

# Augmented Reality System for Engineering Graphics Visualization in Education

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**Abstract** - This paper deals with engineering graphics and 3D visualization are key elements in most scientific and technical disciplines. In engineering education, the development of spatial abilities has been acknowledged by many authors as a factor that is strongly related to higher-level reasoning skills, critical thinking, creativity, and success in STEM(science, technology, engineering and mathematics) fields. Spatial visualization is a term that refers to the aptitudes needed to mentally process three-dimensional information. It is a high level learning objectives often seen in engineering graphics curricula. Although different strategies can be used to improve visualization skills(sketching, physical models, computer graphics and descriptive geometry), these abilities are often developed indirectly by studying traditional engineering graphics topics such as orthographic projection and pictorials.

**Key Words:** Augmented reality, Engineering graphics, Marker detection, Line detection, Marker-based tracking.

## 1.INTRODUCTION

Augmented reality in engineering graphic system allows users to view a 3-dimensional structure of any 2-dimensional view by using augmented reality to display the output 3d model onto the screen using simple techniques. the study shows that humans are more comfortable to study things which they can see with their eyes rather than hearing and imagining, therefore applying these concept to learn engineering graphics our system helps the user to actually see what they are supposed to do. the main objective of augmented reality in engineering graphics system is to enhance the ability of a student to understand and implement the concept of engineering graphics, students can turn the pages of these books, look at the problem inside the book, and finish their assignment much the way they are reading and writing on an ordinary sheet. However, if they focus a camera on the marker, a 3d virtual models pop-up in the computer screen over the real pages. The virtual models superimposed upon the real pages will serve as the tip for imagining the relationship between the 3d geometry and their 2d projections.



Fig. 1. Examples of AR markers embedded in the graphics materials

## 2. EXISTING METHODOLOGY

Authors have develop an AR based support system for teaching hand drawn machine drawing used for training of sketching and orthographic projection drawing in which users can watch virtual object from various orientation. This system develop using ARToolkit which overlays a virtual mechanical 3d object recognized by a cubic AR marker on the screen[15]. The position and the orientation of the AR marker define the position and orientation of the virtual object. During the registration process direction and distance of virtual object from the camera is calculated through recognizing edges of an AR marker process. User can watch 3d object in various aspect like front, back, top, under, left and right through rotating the cubic AR marker.

Researchers have built advanced gardening support system called the Smart Garden(SG) which provides information about what to plant where. Guides user of planting seedlings where different symbols on the screen indicated steps to be taken also virtual plants are overlaid on real image which helps growers to understand he outcome of their decisions intuitively. SG users NyARToolKit for processing. Fiducial marker, a square black frame with unique symbol inside, is used which differentiate markers. Fiducial marker is recognized in the image captured by the camera and the positions and orientations of the markers relative to the camera are calculated.

In AR applications, the students can interact with real, physical objects around them while virtual models are being added to these world. Using these technique, they have a better perception if the objects they observe. The same mental rotation test was repeated with AR model to investigate the benefits of AR model in assisting the students graphic and spatial cognition skills. The questions of the AR

assisted mental rotation test were prepared from the paper test. The 3d virtual model from the AR assisted test were generated by using a CAD system. The CAD models were then converted to AR models by using AR software. In these way, 3d virtual models can be displayed on the computer monitor together with the test paper containing the questions.

### 3. PROPOSED SYSTEM

The proposed system makes the learning process using augmented reality all the way is here. It will add extra features to our existing system. It will remove the drawbacks of existing system as time. This system examines the potential of an augmented reality system as an educational tool in an engineering graphics course. The student of that course will be able to observe 3d objects on the computer screen in a real world environment capture from a web cam, with a special AR marker on a traditional 2d engineering drawing. the developed AR interface can display different 3d models and help engineering graphics students better understand drawings, geometric features and projection views. in addition, the AR interface can increase the student interest and awareness in engineering graphics class assignments.

### 4. SYSTEM DESIGN

Augmented Reality has 3 important modules:

- 1) Camera Interfacing
- 2) Marker Detection
- 3) Marker Tracking

#### 1) Camera Interfacing:

In the very first step of Augmented Reality we have to first interact with the camera of our system. In camera interfacing it will first ask which web cam you want to use. After that it will shows the resolution of our camera and then web cam is start up.

#### 2) Marker Detection:

In marker detection it will first divide the image into regions then it detect the edges and find the segments from that region. Merge that segments into lines and extend it along with edges and finally it will detect the marker.

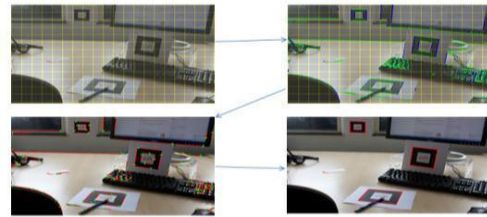


Fig.2. Example of Marker Detection

#### 3) Marker Tracking:

After marker detection the last step is to track that marker. In marker tracking it will track the object on that marker with the help of x, y and z co-ordinates. This will place that object on the marker for visualization.

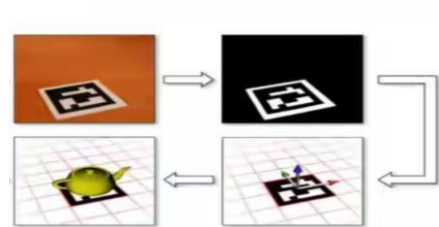


Fig. 4. Example of Marker Tracking.

### 5. CODING

After successful Modeling the next important task is coding. Coding refers to :

1. Computer programming , the processes of designing, testing, debugging, trouble shooting and maintaining the source code of computer programs.
2. The process of statistical classification of information.
3. Coding (social sciences), refers to an analytical process in which data, in both quantitative form (such as questionnaires results) and quantitative (such as interview transcripts) are categorized to facilitate analysis.

#### For User Side:

1. User start the system.
2. User displays the marker in front of camera.
3. User receives corresponding 3d output.
4. Stop.

**For System Side:**

1. System starts.
2. System receives the input marker from the camera.
3. If marker is identified then find the corresponding 3d model.
4. Mount the 3d model at the specified point.
5. Display the content to the user.
6. Stop.

**Software's used:**

A requirement specification for software system is complete description of the behavior of the system to be developed and it include the set of use cases that describes all interactions the user will have with the software . in addition to the use cases the SRS also contain non-functional requirements. Non-functional requirements are requirements which impose constraints on the design or implementation (such as performance engineering requirements, quality standard or design constraints).

1. .Net Framework 4.0
2. Visual studio 2010
3. Windows 7

**Language used: C#**

**6. RESULT SET**

The results set of these system describe about the results which are derived after the project is tested. Result set shows how each and every module runs and what its result is the result set are as follow:

**1. Starting the system:**

This is the initial screen using which the user is supposed to start the system. Figure shows the representation of the screen.

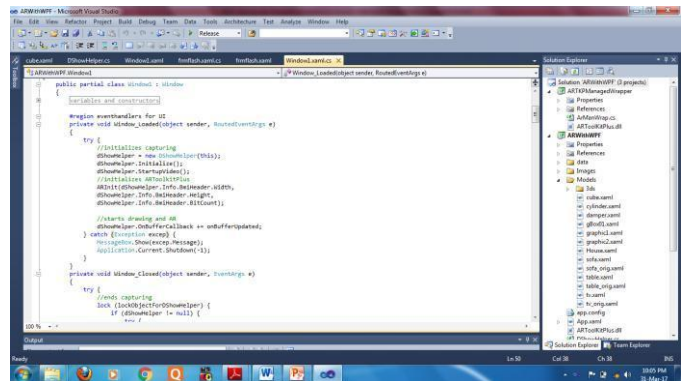


Fig. 4. Starting System

**2. Select the Input Component (Camera):**

The system prompts input components available to it. The user has to appropriate option for amongst the suggested devices.



Fig. 6. Selection of Capture Device

**3. Obtaining the Output:**

After the previous step the user confirms the input component using which the system operates.

The user hold the input image containing the marker in front of the camera.

The system scans the input image and searches the previously stored images in the defined database.

After completion of the search the system find the most accurate result corresponding to the input image.

Using the previous result the 3d model associated with the marker is mounted at the point specified by the programmer.

Final output of the mounted 3d model is displayed on the screen which is visible to the end user as an augmented object.

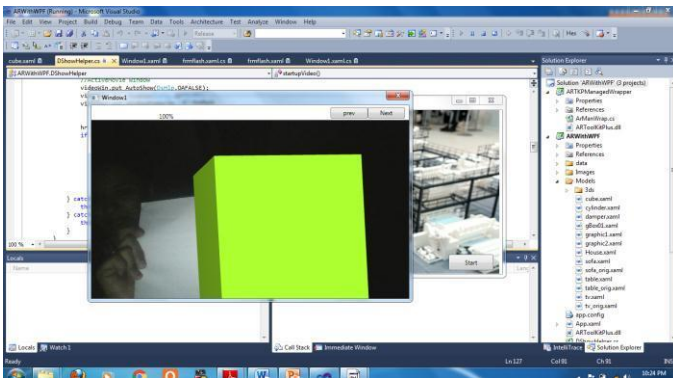


Fig. 5. Showing Output

## 7. CONCLUSION

Thus we have studied and completed literature survey of this topic, Augmented reality in engineering graphics. In that we studied different aspects of analyzing augmented reality applications. We completed the requirements analysis by studying the requirements of our project. In the design phase we have designed working of the project.

The purpose of these survey is to provide an overview of the functionality of our augmented reality in Engineering Graphics System. Most of the systems use virtual reality and its applications. Hence we found that using augmented reality in learning process increases the ability to learn and help to grasp better.

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