Slovenská Technická Univerzita

Fakulta Informatiky a Informačných Technológií

Rozšírená realita a jej využitie

Semestrálna práca

2020 Juraj Brodniansky

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Študijný program: B – INFO 4

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Juraj Brodniansky

Čestné vyhlásenie

Prehlasujem, že som semestrálnu prácu vypracoval samostatne s využitím získaných teoretických poznatkov a s použitím uvedenej literatúry.

Zvolen, December 2020 Juraj Brodniansky

Obsah

Abstract

Augmented Reality is an area of 3D visualisation only in its development and is ascending to its full potential in IT. Despite of fact its only virtual based, it can be implemented in vast amount of areas. According to its flexibility, it may be used in Architecture as a tool for creation and design of a architectural models and previews of its outcome. In addition, the artifical reality may be used also in the field of engineering, and in presence is already used, visualising of technological components and automated manufacturing engines, and creation of these components which can be passed to either 3D print or any other way of production.
Augmented reality and its parts, are composed of multiple ways of visualising and interpreting reality. Its main idea is to reflect the reality with the addition of augmented parts such as mentioned 3D models, and are supposed to ease the human mind of the part of space imagination.
This scientific work is focused on to pointing on the usage and implementation of Augmented Reality and its parts in different areas, and explanation of its implementing in to the process of production. This work is defining the areas of usage and is refering to other scientific documentations in belief of being referred to in further works in the Augmented Reality.

Anotácia

Rozšírená realita je oblasť 3D zobrazovania v procese vývoju a pomaly dosahuje svoj potenciál. Na rozdiel od faktu že je to digitálny virutálny priestor, sa dá táto oblasť implementovať do množstva oblastí. Vzhľadom na tento fakt, v architektúre sa dá použiť ako nástroj pre tvorbu a dizajn návrhov budov. Rozšírená realita môže byť taktiež použitá v strojárstve, v súčastnosti sa už niektoré prvky rozšírenej reality už používajú, zároveň môže byť použitá aj na vizualizáciu komponentov mechanizmov a autmoatizovaných strojov, a na tvorbu komponentov ktoré následne sa posúvajú na 3D tlač alebo iný spôsob výroby.
Rozšírená realita a jej súčasti, sú zložené z rôznych spôsobov zobrazovania reality. Ich hlavnou myšlienkou je odzrkadliť realitu s pridaním upravených súčastí ako napríklad spomenuté 3D modely, a má uľahčiť ľudom proces tvorby uľahčením zobrazenia do priestoru pričom nemusia používať priestorovú predstavivosť.
Táto vedecká práca je zameraná na poukázanie využitia a prípadne implementácie rozšírenej reality a jej súčastí do odlišných oblastí, a vysvetliť implementáciu a proces zapojenia do výroby. Táto práca definuje oblasti a využitie pri čom sa odkazuje na iné vedecké dokumentácie v myšlienke byť referovaná na iné práce v rozšírenej realite.

1 Úvod

Práca je primárne zameraná na poukázanie na možnosti využitia rozšírenej reality v rôznych oblastiach a prípadne jej implementácie alebo jej už využitia v praxi. Hlavnou súčasťou je aj poukázanie na konkrétne použitie pre rôzne problémy v daných oblastiach, pričom to je iba zlomok použitelnosti v praktickom prostredí.

2 Contents of documentation

2.1 VisAr3D: an approach to software architecture teaching based on virtual and augmented reality

This paper aims to present an approach entitled VisAr3D to support software architecture teaching by means of virtual and augmented reality. Thus, it intends to define a 3D visualization environment which includes exploration, interaction and simulation resources to establish a practical and attractive learning, focusing on large scale systems. [5]

2.2 Applying Relief Mapping on Augmented Reality

Augmented Reality is a variation of Virtual Environment (VE) in Virtual Reality (VR). Virtual Reality technologies Virtual Environment makes user experiences immersion inside a synthetic environment and user cannot see the real world. In contrast, Augmented Reality (AR) medium of information added to the real world in registration with the world to combine virtual objects and real world. Technically, Augmented Reality is able to enhance all five senses by adding digital or computer generated information such as images, audio, video, interaction and overlaying them over in physical world. Its most commonly use is visual. Augmented Reality allows the user to see the virtual object blended in real world environment. To apply Augmented Reality to applications used for illustration the architecture or infrastructure of building, 3D visual model is a content which is good way to show obviously architecture's element because it is able to display the appearance of each building part separately responding to camera perspective in real-time. That means AR system have to re-render the digital object every time the viewer changes position even a tiny bit as temporal registration. Therefore, the computations for three-dimensional computer graphics must be considered about rendering system on the observed devices because time lags could be occurred when lacking computational speed while it is operating the imagery overlay on the top of the physical world for each frame. There are mainly constraints that are limited the AR system performance such as limited memory and limited computational capability. To enhance the limitations of handheld devices, this research applies Relief Mapping algorithm to 3D model in Augmented Reality technology to reduce the number of polygons

on the facade of Sino Portuguese Architecture which consist of many bas-relief patterns on their facades. Our system uses game engine, Unity3D, for real-time rendering and Vuforia SDK implemented augmented reality application on handheld device. The result of the research after applying Relief Mapping technique instead of using the conventional modeling creation, more than 80,000 polygons/ 1 bas-relief, is to create by having a single polygon per a bas-relief and the quality of visualization is compatible to each other on AR application. [1]

2.3 Remote augmented reality engineering labs

This research is mainly concerned with remote labs dedicated to disparate types of scientific and engineering experiments. Educational engineering labs present an essential part in engineering education because they provide practical knowledge for students. Unfortunately, these labs equipped with costly instruments are available for little and limited periods of time for a huge number of students. An approach to circumvent the mentioned problems is by employing virtual and remote labs that assist the students in developing their practical skills, but applying this type of labs leads to the fact that students suffer from the weakness of the reality representation of experiment equipment. Our research is aimed at checking and proofing the appropriateness of augmented reality (AR) to be used in representing client user-interfaces in remote labs. Students can carry out an engineering experiment represented by real and virtual elements, components and equipment overlaid with virtual objects. [3]

2.4 Augmented Reality for Big Data Visualization

Information delivery in a visual format is always a better way of communication. Even with many data visualization techniques available, visualizing enormous amounts of data has always been a challenge. With recent advancements in technology, many new visualization techniques unfold, one of which is visualizing data through Augmented reality(AR). AR and big data have always gone together as AR requires large data sets to render information virtually in a real-time environment, and big data provides the same. In this paper, we explore some of the conventional visualization techniques and discuss the scope and possibilities for AR data visualizations. We also explore the areas implementing the technique of visualizing big data with AR. The advantages and limitations are also discussed. [4]

2.5 Interactive Sculpting Using Augmented-Reality, Mesh Morphing, and Force Feedback: Force-Feedback Capabilities in an Augmented Reality Environment

This article describes an innovative methodology to integrate force-feedback capabilities into an augmented-reality (AR) environment to perform real-time

morphing of geometrical surfaces with functionalities. The methodology addresses the interactive sculpting applied to engineering problems with geometry modification and optimization. The objective is to give the designer a computer-aided design (CAD) tool that allows for the modification of a component shape directly touching its virtual representation. The proposed approach is based on the use of radial basis function (RBF) morpher to achieve reliable and robust results in real-time computation. The methodology combines the potentialities of the video-based AR with the use of a force-feedback device. The mixture of such ingredients produces a high level of realism and enhances the interaction level between the user and the objects to be edited, moving a step forward in comparison with standard computer-aided engineering (CAE) methodologies. [6]

2.6 An Augmented Reality System for Astronomical Observations

Anyone who has gazed through the eyepiece of an astronomical telescope knows that, with the exception of the Moon and the planets, extra-solar astronomical objects are disappointing to observe visually. This is mainly due to their low surface brightness, but also depends on the visibility, sky brightness and telescope aperture. We propose a system which projects images of astronomical objects (with focus on nebulae and galaxies), animations and additional information directly into the eyepiece view of an astronomical telescope. As the telescope orientation is queried continuously, the projected image is adapted in real-time to the currently visible field of view. For projection, a custom-built video projection module with high contrast and low maximum luminance value was developed. With this technology visitors to public observatories have the option to experience the richness of faint astronomical objects while directly looking at them through a telescope. [2]

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