BILKENT UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE

CS491 – SENIOR DESIGN PROJECT

PROJECT *inlight*

PROJECT SPECIFICATION REPORT

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1. Introduction

Augmented Reality has become a trending topic in Computer Science. Augmented Reality can be used in a wide variety of different areas such as gaming, education, architecture and medicine. This is largely due to the fact that “Real Life” is always open for augmentation in most cases. These augmentations are often intended to provide ease of use, understanding and a new means of experiencing the reality in general.

This project, similarly, is intended to be used in decoration and furniture industry by making it possible to render realistic looking objects in Augmented Reality. For this reason, the project aims to create a solution for real time dynamic lighting in Augmented Reality environment. Without lighting details, the objects and materials in Augmented Reality environment do not exhibit the realistic look of an actual, existing object. Therefore, finding a solution for properly calculating the illumination and the necessary lighting effects bear a crucial importance for rendering objects in a photorealistic fashion.

Applications of this project may involve a large variety of different Augmented Reality devices ranging from dedicated AR glasses to smart phones and tablets. Regardless, the primary goal remains the same, achieving realistic visuals by casting the light effects and illumination on the virtual object to be rendered in AR environment in real time.

1.1 Description

Our project focuses on lighting in Augmented Reality (AR) applications. Our goal is to research how the information about lights in the real-world environment can be captured in real-time in a way that the captured information can be used to make real-time rendering more photorealistic. Although all AR users are also our potential users, we are targeting decorators and the people who are decorating their homes, offices etc. to help them visualize products on the real environment that they will be put into, and ease customers' decision making. We want the technique that we will develop to be used in different mediums and with different devices, such as tablet applications and AR glasses.

There are several techniques that we plan to evaluate. The first one is Image-Based Lighting (IBL) with environment mapping using dome or cube mapping. It will also use High Dynamic Range imaging (HDR) for greater realism. The cameras found in mobile devices can be utilized for imaging the environment, and the data can be processed and used for rendering on the same device. For AR glasses, currently used technique is to detect light sources using the image that is going to be augmented. The ambiguity of the results of this method results in less realistic renderings. Shading and reflections may be computed more accurately and in real-time by placing a specialised wide-angle camera to the location of the overlaid object and using IBL.

Another possible technique is to calculate positions and fluxes of the lights in the scene from the image and use this data for rendering.

1.2 Constraints

Mobile devices may cause several constraints. Photorealistic rendering is a costly job which may take a long time on mobile devices. Therefore the device that will use our set of solutions should have high quality hardware or rendering can take more time than a feasible duration. Furthermore, cameras in current mobile devices have very limited field of view, so they cannot detect the light sources located at the edges of camera. In this case, user of the mobile device will have to rotate the camera to cover all angles and rendering will not be fully real time.

Lens flare caused by light scattering or directly hitting on the lens system is another problem we have to address. It may manifest itself in the form of blazes, rings and circles across the image or view. This bears crucial importance as to detect light sources that are within the camera's sight correctly, without confusing actual light sources with lens flares in the captured image. Lens hoods are usually used on professional cameras, however it cannot be the case for mobile devices. For this reason, a programmatic approach towards the solution of this problem needs to be taken into consideration.

1.3 Professional and Ethical Issues

The project will likely need to incorporate existing software code as well as various development tools. Most of the existing code that is intended to be used in the project are open source, licensed with GNU General Public Licence and (GPL) along with Lesser General Public License (LGPL) as well as Apache License and such. While having the same fundamental purpose of preserving and limiting the usage of open source code, each of these licenses have differing terms and conditions. Respectfully, in order to incorporate these software properly, each of these licences need to be understood clearly beforehand. Otherwise, failing to understand or abide by the terms that these licences imply is likely to result with unethical use of code and various legal issues in long-term.

2. Requirements

Achieving high quality photorealistic rendering is our primary goal. Our solution should render given scene for different types of lighting as realistically as possible. In order to increase the rendering quality, our system should locate the light sources and fluxes or create a model that can simulate the same effect on the viewed scene.

Our solution should complete the rendering under a reasonable time limit. Our intent is to make our solution feasible to use in real time systems. Rendering time is crucial so the targeted users like interior designers can get immediate feedback on their work.

Our solution should be adaptable to different environments. We are targeting both professional and amateur users, therefore expecting that a variety of devices can be used. A device independent solution that can be ported to various different other devices without running into dependencies is important goal.

3. References

"Open Source Licenses". Retrieved October , 2014 Available: http://opensource.org/licenses