# Interior Design in Augmented Reality Environment

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**Abstract:** We presents an application of Augmented Reality technology for interior design. Along with the dramatic progress of digital technology, virtual information techniques are also required for architectural projects. Thus, the new technology of Augmented Reality offers many advantages for digital architectural design and construction fields. AR is also being considered as a new design approach for interior design. In an AR environment, the virtual furniture can be displayed and modified in real-time on the screen, allowing the user to have an interactive experience with the virtual furniture in a real-world environment. Here, AR environment is exploited as the new working environment for architects in architectural design works, and then they can do their work conveniently as such collaborative discussion through AR environment. Finally, this study proposes a new method for applying AR technology to interior design work, where a user can view virtual furniture and communicate with 3D virtual furniture data using a dynamic and flexible user interface. Plus, all the properties of the virtual furniture can be adjusted using occlusion- based interaction method for a Tangible Augmented Reality.

**Keywords**: Augmented Reality, Tangible AR, CAAD, ARToolkit, Interior design.

## I.       INTRODUCTION

Augmented Reality (AR) employs computer vision, image processing and computer graphics techniques to merge digital content into the real world. It enables real-time interaction between the user, real objects and virtual objects. AR can, for example, be used to embed 3D graphics into a video in such a way as if the virtual elements were part of the real environment.

In this work, we will create knowledge based AR system. One of the challenges of AR is to align virtual data with the environment. A marker-based approach solves the problem using visual markers, e.g. 2D barcodes, detectable with computer vision methods.

The technology behind *Augmented Reality* is taking a real-world view and enhancing it with computer-generated imagery.

We believe that one of the most powerful uses of virtual worlds will not be to replace the real world, but rather to augment the user's view of the real world with additional information.

This idea, introduced by Ivan Sutherland's pioneering work on head-mounted displays, is often referred to as augmented reality.

For example, graphics and text overlaid on the surrounding world could explain how to operate, maintain, or repair equipment, without requiring that the user refer to a separate paper or electronic manual.

Gartner hype cycle for emerging technologies in 2011, with AR high-lighted



## II.       BASIC CONCEPTS

Applications allow virtual imagery to be superimposed over live video of the real world:
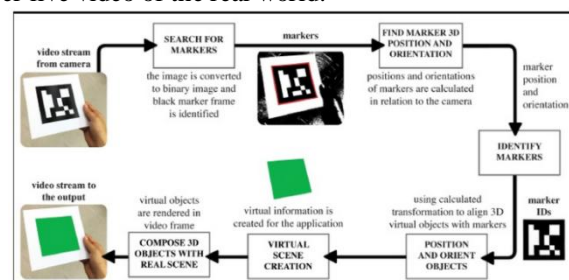
Application works as follows:

1.      The camera captures video of the real world and sends it to the application.
2.      Application searches through each video frame for any square shapes.
3.      If a square is found, the application calculates the position of the camera relative to the black square.
4.      Once the position of the camera is known a computer graphics model is drawn from that same position.
5.      This model is drawn on top of the video of the real world and so appears stuck on the square marker.
6.      The final output is shown back in the handheld display, so when the user looks through the display they see graphics overlaid on the real world.

A marker is such a sign or image that a computer system can detect from a video image using image processing, pattern recognition and computer vision techniques. Once detected, it then defines both the correct scale and pose of the camera. This approach is called marker-based tracking



The first goal of a marker detection process is to find the outlines of potential markers, and then to deduce locations of marker's corners in the image. In addition, detection system needs to confirm that it really is a marker and decipher its identity. Finally, the system calculates the pose using the information from the detected marker location.

The basic marker detection procedure consists of the following steps:

1. Image acquisition
    Acquisition of an intensity image.
2. Preprocessing
    Low level image processing
    Line detection/line fitting
    Detection of the corners of the marker.
3. Detection of potential markers and discard of obvious non-markers
    Fast rejection of obvious non-markers
    Fast acceptance test for potential markers.
4. Identification and decoding of markers
    Template matching (template markers)
    Decoding (data markers).
5. Calculation of the marker poses
    Estimation of marker pose
    Iterative pose calculation for accurate pose.

## III.      SYSTEM ARCHITECTURE

Imagine a teacher and a group of students huddled around a Dante manuscript or early printed edition in the Library. The project aims to use AR (Augmented Reality) to simultaneously allow students to experience the magic of original materials, whilst enhancing the learning experience by 'surrounding' the object with digitised content; images, texts, online learning resources and information on related objects held in the Library and elsewhere.      While digitisation is often a suitable alternative to direct access to Special Collections material, it is essential that students are exposed to original materials during their studies: in order to confront and question the materiality of objects, to be inspired, and to prepare them for solo research. Many tutors recognise that exposing their students to original Special Collections material, even on a limited basis, can spark their enthusiasm for and engagement with wider classroom-based and remotely-taught courses. Yet students are constrained by the fragility and physical nature of the material.

Figure shows a flowchart for a simple augmented reality system. The capturing module captures the image from the camera. The tracking module calculates the correct location and orientation for virtual overlay. The rendering module combines the original image and the virtual components using the calculated pose and then renders the augmented image on the display.
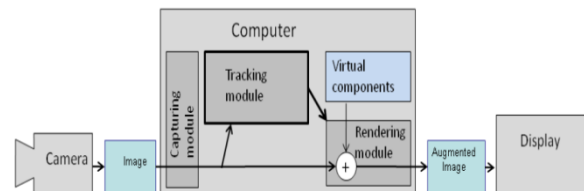


The tracking module is "the heart" of the augmented reality system; it calculates the relative pose of the camera in real time. The term pose means the six degrees of freedom (DOF) position, i.e. the 3D location and 3D orientation of an object.

The tracking module enables the system to add virtual components as part of the real scene. The fundamental difference compared to other image processing tools is that in augmented reality virtual objects are moved and rotated in 3D coordinates instead of 2D image coordinates.



The simplest way to calculate the pose is to use markers. However, the mathematical model (projective geometry) behind other pose calculation methods is the same. Similar optimization problems arise in different pose calculation methods and are solved with the same optimization methods.

We can consider markers to be a special type of features and thus it is natural to explain marker-based methods first and then move on to feature-based methods and hybrid tracking methods. We concentrate on marker-based augmented reality.
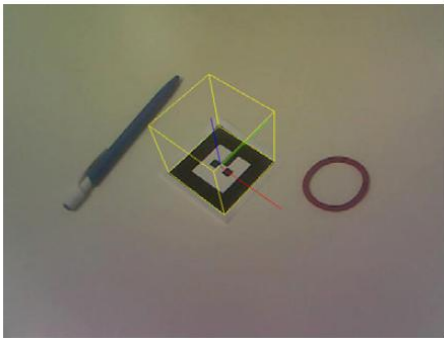
The rendering module draws the virtual image on top of the camera image. In basic computer graphics, the virtual scene is projected on an image plane using a virtual camera and this projection is then rendered. The trick in augmented reality is to use a virtual camera identical to the system's real camera. This way the virtual objects in the scene are projected in the same way as real objects and the result is convincing. To be able to mimic the real camera, the system needs to know the optical characteristics of the camera. The process of identifying these characteristics is called camera calibration. Camera calibration can be part of the AR system or it can be a separate process.

## IV.       CONCLUSION

We examined virtual furniture and adjustment work to create a new design method using Augmented Reality technology for Interior Design education. In particular, AR technology opens up many new research fields in engineering and architecture. In an AR environment, design work can become more lively, convenient, and intelligent. Plus, design work and manufacturing can be conducted at the same time and we close relationship with each other. With AR, the virtual products of graphic technology are not only for simulation but also obtain real higher values. Furthermore, AR technology can become a new animated simulation tool for interior design, allowing the user to see a mixed AR scene through HMD, video display, or PDA. It is also anticipated that the interactive potential can be increased according to the user's needs.

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