

# Virtual Furniture Application Using Augmented Reality

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## Abstract

Information technology currently supports the development of human interaction with virtual environment. This development will continue in developing in the form of Human Computer Interaction (HCI). Augmented Reality is a field of computer research which deals with the combination of reality with computer generated data. The main purpose of this project is to develop a windows application for trying different furniture items in a virtual way. This application will eliminate the need of physically visiting the furniture store which is very time consuming activity. This research is using photo-realistic 3D models to rendering used in computer graphics. Rendering of the basis for colour and shading in order to make it appear solid and 3D. These 3D furniture models are superimposed on to the live feed of real space taken from the camera. After imposing the model it will appear as, it is actually placed into the real world. Using this application one can choose from the different set of furniture and try it on their space.

## Keywords

HCI- Human Computer Interaction, 3D -Three dimensional, AR- Augmented Reality

## I. Introduction

The main purpose of this project is to develop an application for trying different furniture items in furniture stores without using the usual means which is a very time consuming activity. Besides, this it might be easier to use this technique in Online shopping as an option for user to try out the furniture items in their room they are thinking to buy and allow user to visualize the room how it will look after placing furniture in it. User can try out multiple combinations virtually, without physical movement of furniture items. Our motivation here is to increase the time efficiency and improve the accessibility of furniture try on by creating furniture layout augmented reality application.

## II. Proposed System

The proposed the system augmented reality conferencing system which uses overlay of virtual images on the real world. Remote collaborators are represented on Virtual Monitors which can be freely positioned about a user in space. Users can collaboratively view and interact with virtual objects using a shared virtual whiteboard. This is possible through precise virtual image registration using fast and accurate computer vision techniques and HMD calibration. A method for tracking fiducial markers and a calibration method for optical see-through HMD based on the marker tracking.

## III. Algorithms

Marker Detection Procedure:

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. 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.

## 1. RGB to GRAY Scale



Fig. 1: RGB to Gray Scale

**2. Thresholding**

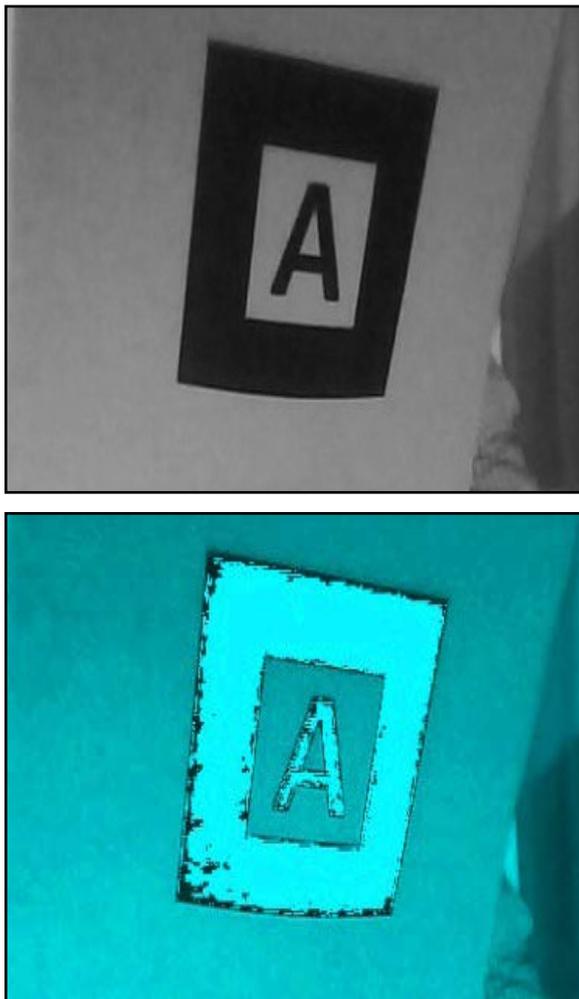


Fig. 2: Thresholding

**3. Marker Detection:**

The basic marker detection procedure consists of the following steps:

1. Image Acquisition:  
Capture the image through camera.
2. Pre-processing  
Here, the captured image is filtered. Image filtering technique used is RGB to Gray scale conversion, Thresholding (binary image).
3. Detection Of potential markers and discard of obvious non-markers  
Detect the required marker from image and discard the non-marker from binary image.
4. Identification and decoding of markers:  
Identify marker, find the edges and corners of the black marker and decode its characteristics.
5. Calculations of the marker pose:  
Now calculate the position of marker in real world for superimposing the three dimensional image.

**4. Superimpose 3D object:**

In this process the 3 dimensional objects are overlaid on to the 2 dimensional image frame acquired from camera. This will appear as it is actually placed in real world.

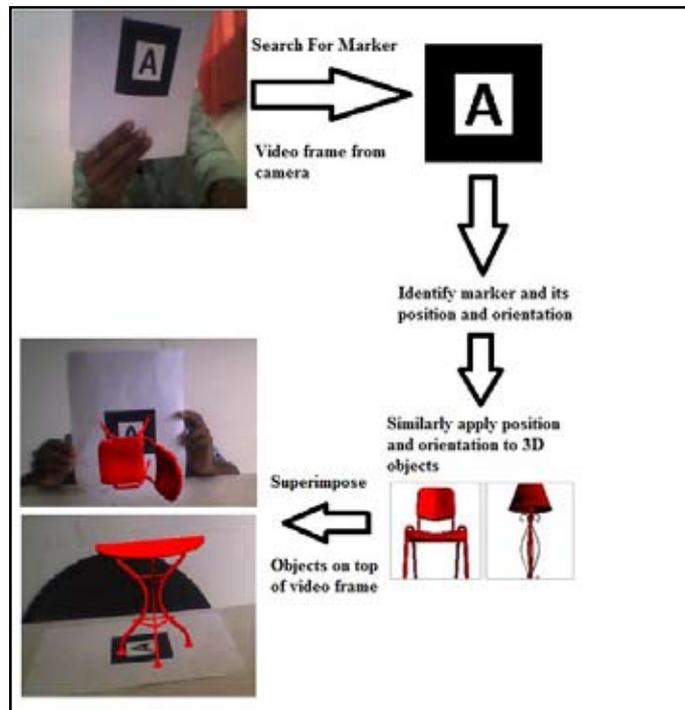


Fig. 3: Marker detection and superimpose method.

**5. 2D and 3D Transformation:**

The transformations done on objects are scaling, rotation, shearing etc.

Transformations are performed by multiplying transformation matrix by function. In 2D transformation, suppose we have transformation matrix  $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$  is transformed by  $\begin{bmatrix} x \\ y \end{bmatrix}$

So it will be  $\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$

Similarly to perform 3D transformation  $\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$

at the point  $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$  it will be  $\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$

**Scaling**

For the scaling we have,

$X^1 = S_x * X$

$Y^1 = S_y * Y$

$Z^1 = S_z * Z$

Matrix is formed as  $\begin{bmatrix} Sx & 0 & 0 \\ 0 & Sy & 0 \\ 0 & 0 & Sz \end{bmatrix}$

**Rotation**

There are three different sets of rotation matrix for each axis to be rotated,

$$\begin{aligned} \text{X-axis rotation: } & \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos \theta & -\sin \theta \\ 0 & \sin \theta & \cos \theta \end{bmatrix} \\ \text{Y-axis rotation: } & \begin{bmatrix} \cos \theta & 0 & \sin \theta \\ 0 & 1 & 0 \\ -\sin \theta & 0 & \cos \theta \end{bmatrix} \\ \text{Z-axis rotation: } & \begin{bmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 0 \end{bmatrix} \end{aligned}$$

#### IV. System Design

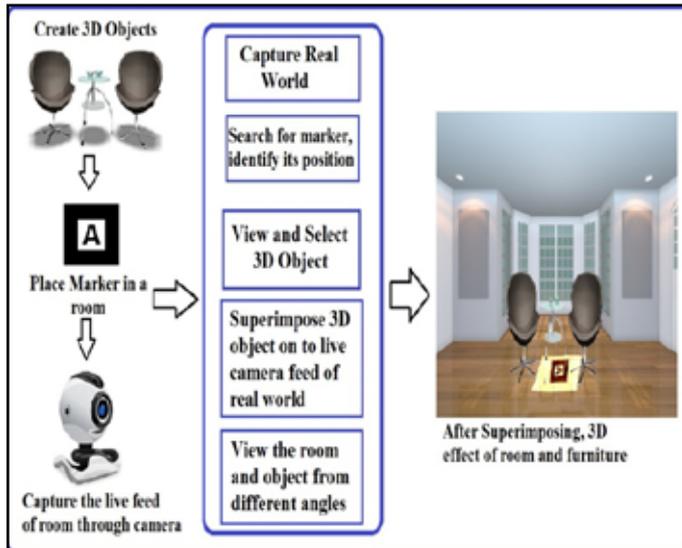


Fig. 4: System Architecture

#### V. Conclusion & Future Work

This system will help buyer who want to buy furniture in real environment. Customer will use it to determine how to set up furniture in house. This system proposed the furniture layout augmented reality application based on the visual marker-based tracking methods. Customer will have the exact view that how to set up the office, house and any space which is required for the use. User can try out multiple combinations virtually, without physical movement of furniture items.

In future works, we need to consider the feedback of user's evaluation as a human interface. In AR studies, not only the estimation of the camera poses and position, the recognition of the real environments, and the Augmented Reality interfaces are necessary for realizing the AR, but also the user's evaluation are very important issues. This system is to watch over for avoiding dangerous layouts of furniture, considering the space between the furniture and rooms.

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