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Furniture Layout Application Based on Marker Detection and Using Augmented Reality

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Abstract - ***Nowadays information and communication technology supports the development of human interaction with physical, computer and virtual environment such as science, commercial, banking, education, etc. Augmented reality is a field of computer research which deals combination of reality with computer related data. In early days if we users wanted to buy a furniture objects without visiting the shops it was possible but it was not possible to check how the object actually looks in home structure. Now in our proposed system, it is possible for user to buy the furniture objects sitting in the home without visiting the shops. The main purpose of the project is to develop a windows application for trying different furniture in virtual way. The application will eliminate the human efforts by physically visiting the furniture store which is very time consuming activity.***

Key Words: *HCI: Human Computer Interaction, Augmented Reality, Marker Detection, Direct Linear Transformation, Rendering*

1. INTRODUCTION

Augmented reality a technology in which we can see the objects in physical world virtually, thus providing a composite view. It gathers a wide variety of user experiences. We are going to make a system with augmented reality that lets user to try on virtual furniture to user's real home structure before buying from that user will be able to choose furniture much easier. It will not be necessary to go shopping long looking for the large user need, or use a tape to measure to find out whether the furniture would fit in customer's room or not. The main purpose of this project is to develop an application for different furniture items. In furniture stores virtually without using the actual means which is very time consuming activity. By using this application it will be easier for the user to do online shopping of furniture application. This will also help the user to try out the furniture items in their room and they are able to see how it will look after placing furniture in it. User can try out multiple combination of furniture objects virtually without physical movements of furniture items. Our motivation here is to increase the time efficiency and also improve the accessibility of furniture to try on by creating furniture layout augmented reality.

2. LITERATURE SURVEY

[1] Deepak Uplaonkar, Saurabh Saoji, Surbhi Paranjape, Nikhil Andhalkar, Rajni Chorge, Rohit Jainapur has proposed a technique augmented reality system for the home furniture layout based on fiducial marker detection. In "Virtual Furniture Application based on Augmented Reality" paper. They took furniture objects as a data set. The advantage was that it was easily understood and handle. But the only disadvantage was that it was only useful for single object.

[2] Vaibhav Raut, Umesh Sanap, Tejas Holam, Pranav Dubey has proposed a technique augmented reality system for the home furniture on android phone based on planar object tracking. In "Furniture Layout AR Application Using Floor Plans Based on Planar" paper. It had time efficiency and also high scalability also flexible. But the object could be viewed only in 2D pose.

[3]Raviraj Patkar, Pratap Singh, Swati Birje has proposed a technique augmented reality system for the home furniture objects like chair, flower pot, jug etc. on android OS based on marker detection and reorganization method. In "Marker Based Augmented Reality Using Android OS" paper. Devices used in this paper were cheaper in cost but the speed of detecting or recognizing the marker was slow.

[4] Taiki Fuji, Yasue Mitsukura, Toshio Moriya has proposed a technique augmented reality system for home furniture object based on marker detection. In "Furniture Layout AR Application Using Home Plans Based on Planar"

paper. It was very fast for detection and tracking of the marker. Also it was a combination of multiple objects. But it was more costly as it required HMD Goggle and it was only developed for 2D objects.

[5] Mai Lee, Aaron Zarraya, Kangrong Zhu has proposed a technique augmented reality system for the home furniture on android phone based on marker detection. In ''An Augmented Reality Application Previewing 3D Décor Changes" paper. It was combination of multiple objects and easily handled but storage space requirement was high and it had slow processing and transmission speed.

3. COMMENT ON LITERATURE SURVEY

Mai Lee, Aaron Zarraya, Kangrong Zhu has proposed a technique augmented reality system for the home furniture on android phone based on marker detection in their paper ''An Augmented Reality Application Previewing 3D Décor Changes". They used a technique which was easier in online shopping that gave the user opportunity to try out different furniture items. Using this technique user can try out multiple combinations of furniture objects virtually without physical movements of furniture items. They developed a system through which user can view the furniture objects from all angles i.e. 3D view. As compared to other system this method has two benefits, one is that user can view of multiple objects simultaneously. Another is that it gave the user better view i.e. 3D view which helped user to better understand how the object will actually appear after placing it in home structure. As a result of this experiment accuracy, performance and robustness of this method was achieved.

4. PROPOSED SYSTEM

We are going to develop an application where user have to place the marker in a room where he want to try out furniture items. The user's webcam will be on and through the webcam he will capture the live feed of the room. Then application search the marker using fiducial marker detection algorithm. To identify the position of marker using direct linear transformation algorithm. Whichever furniture object the user want to try out he will select that object from the database. Then the application will superimpose 3D object. In three dimensional objects are overlaid on to the two dimensional image frame acquire from webcam. This will appear as it is actually placed in the real world. And finally the user can view the room and object from different angles.

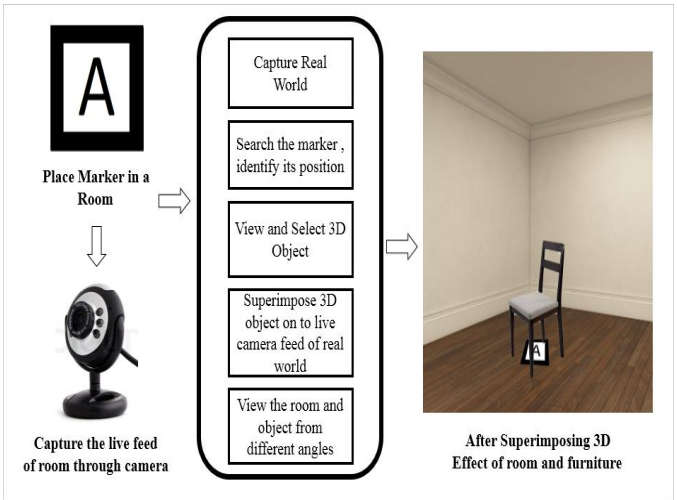

Fig -1: 3D Effect of Chair in Room

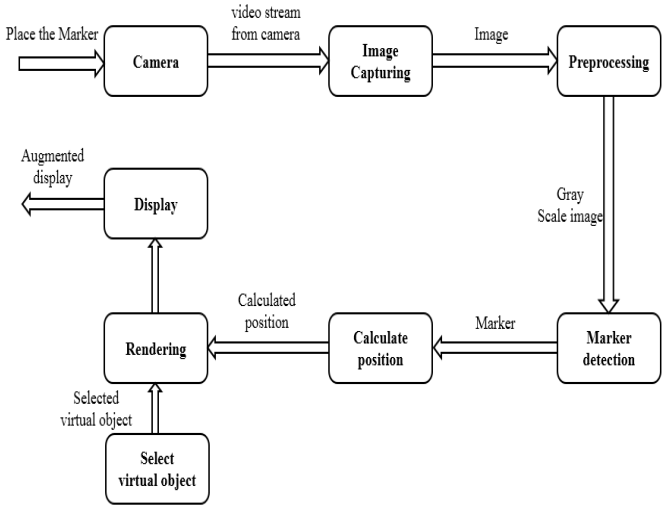

Fig -2: Architecture Block Diagram

Our system is developed using marker and its architecture as shown in figure 2 contains following modules.

4.1. CAMERA

A real-world live video is feed as an input from the web cam to the camera module. Displaying this live feed from the web cam is the reality in augmented reality. This live video stream is given as an input to the image to the Image Capturing Module.

4.2. IMAGE CAPTURING MODULE

The input to Image Capturing Module is the live video feed from the web cam. Image is captured by using button. And these captured Image is passed to the Preprocessing Module.

Fig -3: Captured Image [1]

4.3. PREPROCESSING

Fig -4: RGB Image [1]

Captured RGB image is converted into Gray scale image. These Conversion is done by using OpenCV libraries. These Gray Scale Converted Image is passed to the Marker Detection Module.

Fig -5: GRAY Scale Image [1]

4.4. MARKER DETECTION MODULE

Fig -6: Detected Marker [1]

Image received from preprocessing module is used for Marker Detection. And marker is detected by using Fiducial Marker Detection Algorithm. And these marker is passed to next module.

4.5. CALCULATE POSITION

Actual position of marker is calculate by using Direct Linear Transformation Method.

4.6. RENDERING

In these module there are two inputs, Calculated Position of marker and selecting dataset object. Rendering Module

is used to impose the 3D object on calculated Position of Marker.

4.7. DISPLAY SCREEN

Fig -7: Object view after imposing on position of marker

We can able to see the Preview of superimposed image in different angle.

5. 2D AND 3D TRANSFORMATION

These Transformations are performed on objects for scaling, rotation, shearing etc.

Transformations are used by multiplying transformation matrix by function 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,

$X' = S_X * X$

$Y' = S_Y * Y$

$Z' = S_Z * Z$

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

Rotation

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

X-axis rotation $\begin{bmatrix} 1 & 0 & 0 \\ 0 & cos\theta & -sin\theta \\ 0 & sin\theta & cos\theta \end{bmatrix}$

Y-axis rotation $\begin{bmatrix} cos\theta & 0 & sin\theta \\ 0 & 1 & 0 \\ -sin\theta & 0 & cos\theta \end{bmatrix}$

Z-axis rotation $\begin{bmatrix} cos\theta & -sin\theta & 0 \\ sin\theta & cos\theta & 0 \\ 0 & 0 & 0 \end{bmatrix}$

6. FUTURE SCOPE

In future our project dataset will be scalable. The user might not only be able to try out furniture objects but also they can also try out garments, goggles, watches, hair styles etc. It can also be used for shopping malls, interior designing, Medical Science etc.

7. CONCLUSION

These system will help the customer to view the furniture object virtually in real environment before buying the object. Due to these system customer will come to know how his home structure would look after buying the furniture object. These proposed system would let the user to try multiple combination of object virtually without physical movement of furniture objects. These will help the buyer to determine how to setup furniture in home structure.

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