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# *Implementation of the 3d Digitalized Brochure using Marker-based Augmented Reality for Real Estates*

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*Abstract*— **Nowadays, due to increasing growth in all sectors, be it in healthcare, infrastructure, finance, education, and logistics, etc. the world has come closer to foster their needs. Even though in the era of smart technology constructors, builders are using the traditional method, i.e., usage of brochures by generating 2D sketches of project layout. Builders use these catalogs to sell their construction sites like flats, buildings, or any property to customers by just showing them various floor plans, multiple views, etc. This procedure aims to be unproductive and inefficient because it does not give a clear idea regarding how exactly the property will look.**

**Augmented Reality, shifting to new emerging technology, gives an entirely new perspective for development. This paper discusses the AR implementation that provides many advantages for construction planning, which will help customers to draw a clear view regarding the properties before making deals without actually visiting the sample flats. The paper's focus is to develop an AR-based brochure as a planning tool that will serve as an application to intelligently increase the customers by minimizing their efforts and easing their decision-making process and maximizing the overall productivity.**

**Keywords**— ***Brochure, 3D Live models, 2D models, Augmented Reality (AR), visual representations.***

## I. INTRODUCTION

In the current scenario, 2D modeling is being used on a large scale in various fields. Even though 3D models are emerging, they are not using those models on a large scale. Augmented Reality can be used in multiple areas like education, infrastructure, interior designing, automobile, marketing, etc. Hence, this system will try to provide a user- friendly interface for the users and provide a clear spatial view allowing them to make effective decisions and overcome this gap.

In today's world, Estate Agencies are the leading business. Many people rely on estate agents and their services to sell their properties, renting them, and buying properties. So the market is vast, and day by day, the growth of this market is inclining towards its peak. This technology also opens a door for competition among the estate agents to make successful deals with people and leveraging their needs and even fulfilling their expectations. Besides that, the estate agency has emerged into marketing and sales, so one should be good enough in both as a marketing agency for the client and also should effectively market their properties using various technologies. The main motive of an agency must be to differentiate their own business from other businesses and provide better results to the customer.

Moreover, this can be achieved by thinking smart. The estate agents are currently attracting clients by focusing on their "sample flats" provided with the brochures. In this process, the client has to visit various agencies and look for the best deals that the agent provides. Also, clients need to spend their time visiting the sample flats and waiting until the sample flats are ready. Till that, they do not get a clear idea of how that flat exactly looks. This approach sometimes leads to delay in their decision to choose that property. Hence becomes time-

consuming for the sellers as well as for the buyers. It allows real-time interaction between the users concerning the real environment. AR technology systems can help users overlay augmented plans onto the real world. This gives a clear view of showing 3D models by using Augmented Reality as the key by fulfilling the user's expectations.

## II. Related Work

The following research articulates various applications of Augmented Reality in multiple domains. Augmented Reality can be a good fit for use where an application wants to give the user a user-friendly touch. E.g. an application based on marker-based technology allows positioning the furniture as per the user's requirement, which eventually gives the user a clear idea of the spatial view while arranging the types of furniture before actually placing it. [5] Along with AR, VR technology can also be used. VR technology is immensely used in an architecture project, yet it could not consider the accurate images of the ongoing construction site. [6] VR can be an advantage where an application deals with demonstrating visual graphics to the user. VR provides a real feel to the user when the user experiences the VR environment. Stefanie Zollmann dealt with AR for a construction project. He used AR technology to support continuous monitoring and change detection methods for documentation of the construction site. [7] AR is being used in construction planning and various applications. Using visualization is necessary to provide digital information. [3] MR can also be used with this application to offer onsite visual presentations of the construction site. SLAM method can be used to generate 3D views of captured images. This can be used in applications that deal with the arrangement of furniture. Nevertheless, this needs special tools that can capture the details of the image. [11]. AR is also used in E-commerce websites. It is used to convert the 2D image of the product into a 3D object to improve the visual graphics. [12]

## III. Project Scope

Augmented Reality, an emerging technology, uses a technique of superimposing some graphics, audiovisuals, and other enhancements over the real world. The main motive behind this system is to have a valid deal with customers and to build an interface for customers that will allow users to get a clear vision regarding the floor maps by placing the application onto the brochure. Augmented Reality achieves this by mapping the real-world coordinate system to the virtual coordinate system. This technique is known as SLAM, i.e., simultaneous localization and mapping. Using SLAM methodology will enhance the customer's vision to understand the model before making deals. It can be a potential market for this technology advancement. Furthermore, it can create elaborative visual presentations. This system will also give a platform for civil engineers to integrate their work samples within this system.

## IV. Proposed Work

In the researches of computer graphics, view recommendations, viewpoint evaluation, viewpoint scoring method based on the projected area are studied but never adapted in real estate design plans [1]. Some systems dealing with augmented reality (AR) technology can switch between Virtual Reality and Mixed Reality for better performance [2, 3]. An example of an AR system that deals with the planning of urban areas are the ARTHUR project. It works as a tool for designing architectural and urban designs. This system uses sketchand+ for 3D models [4].

Similarly, the proposed system uses the phone build-in camera to have a real scene, and it shows the 3D models fed into the database. These 3D models are made in Autodesk 3ds Max and then imported into the application.

### A. *Datasets fed to obtain AR*

Two images are used for targeting the brochure. The first image shows the 3D view of a building, and the second image shows the floor plan of the 3D model. All these datasets are in 2D format, and any number of copies can be used for targeting. Then these models are fed into the Vuforia SDK. The following are the target images used in this system.

**Fig. 1: Dataset 1 (2D image of the building)**

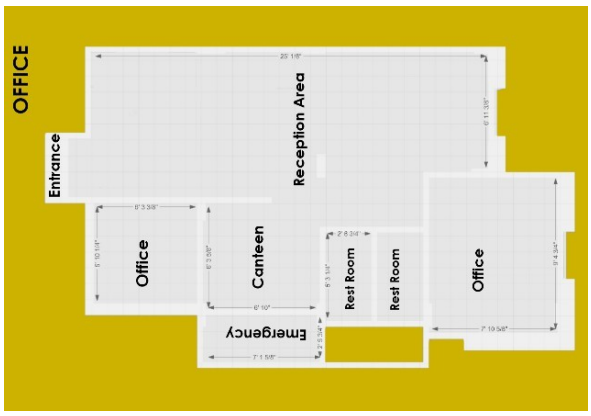


**Fig. 2: Dataset 2 (2D image of the floor plan)**

*B. System Architecture*

This section describes how the modules interact within the system. Here, three entities are involved.

1) Data Administrator – Person responsible for managing the dataset.
2) Agent – Primarily use this system to attract their clients.
3) Customer – The end users.

The Database Administrator will gather all the requirements from the agent for developing the brochure and form the 3D models accordingly. These models will get feed into the database (Vuforia), which is responsible for targeting the images. Further, these models will be imported into the Unity 3D software, where the application's final development occurs.

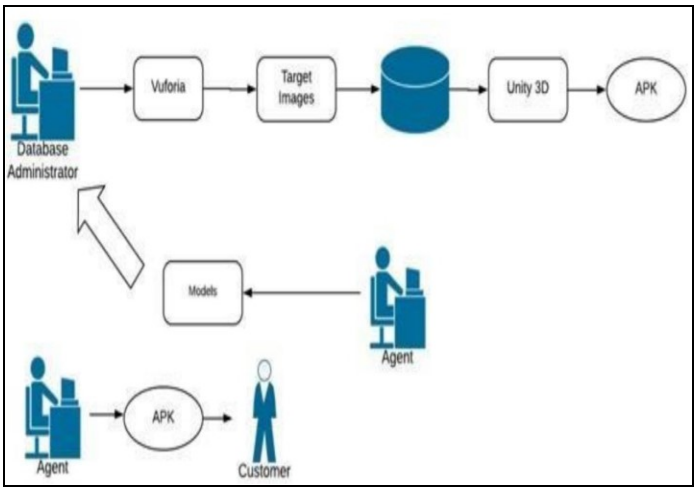


**Fig. 3: System Architecture**

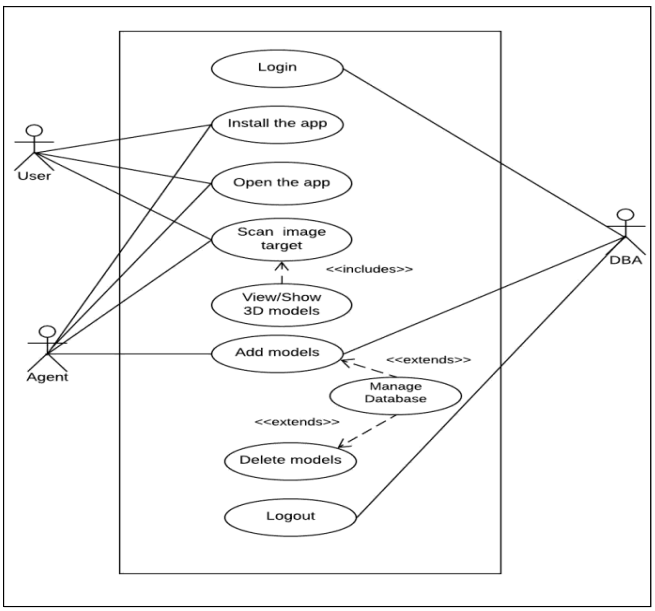


**Fig. 4: System Use Case**

*C. System for the 3D view of 2D image*

This system uses the Vuforia SDK for storing the target images. After placing the camera on target images, the augmented view of 3D models are obtained. Target images get ratings according to the clarity of the pixels. Higher the score, more powerful will be the target image and hence the model that is augmented. The evaluation will show the efficiency of the target image.

This system implements by mapping the 2D brochure with its 3D model. It will transform the earlier system by augmenting the new system using target images with Unity 3D and Vuforia. Unity 3D is the software used to reshape the models by giving it proper dimensions according to the parent screen. The system detects the target image and augments the object virtually on that targeted surface.

*D. Evaluation Criteria*

The criteria for evaluating the image for marker-based detection is straightforward. The very primary focus of this method is to identify the outlines of the marker images. The next step involves deducting the marker's image corners. This process is very crucial since it confirms whether the supported image is a marker or not. Finally, the system then evaluates the image's location supplied by the marker image that is detected. Algorithm for detecting marker-based image are as follows:-

(1) Acquiring image x – When an image is fed in Vuforia as a target image, its intensity is procured.
(2) Pre-Conditioning – This step involves processing down the image at lower levels. This includes exposing the lines and borders of the image. This makes sure that the pixels of lines and borders are transparent.
(3) Detecting possible markers and discarding the observable non- markers – Based on the result that obtained in step 2, images are labeled as markers and non-markers. Images that are labeled as markers are accepted, and non-markers are discarded.
(4) Identifying and decoding the markers – Once images are identified as marker images, they are decoded and used for mapping.
(5) Calculating the marker image value – Now, the markers are evaluated for ratings. Higher the rating more efficient will be the output for mapping.

*E. Equation*

The dissimilarity value where normalized cross-correlation is

$$D = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2} \sqrt{\sum_i (y_i - \bar{y})^2}} \quad \ldots. (1)$$

Here,

$x_i$ = Marker image pixel value

$y_i$ = Target image pixel value

$\bar{x}$ = Mean value of marker image pixel

$\bar{y}$ = Mean value of the target image pixel

The purpose of evaluating the dissimilarity value is to find the measure of the degree to which the target image values (brochure's image) match with the values of the marker's pixels (an image that is used as a dataset). Since the system matches the values of marker image with target image values multiple times, a large set of values for both images is required. Hence the equation takes multiple input values of both images as $x_i$= (x1, x2, x3….xn) and $y_i$= (y1, y2, y3 ….yn). Values of marker image and target images are mapped. More the similarity between two images, the higher the chances of image getting detected by the application and more ease for augmenting. If the dissimilarity value is high, then the image cannot be used for augmenting.

## V. Result Analysis

This section focuses on the snapshots of the exact outputs that can be seen by the user. This section also contains the results of the presently used system. This is the front page of the brochure that shows the 2D image of a building. (Presently used system)

**Fig. 5: 2D view of the building**

The below section provides the Vuforia application snapshots, where the brochure's database is stored. It stores the images and models that are used for targeting the catalog. This shows the evaluation of the values of marker images.

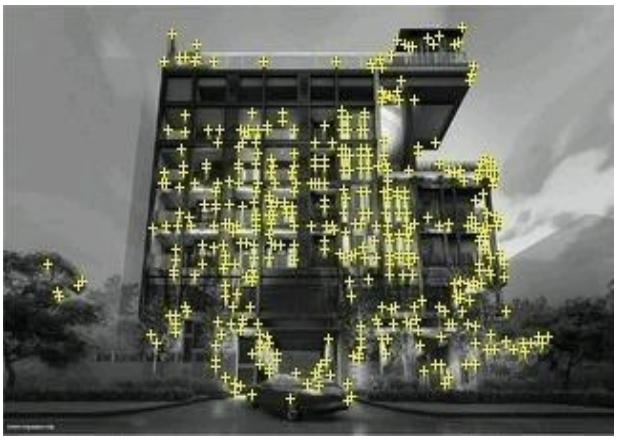

**Fig. 6: Pixel Evaluation Image**

The following image shows how the augmented brochure looks like when the application is placed on it.

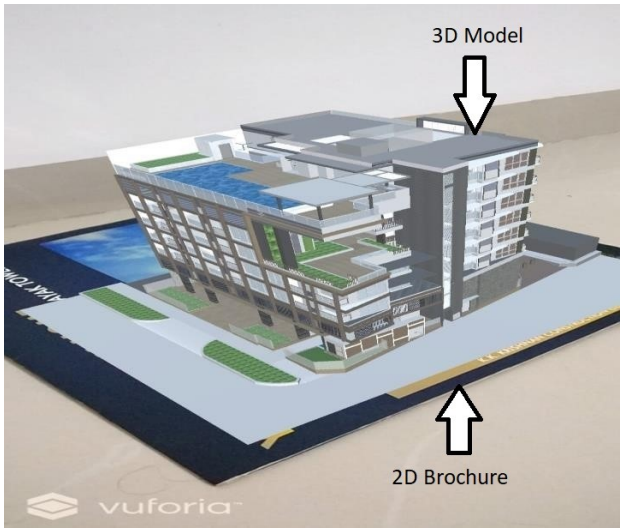


**Fig. 7: An augmented image of the building**

Model built in 3Ds max. Different 3D model building applications can also be used.

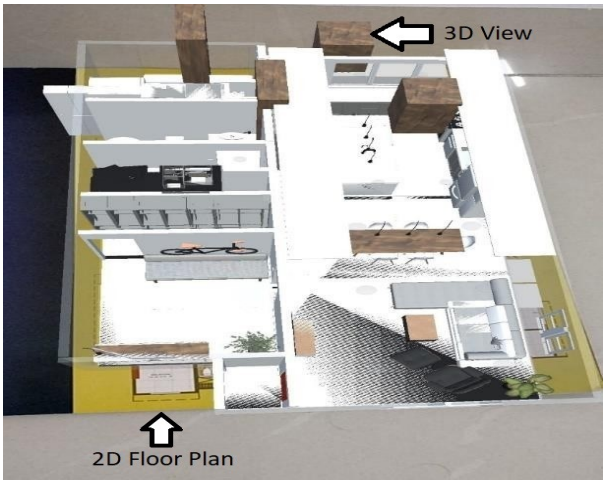


**Fig. 8: Augmented view of the floor map**

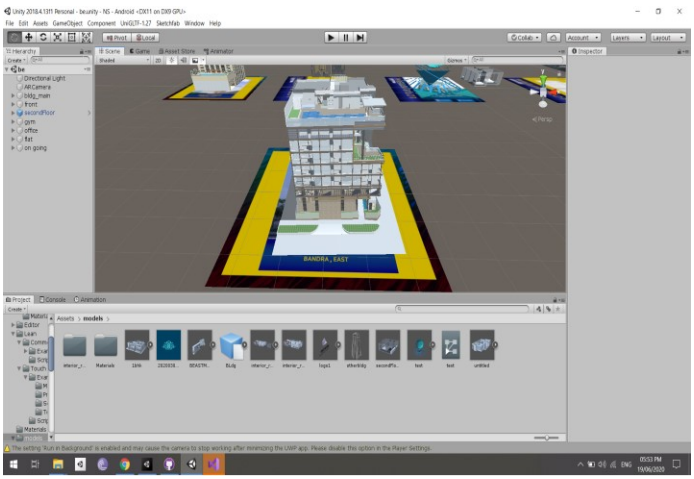

**Fig. 9: Interface in which models are configured (Unity 3d application)**

## VI. CONCLUSION

The use of Augmented Reality in Infrastructure Development has provided a digital touch by transforming the use of 2D brochures into a 3D brochure. The development has aimed at improving efficiency while being effective and innovative. The system tries to be simple and efficient by using new technologies to make the system more accessible and compatible. This system is capable of enhancing the performance by allowing multiple users to experience and visualize how the property exactly looks like by minimizing their attempts to visit the sample flats and make their deals. This system proves to be a helping tool for real estate agents in acquiring new customers as well as in increasing customer engagement and retention. It requires a lower development cost and is capable of boosting productivity. Future scope includes enhancing the user interface by providing the constructor to directly upload the models via the application's UI to improve the visual representations. Also, in addition to our system, a generic system can be implemented that serves multiple features within a single application for users like allowing the user to arrange their furniture, setting their interior layouts, etc.

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