



# Dynamic 3D Modelling of Architectural Floorplans and Displaying it in Augmented Reality

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## Abstract

“ARkeyTech” is a project that intends to develop a 3D model from a 2D floorplan drawing. It takes input from a 2D floorplan drawn by an architect and dynamically generates a corresponding 3D model of the same. Later this model is display using Augmented Reality for a better visual understanding. This is achieved using a 3D game engine like Unity3D and an Augmented Reality (AR) engine like Vuforia.

**Keywords:** AR; floorplan; dynamic 3D modelling

## I. Introduction

It is often difficult for common, non-technical people understand the complicated 2D floorplan drawings that an architect draws. Moreover, the drawings include a lot of technical jargons and symbols, the knowledge of which is unknown to common people. Also, 2D images of a 3D space (like a house’s floorplan) do not give a clear idea of how the finished product will look.

ARkeyTech helps to solve all the above-mentioned problems in under a single roof. It takes input an image of a floorplan. Dynamically creates a 3D model of the same at runtime. Finally displays the model in AR.

This helps the user to understand the floorplan thoroughly and help them to visualize how the finished product might look before its completion. It will also help them in planning the arrangement of the house, before it is even ready.

Mobile devices nowadays have become pretty powerful and have impressive processing power. This fact can be leveraged to deploy Augmented Reality applications on modern mobile devices. Also, the increased network speeds help in reducing the delay between the client and server communication required for the app.

## II. Problem Statement

It has been observed that the floorplan architect designs are complicated for common people to understand. Also, 2D images of a 3D space (like a house’s floorplan) do not give a clear idea of how the finished product will look.

Our project aims towards creating a software that scans such floor plans and dynamically generates a 3D model of the same and displays it in Augmented Reality.

This would help the user to get a detailed idea of how the finished structure (room/house) would look like and then help the user to plan further development.

## III. Literature Review

Whatever we have observed until now shows us that there are a few systems which are present in the market under the same domain. But these models have drawbacks and are not very optimized. Current products have several errors like, image processing error, unoptimized image cleansing while converting the 2D floorplan data to 3D.

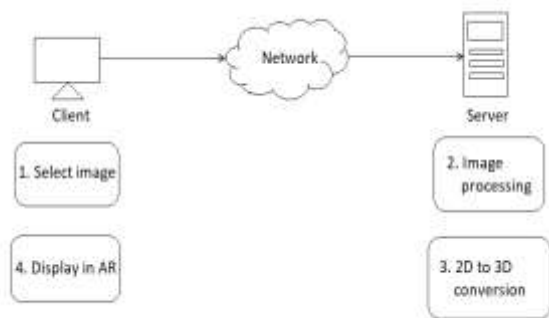
Our project targets these drawbacks and works on it making the model sustainable for a long time and also very efficient. We put forward a project for dynamically converting the floorplan to 3D. With the optimization we also offer the consumers an easy to use UI as well as high portability, via the mobile app.

### IV. Methodology

Implementation of the project is done in 3 phases, namely

- Image Processing,
- 2D to 3D conversion
- Displaying in AR.

*This is how the project architecture looks:-*



• Figure 1: Project Architecture.

Prior to these steps, the image must be selected from the mobile device to be sent to the server for processing. This is done with the help of a plugin called AndroidNativePlugin<sup>[8]</sup>. This plugin uses core Java methods to provide basic Android functionalities like toast messages, gallery access, etc.

#### A. Image Processing.

Once an image has been captured as shown in figure 2 is sent to the server, it is passed through a series of OpenCv-python functions to extract information. First, a dilate operation is applied to remove finer details like text. This dilate operation can be performed multiple time to remove more unwanted details. Only the components exceeding a minimum threshold value in the size of pixels are kept.



Figure 2: Before Processing

Image Processing technology and OpenCv 4.5.4 library<sup>[6]</sup> in Python version 3.9<sup>[3]</sup> is used to detect walls and clean noise for optimal visualization. As image is being processed as a grayscale the dilated floor plan with minimum distortion is inverted (negated) with the help of ImageOps Module of Pillow Library<sup>[7]</sup> available for python. Finally another round of denoising is carried out resulting into a noise-free, well-processed floor plan.

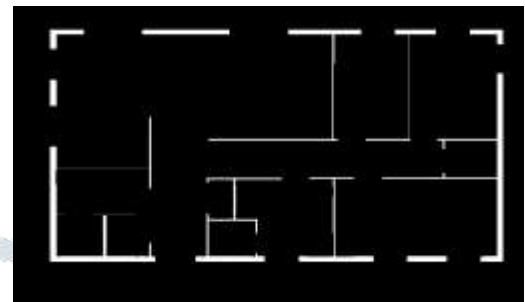


Figure 3: After Processing

#### B. 2D to 3D conversion.

The pre-processed image from phase A is treated as an input here. The numpy-stl Library <sup>[5]</sup> is used to convert the input image to a 3D STL Model. It is a simple library to make working with STL files (and 3D objects in general) fast and easy. Due to all operations heavily relying on numpy this is one of the fastest STL editing libraries for Python available.



Figure 4: After converting into 3D model

#### C. Displaying in Augmented Reality (AR).

The third phase of implementation is the one where the client receives the 3D model from the server. This model is then displayed in Augmented Reality for getting a better idea of how the actual, finished construction would look like.

To accomplish this, an Augmented Reality (AR) engine is required. The AR engine used in this project is named Vuforia <sup>[4]</sup>. Vuforia uses computer vision technology to recognize and track planar images and 3D objects in real time and requires two

parameters to complete this phase. First is a 3D model which is provided by the server and an “image target”, upon which it overlays the 3D model.

Vuforia runs multiple scripts in background that work together and whenever the image target is detected, it overlays the 3D model upon it and enables the user to experience how the finished construction will look like.

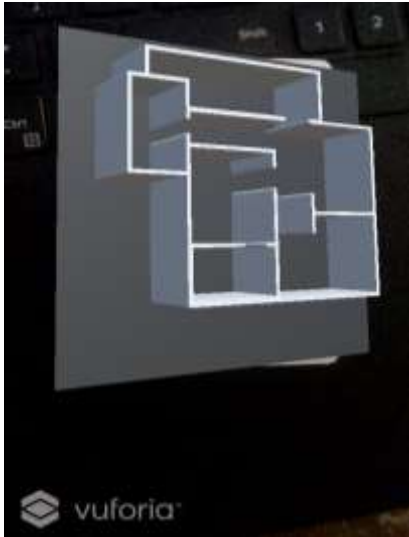


Figure 5: Displaying 3D model in AR

## V. Result and Analysis

The final result of this project is a 3D model, which is obtained from 2D architectural floorplan drawing, after undergoing image processing and dynamic 3D modelling. The main idea behind the project was to create an app that provides multiple functionalities like image processing, dynamic 3D modelling and AR displaying all under one roof.

The app uses a server running Python scripts, so as to relieve the client’s device from all the heavy processing and at the same time reap the benefits of Python’s extensive image processing libraries. The Vuforia SDK uses a tracker-based method which also introduces a little delay in the AR display phase.

## VI. Future Scope

The future scope of this project is to deliver an even seamless process of 2D to 3D conversion and also upgrade the current “Only AR facility” and integrate the functionality of VR (Virtual Reality too).

Upgrading and increasing servers is also in the plans, where there will be a higher processing speed and the results will be obtained even faster.

## VII. Conclusion

In this research paper we have presented a tool to extract values from 2D image of a blueprint and creates a 3D model in real time. The main outcome of research is to create 3D models dynamically and give customers the ability to customize their prefabricated home interiors while maintaining the design of the exterior structure. Augmented Reality offers a real visualization of the final product for customers, enabling clients to create their dream homes.

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