Augmented Visualization of Modeling & Simulation Analysis Results

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Abstract. Augmented Reality (AR) technologies enhance users' sense of reality and immersion by augmenting additional information (e.g., images, texts, 3D models, etc.) to the actual environment through cameras, making it possible to convey information and conduct tasks more effectively. This paper proposes augmented reality-based visualization system to effectively provide M&S’ analysis results. It is particularly useful to utilize AR-based M&S’ analysis results in various environments (offices and conference rooms) without geographical restrictions. Also, the user can perform the task via increasingly visualizing the M&S model and the analysis result in Rapid RP(Prototype) as well as the image based marker on the Augmented Reality

Keywords: Modeling and Simulation, Augmented Reality, Engineering Analysis

1 Introduction

Life cycles of products have increasingly been reduced in recent years as customer requirements have varied and rapidly changed. This makes companies develop and produce products in a short period of time to meet customer demands. In order to achieve this ends, it is important to reduce time and cost of the product that is being developed through verification at the design stage. Following this trend, a new paradigm aiming to design and verify products in a virtual space is emerging. [1, 2, 3, 4, 5, 6].

It needs collaboration between many stakeholders involved in the development to verify M&S’ analysis results, which are required to design and develop products. Therefore, many stakeholders involved in the development process in various environments (offices, meeting rooms, and workrooms) should be able to more effectively use M&S’ analysis results. In addition, there needs to be a support for users to review results more easily as the level of understanding of M&S’ analysis results may vary depending on the level of knowledge of such users.

Augmented Reality (AR) technologies enhance users’ sense of reality and immersion by augmenting additional information (e.g., images, texts, 3D models, etc.) to the actual environment through cameras, making it possible to convey information and conduct tasks more effectively. Moreover, AR technologies are used in various areas such as virtual product reviews or manufacturing system designs. Due to the
development of smart devices, users can use augmented reality more easily with their smart devices. Thus, smart device-based augmented reality can provide M&S' analysis results to users so that they could review and use the results more easily and accurately without geographical restrictions.

This paper proposes augmented reality-based visualization system to effectively provide M&S' analysis results. It is particularly useful to utilize AR-based M&S' analysis results in various environments (offices and conference rooms) without geographical restrictions. Also, the user can perform the task via increasingly visualizing the M&S model and the analysis result in Rapid Prototype (RP) as well as the image based marker on the Augmented Reality.

This paper is comprised of the following: In Chapter 2, we describe the system structures and implementation of the M&S presented in this paper. Finally, Chapter 3, concludes the study.

2 Design and Implementation of Proposed System

The Modeling & Simulation system in this paper is an entry-level structure/ fluid system developed by using open sources so that novices can easily and conveniently use the system. M&S SW assigns models for interpretation and functional conditions through preprocessor phase and interprets structures and thermal fluid analysis through this. The results conducted can be confirmed by interpretation rendering and chart. The whole processes are structured so that users not familiar with M&S SW can use the system according to the procedures of the workflow (Fig. 1).

![Conceptual Diagram of proposed System](image)

**Fig. 1. Conceptual Diagram of proposed System**
By using smart device, under augmented reality environment, for visibility of M&S model and analysis result, the study used Unity3d[7] and Vuforia SDK[8] and also, as the smart device, the study used devices (Lollipop, MarshMellow), based on Android platform operation system (Lollipop, MarshMellow).

In this study, the first case is the cycle frame. The cycle frame keeps receiving load while it is running. Therefore, physical damage may happen. Such physical damage may threaten user’s safety, etc so it comes to important problems in frame design and the cost to prevent physical damage has been gradually increased. Thus, as for the cycle frame, the study performed M&S, used smart device and virtualized augmented reality (Fig. 2). The augmented reality on M&S result of cycle frame uses natural marker. Based on such concept, user can review M&S result on cycle frame under augmented reality, in which the user can perform interaction through touch interface as well. First by using touch interface, when user selects M&S model, the Gizmo on moving and rotating is generated, at which Gizmo’s each axis is selected and also, moving and rotating go through interaction.

![Fig. 2. Augmented reality on M&S analysis results of cycle frame](image)

### 3 Conclusion

The study proposes augmented reality method on M&S analysis result. As for M&S analysis result, dynamic mesh was generated and its analysis result applied Shader in order to express analysis result as well as generated Mesh. The study used the smart devices such as smart phone and pad. Also, M&S model went through augmented reality by using Natural Marker. However, the study did not provide augmented reality on fluid analysis. In addition, as for using RP, Natural Marker should be need because there was not any reason why RP shall be used directly. Therefore, in next study, by putting M&S result on the fluid analysis on augmented reality and provide it to each user, the study intends to analyze and research fluid analysis-related program, etc. such as OpenFoam[9] and also, by using RP or real materials (actual facilities,
etc.) together with smart phone, M&S model is expected to be visualized more naturally by direct recognition.

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References