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Development of a user interface for manual metal arc welding process training in an interactive augmented reality environment

Kalpana Shankhwar and Shana Smith
Department of Mechanical Engineering, National Taiwan University, Taipei, Taiwan

Abstract

This study develops comprehensive a manual metal arc welding process training system in augmented reality environment. The user can visualize the effects of various welding parameters such as torch angle, welding direction, arc length, current, voltage and welding speed on welding process by interacting with user interface. This system utilizes Arduino to integrate the distance measuring sensor with Unity 3D for measuring the arc gap. The electric arc is stablished when the predefined gap is measured by the distance sensor in AR which replicates the real welding process.

Introduction

Augmented reality has gained a growing amount of importance in past two decades due to its wide range of applications in industries in which one of them arc welding process. AR which is a set of innovative and effective human computer interaction technique, has potential to simulate the arc welding process. The current welding training system can be used to train the new operators and Engineering students. AR training system can be proven to be cost effective and time efficient and can prevent the new beginners from the hazards due to intense ultraviolet rays and extremely high temperature during welding. This system can be helpful for the Engineering students to learn the theoretical part involved in welding process by interacting with the user interface.

Methodology

- This research used Unity 3D a game engine software by which virtual objects and scene is created. The scripts involved in various sections of the training system are written in C sharp.
- An augmented reality Vuforia engine software development kit (SDK) is used in this research for the development of marker based tracking of the real objects.
- A virtual reality headset HTC Vive Pro is used in this research for the visualization of the virtual welding training in Augmented reality.

Schematic of the system

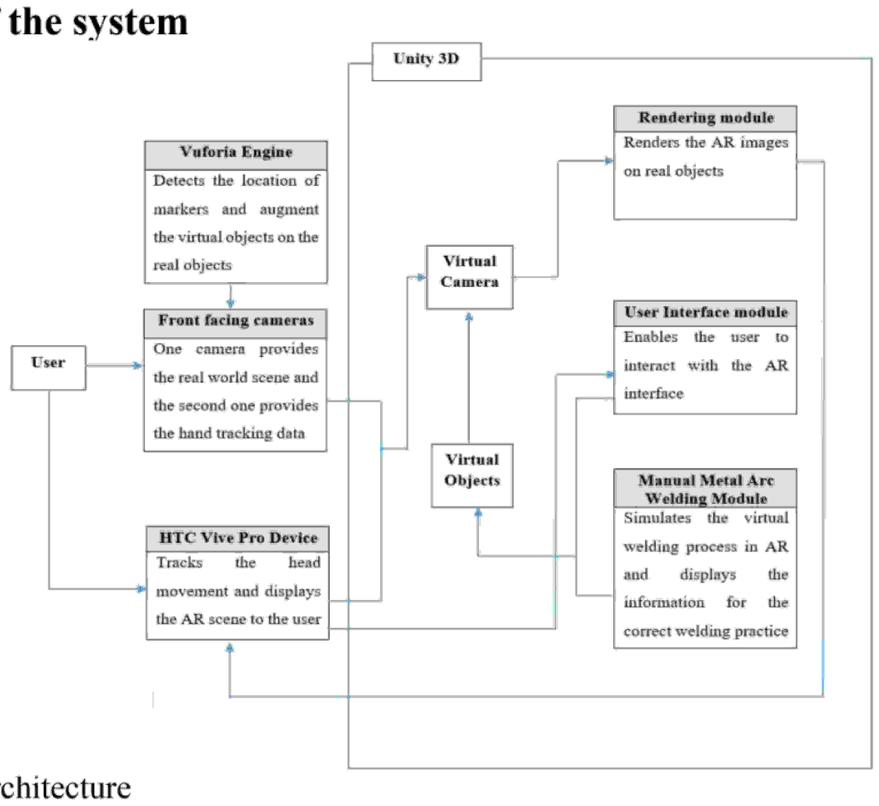

Fig. 1 System architecture

Results

Fig. 2 User Interface with welding parameters changing buttons

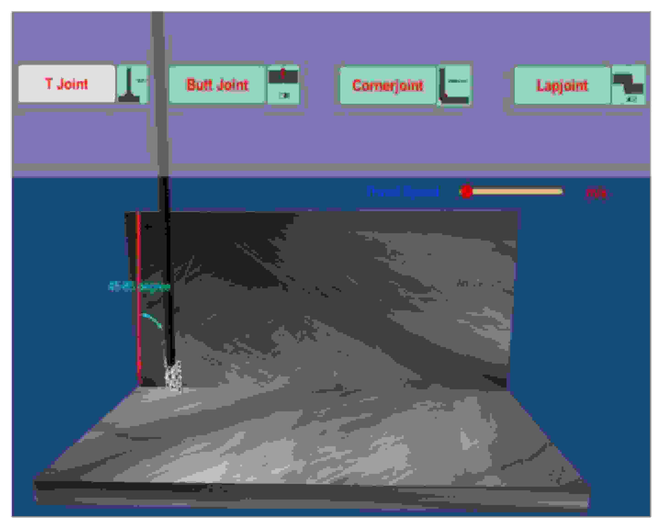

Fig. 3 Welding training for the speed control with UI buttons for different joint geometries

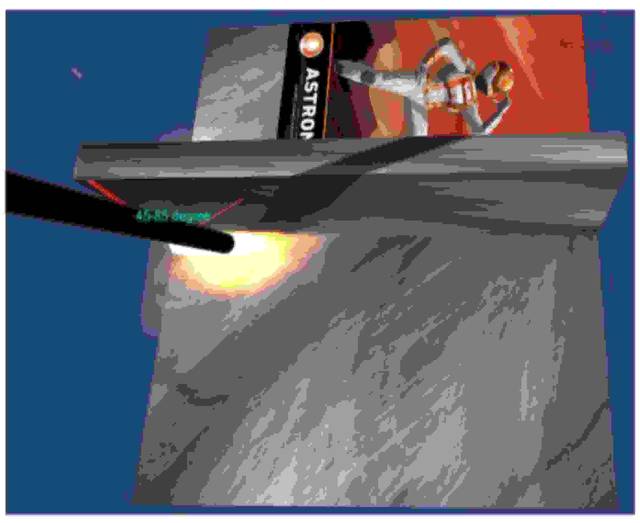

Fig. 4 Virtual arc establishment

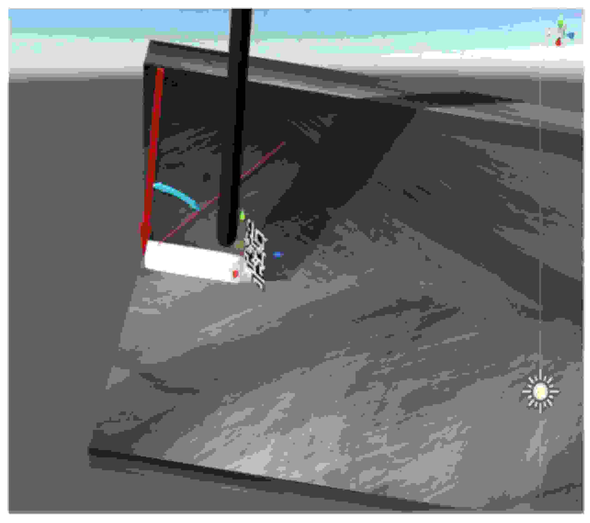

Fig. 5 Virtual weld bead on the virtual weld plate

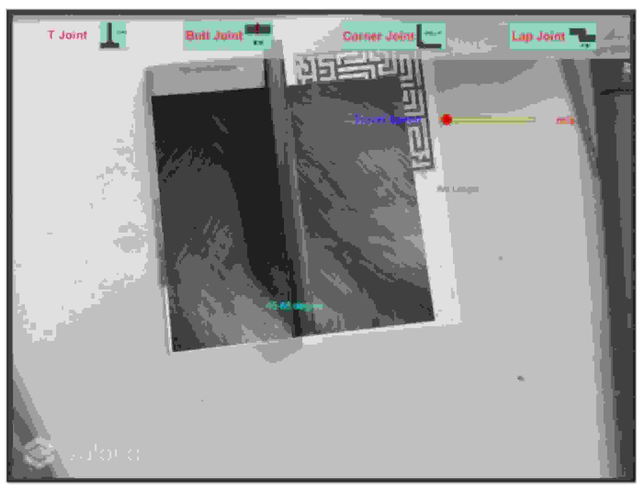

Fig. 6 Augmented reality scene with overlaid virtual workpiece on real workpiece

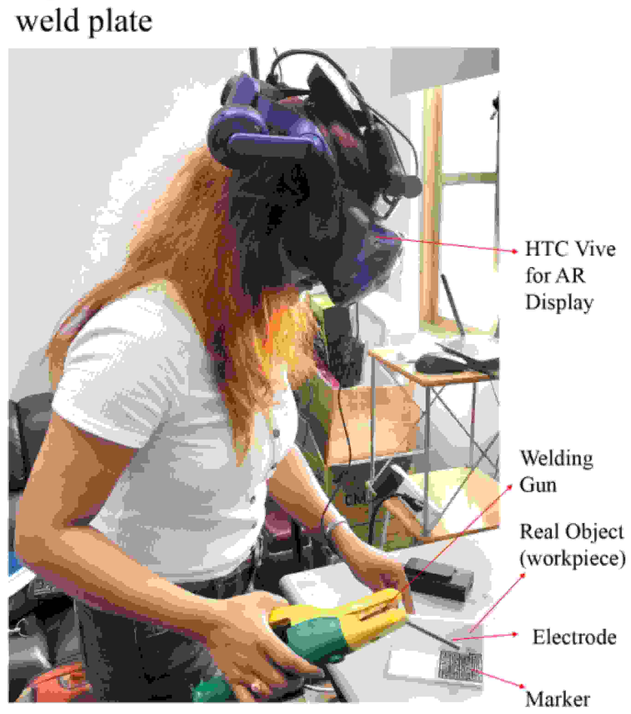

Fig. 7 System hardware architecture

Summary

According to the depicted results, user can practice manual metal arc welding process by varying various welding parameters. User can practice to maintain an arc gap and a particular welding speed in a specified range of inclination angle of the electrode. User can visualize the effect of welding voltage, current, speed, arc length and inclination angle on the penetration depth and width of the welding bead.