in 1996 [39].

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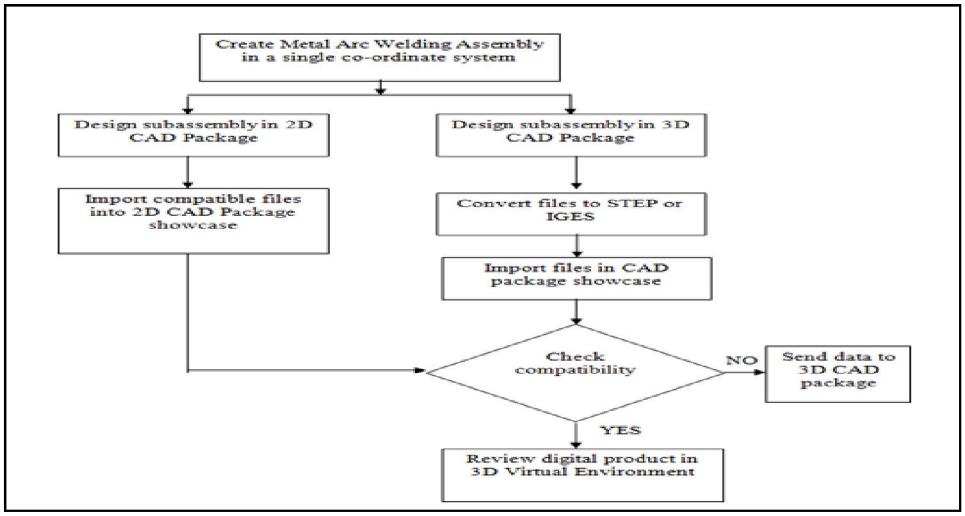
V. FLOWCHART OF DESIGN METHODOLOGY

The virtual reality welding design process consists of two phases:

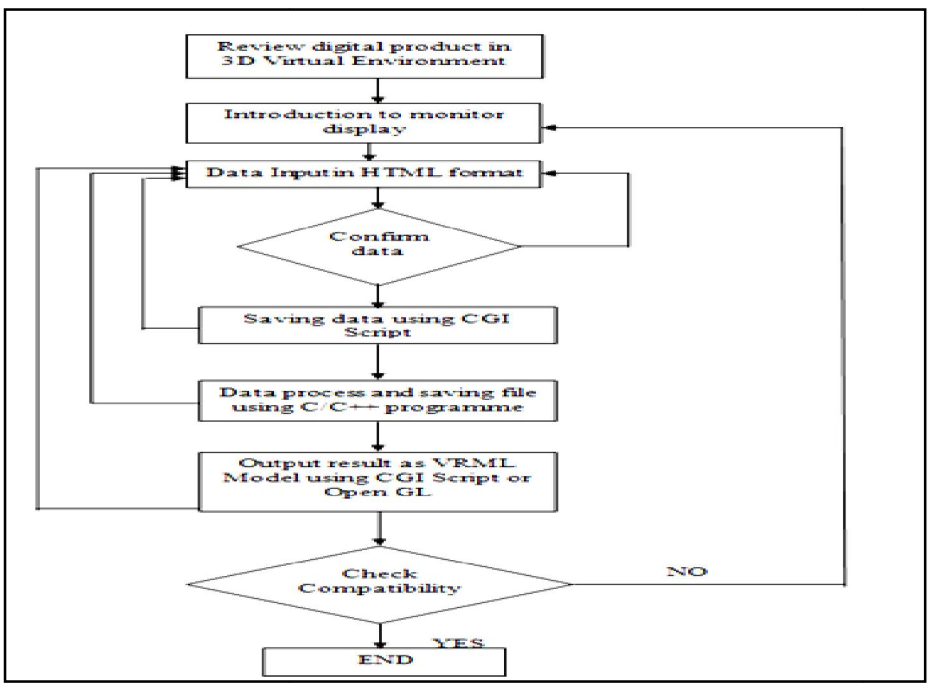
Stage 1: Modeling a Metal Arc Welding Assembly using a Commercial CAD Program

Stage 2: Convert a 3D virtual model to a VRML model for a realistic virtual experience.

Stage 1



Stage 2



VI. CONCEPTUAL DESIGN OF VIRTUAL WELDING PLATFORM

3ds Max 2009 has been used to construct the conceptual design. There are two components to the virtual welding platform architecture that is seen in fig. 6.1. The trainees are introduced to the notion of virtual reality in the first section, which consists of tables and a desk. The second section, on the other hand, is equipped with a worktable, a

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virtual welding machine, VR glasses, a head-mounted display, gloves, and sensors to establish a barrier between the virtual and physical worlds.

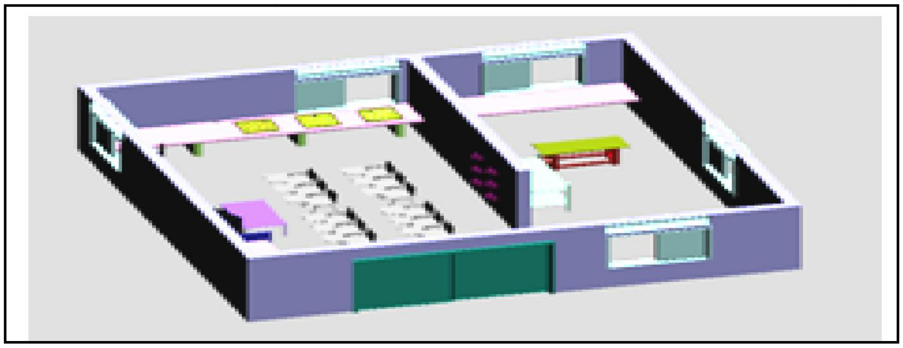

Figure: Virtual Welding Platform

VII. CONCLUSION

The current concept of virtual engineering is the result of advancements in computer graphics, virtual reality, modeling, and simulation technology. The design, prototype, design modification, scale production, and product and process development phases of conventional manufacturing are all radically changed by these technologies.

This paper presents an overview of virtual reality concepts, technologies, applications, and challenges. It is critical to comprehend from this study that virtual reality (VR) offers improved means of interaction and information visualization via suitable modeling, design, and analysis, which may be used to address real-world engineering problems. The conceptual design of the virtual welding platform is ultimately produced using commercial CAD software, and a design procedure is established to complete the virtual environment and proceed.

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