

INTERIOR DESIGN USING AUGMENTED  
REALITY

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## ABSTRACTS

This project provides the public with an attractive and interactive interior design application using Augmented Reality. Nowadays, there are a lot of people familiar with the computer system and communication technologies. Hence this exploring the prospect of a new form of Virtual Reality (VR) application called Augmented Reality (AR) technology develops more rapidly. Augmented reality is a field of research which deals with the combination of real-world and virtual environment. It is an environment that applies between virtual reality and real environment. There are several problems induce me to create an interior design application in AR. Nowadays, people are busy with their work. People are no time to go to various stores to buy furniture for their home, shop or office. There is difficult to fulfil the customer's contentment of decorate their room without imaginary picture to refer. Printed furniture catalog is basically a paper based information with lots of texts and images which does not provide any interaction for the user. And people can't view a better graphics of visualization because the design layout is statically presented on papers.

Due to that, AR and 3D technology must be applied into interior design area. It is an application which includes furniture and furnishings will develop in three-dimensional surface of object and present by using augmented reality. It will perform the interactive and attract the attention from the public. In this project, I choose Waterfall methodology as a guideline to develop my product throughout this project. By having a methodology, I can carry out my project successfully. As we know, augmented reality technology is still new in our country, but it is a fact that AR technologies would potentially to be the future technology trend to the public.

**Keywords:** Augmented Reality, interior design application

## ABSTRAK

Projek ini menyediakan reka bentuk aplikasi dalaman secara menarik dan interaktif kepada masyarakat dengan menggunakan Realiti Augmented. Kini, terdapat banyak orang yang biasa dengan sistem komputer dan teknologi komunikasi. Jadi ini menerokaan prospek bentuk baru terhadap Realiti Maya (VR) atau teknologi dikenali Realiti Augmented (AR) telah berkembang dengan pesat. Realiti Augmented (AR) adalah satu bidang pengabungan antara dunia sebenar dengan persekitaran yang bermaya. Terdapat beberapa masalah yang mendorong saya untuk mewujudkan sebuah reka bentuk aplikasi dengan AR teknologi. Kini, masyarakat kejar dengan kerjayaan mereka. Mereka tiada masa untuk melawat kedai-kedai perabot membeli perabot untuk rumah, kedai dan pejabat mereka. Pelanggan tidak dapat memuas hati terhadap penghiasan bilik mereka tanpa merujuk gambaran khayalan yang disediakan. Katalog perabot bercetak pada asasnya adalah maklumat kertas dengan banyak teks dan imej yang tidak menyediakan sebarang interaksi untuk pengguna. Dan orang ramai tidak dapat melihat grafik yang lebih visualisasi kerana reka bentuk asal dibentangkan secara statik atas kertas.

Oleh itu, AR dan teknologi 3D harus diterapkan ke dalam aplikasi reka bentuk dalaman. Ini adalah sebuah aplikasi yang mengandungi perabot dan hiasan perabot dengan mewujudkan dalam bentuk tiga dimension dengan Realiti Augmented. Dalam projek ini, saya memilih kaedah Waterfall sebagai garis panduan untuk membangunkan produk tersebut. Dengan metodologi yang sesuai, saya dapat menjalankan projek saya secara berjaya. Seperti yang kami diketahui, teknologi augmented reality masih mundur di negara kami, walaubagaimanapun, teknologi AR berpotensi untuk menjadi trend teknologi masa depan kepada masyarakat.

**Kata kunci:** Augmented Reality, aplikasi reka bentuk dalaman

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## **PART 1**

### **INTRODUCTION**

#### **1.1 Introduction**

It seems that every few years, people all over the world are increasingly using Augmented Reality and 3D technology in their daily life. As computer technology getting better, augmented reality and 3D technology developed more rapidly. Augmented Reality (AR) is a branch of computer science research and Virtual Reality (VR) are deals with augmenting the environment with computer-generated information. It is the technology that strengthens the view of the real world of the user with computer-generated information. AR is a field of research which deals with the combination of real-world and virtual reality. Most often, the augmentation is visual. It is not just visual augmentation is important, but it is also necessary to possess auditory augmentation (computerized earpiece whispers information into a person's ear), touch augmentation (also called haptic augmentation) or augmentation via a personal digital assistant (PDA).

While for 3D, refer to the Wikipedia description, 3D computer graphics are graphics that use a three-dimensional representation of geometric data that is stored in the computer for the purposes of performing calculations and rendering 2D images. In 3D computer graphics, 3D modeling is the process of developing a mathematical representation of any 3D surface of object through specialized software. The product is called a 3D model which gives a better graphics of visualization.

So here, a project titled “Interior design using Augmented Reality” has been proposed. It is an application which the furniture and furnishings will develop in three-dimensional surface of object and present by using augmented reality. It is the

application that can be use in the mobile phones, tab and etc, especially using Android platform to choose furniture that suitable for their house.

### **1.1.1 Problem Statement**

Wang, Gu, David, Gong & Kim (2007) state unfortunately AR is still not carry out as a real output in the field of architectural design although it actually matured from a pure research field into certain practical industrial applications. This showed that Augmented Reality has had a relatively slow transition into the architecture design sector. For the reason of that, these cause several problems.

Nowadays, people usually will go to the shop for samples to decorate house and room. But majority of the people are busy with work. People are no time to go to various stores to buy furniture for their home, shop or office. It is also difficult to let alone taking it out and trying it at home. If found out that the furniture is not suitable to the house, then the furniture needs to return to the furniture shop. Even if have time to go to the furniture shop, after visit to the shop, people may found out that there is none of the furniture that fulfils requirement. Hence there should have a way to let people use their mobile to view a 3D interior design in anyway and anytime before it populate with the real items.

Next, that is difficult to fulfil the customer's contentment of decorate the room without imaginary picture to refer will make them confuse. And that is so hard to choose the sofa that suitable to the house at the furniture shop. Normally, people will ask the opinion or suggestion from the staff of the furniture shop when can't decide which furniture is suits the house. Hence, the staff of the furniture shop will recommend some of the furniture that may suitable. For the reason that there are limited spaces, so not all the furniture is display in the furniture shop. Thus, staff of the furniture shop may use words to express on the design of the furniture that are not display in the shop. It's hard by explain in words, customer normally do not get a good picture of the design of the furniture because discuss without a visual design. It's really wasting time and energy.

Other than that, there are a lot of people throw off the furniture catalog. There are few reasons that people act like that. Many catalogs that obtain from the public are

not attractive enough. Although some catalog have nice and colourful design, but the picture printed on the catalog is stark and lifeless, that is difficult to attract user's attention. Other than that, many catalog contain a lot of description, users not willing to waste their time on reading a catalog that contain a lot of unnecessary information. It is bored to look on this type of furniture catalog.

On the other hands, in the industrial design field, some of the designers have used sketches with pen on paper to explore and evaluate early concepts (Tek, 2009). This is usually drawn in 2D or 3D hand sketch. In this case, if the interior design furniture is present in hand sketch, designer often encounter situations in which client can't view a better graphics of visualization. For example, client can't view the design of the table, chair, cabinet and etc more effectively.

Hence, below are the problem statements that can be stress in order to implement in this project:

- i. People no time to go to various stores to buy the furniture and furnishing.
- ii. Difficult to fulfil the customer's contentment of decorate their room without imaginary picture to refer.
- iii. There are a lot of people who will throw off the catalog.
- iv. People can't view a better graphics of visualization

### **1.1.2 Objectives**

Currently, augmented reality technology is not well known in the market of Malaysia. But AR technologies would potentially benefit design modifications and refinements due to the support for viewing the design. Nowadays, AR technology has been brought into the field of education, entertainment, commerce, military and etc. Therefore, the main objective of this project is to create an interior design application using augmented reality which to benefit people. It is to enhance traditional catalog which only printed with 2D images. User just needs to download the application and install it in their device. Then play with the 3D virtual furniture in the house spaces. By having an interior design application, user can view the front view, side view and back view of the virtual furniture and at the same time interact with the virtual model.

The next objective is to provide user a new interactive technology to be practise in interior design. It is so interesting to enhance perception of and interaction with the real world. Three types of gestures have been included in this application which is drag, pinch and rotation gesture. And user is allowed to view the 3D virtual model of the furniture in real-time. Users just need to install the application in the device and start to design the ideal environment with several 3D virtual furniture models. Then choose furniture from the list and the model will appear on the screen of the device. User can drag, rotate, enlarge and minimize the 3D furniture model to fit the model in the house. This technology has great potentials to reduce costs, shorten design time for decorate the home space or room (Wang et al., 2007).

The other objective to develop an augmented reality mobile application in interior design that more convenience to the user. By having this augmented reality application, user can use their mobile to view a 3D interior design in anyway and anytime before it populated with the real items. That is the point of interior design using augmented reality application in Android was recommend, which is providing a more precise, power-driven and easier platform for users to choose the furniture that suit to the room or house, without wasting their time and energy to go to various store. User no needs to ask the advice from the expert on how to decorate the house because user can decorate the room or house on own phones by using the application.

Last but not least, an augmented reality application for interior design is developed to produce realistic virtual furniture model in interior design. It gives the feeling of realistic. That is the 3D virtual furniture will looks similar to the real furniture model. Therefore, by looking on the 3D virtual model that appears on the screen, user will have a feeling of realistic. And can decide which furniture is suit to their house.

Therefore, the objectives of the research are:

- i. To create an interior design application using augmented reality technology.
- ii. To provide users a new interactive technology to be practiced in interior design.
- iii. To develop an augmented reality mobile application in 3D interior design that more convenience to the user.
- iv. To produce realistic virtual furniture model in interior design similar to the real furniture.

### **1.1.3 The scopes of this project are:**

- i. User
  - Everybody that has mobile gadget to use the augmented reality application to design their room or house with virtual 3D objects.
- ii. Furnishing companies
  - Implement augmented reality application with virtual 3D representation furniture and furnishings for their customer.
- iii. Content application
  - The application is an interactive AR application. The model focus is the furniture of the living room. So, the 3D models that develop will be the furniture of the living room. In order to use this application, user needs to have camera on their device. After that, user just needs to install the application, turn on the application and point the camera to the living room. User can take a picture of the design space and set the image as tracking pattern. Then, user can choose the furniture from the list and the sofa's image will be overlaid on the room. The whole process can then be reset by reactivating the camera. Last, a screenshot can be saved for further refer.
- iv. Interaction technique
  - Three types of gestures have been provided in this application such as drag, pinch and rotation gesture. User can drag, rotate, enlarge and minimize the furniture model in order to fit in their house. At the same time, user can view different dimension of the 3D virtual object such as the front view, side view and back view of the model by rotate the model with fingers.

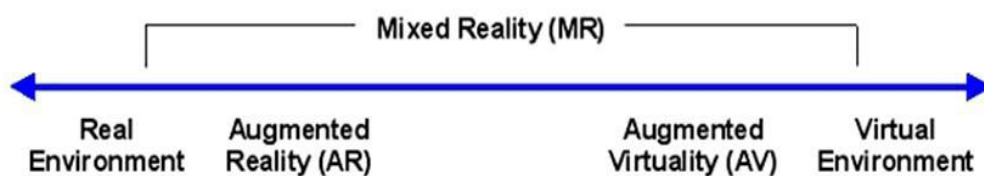
## **1.2 Review of previous work/research and relationship to current project**

Phan & Choo(2010) states that few previous authors had proposed interior design application by using Augmented Reality (AR). They are authors Koller, C. Woodward, A. Petrovski; K. Hirokazu, et al. The related equipment such as data glasses connected Head-mounted display (HMD). Additional, various lightweight solutions using a PDA device has been recommended by the AR Team in Finland (S. Sitanen and C. Woodward, 2003). Nevertheless, this equipment uncommonly used by users.



In an AR environment, User can play with the virtual furniture that displayed in real-time on the screen. It provides a platform that users can interact with the virtual object in a real space. Hence, this research suggests a new way to apply AR technology in the interior design work. With dynamic and flexible user interface, user can look at the virtual object and correspond with the 3D virtual object.

For the reason of Augmented Reality (AR) covering of computer graphics on the real world, this make it became a novel technology. AR is also termed Mixed Reality (MR), mixed reality (MR) which encompassing both augmented reality and augmented virtuality.



**Figure 1.1:** Mixed Reality (MR)

From other research paper, Charles and Sanni have experimented Augmented Interiors with Digital Camera Images. Based on the paper, they develop a system for Augmented Reality interior design based on digital images. With just PC, digital camera and printer, they successfully introduce a solution for augmented interior design. Those are the things that can simply get. The marker can place on anyway of the floor of the space of the house. It will determine the scale and coordinate of the space of the house after the marker has been place. This provides the opportunity to let user to choose the virtual furniture that they want to be placed into the spaces. Actually similar system has earlier been presented, but the specialities of this system are added more functionality to the user interface and improved implementation issues. For example, there is ability to manage objects and adding lighting and shadows to increase the level of realities. They also point out the important of removing the marker from the final images.



**Figure 1.2:** Object moved and rotated to a place (left) and **Figure1.3:** Marker erased and shadows added (right)

The other research paper, Tiina and Sanni (2012) describe a process of the collaborative design and fulfilment request of an interactive interior design service system. The technological purpose was to create interior design concepts that utilize augmented reality (AR), 3D models and user-generated content within the system framework. They come out with the important AR features of the interior design service such as realistic lighting, and number of variety furniture models available. By using the AR technology, it is important to let user visualise a lighting that are more real for the whole day weather based on the location of the windows. This can provide user more realistic light when use the system. With the 3D representation of interior design, user also can't view a better graphics of visualization. For example, User can view the design of the table, chair, cabinet and etc more effectively. Finally, it was important to let user or designer to sense that decorate the rooms and establish a plan was interesting and pleasure when using the interactive interior design service system.

In the future, it believed that many developers will seek augmented reality interaction more deeply, providing interior designer, Furniture Company and etc with more function augmented reality design tools. It also let user interact with a virtual object with simple and easy to use tracked physical tools.

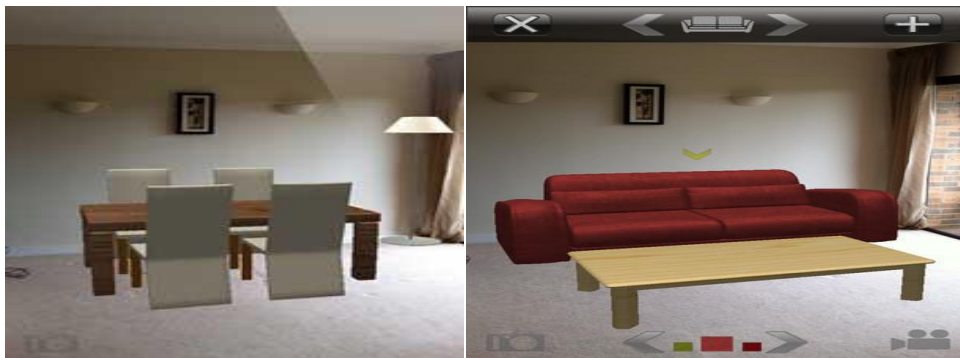
### 1.3 Explain the current system and its limitation

#### 1.3.1 Current system

##### 1.3.1.1 uDecore

The existing system such as uDecore application makes a big difference when compared to traditional method of furniture catalogue. That is uDecore permit user view the 3D furniture and furnishing models in the house spaces using an AR technology. By using this application, user can create ideal environment by decorate the room with different styles of furniture. This application provided up of hundreds of furniture models then commission the appearance and place in house space.

The furniture models are always stored in user device so users have no worry when there is no internet connection. User just needs have camera to visualize furniture models using augmented reality method. User can see the pop-up interior design model such as chair, table, cabinet and etc from any perspective view. It let user embark in the environment both real and virtual knows as mixed reality.



**Figure 1.4:** Design for a dining room (left) and **Figure1.5:** Design for a living room (right) by using uDecore

### 1.3.1.2 SnapShop Showroom

SnapShop Showroom is a tool that helps user to visualize different furniture in the house before purchase the real item. SnapShop Showroom is a free augmented reality application that everyone can easy download it. There are few simple several steps to use this application. First, select a sofa from the libraries provided in the application, and then the sofa's image will be overlaid on the room. Users can move the sofa around in order to fit to the room and change the colours of the sofas. The image can be saving by using this application.



**Figure 1.6:** Design of a virtual chair by using SnapShop Showroom

According Tek (2009), there has been more emphasis on creating new user experience which is satisfactory and enjoyable. For the reason of that, it is important that 3D environments and models are not only looking real, a sense of attractive is also very important. It brought beneficial to let user or designer to feel that decorate the house space was a relax job and feel fun when using the application.

### 1.3.1.3 IKEA Catalog Complete Home Furniture



Figure 1.7: Design of IKEA Catalog



Figure 1.8: Design of IKEA Catalog2

The existing catalog such as IKEA’s catalog has just introduced the 2012 IKEA catalog of design furniture and home decor for IKEA supporter. This catalog contains the latest information about the new furniture. It contains the products for trends 2012. This catalog consist the category of dining room, bedroom, bathroom, lighting, child, home organization, workspace etc. For the reason that it consists of variety of furniture and furnishing, people normally can find and get the ideal furniture. This catalog can

fulfil user requirement. However, some people are prefer go to the various store to look the furniture on spot instead of read on a catalog.

### 1.3.1.4 E-Commerce

E-Commerce is the web services that provide online shopping. Nowadays, many people do online shopping through E-Commerce. This is because there are many choices of products have been provided in this website. By browse the website, user can gather information about products and prices. This make E-Commerce become a favourite place that people like to browse for the product.



**Figure 1.9:** Design of E-Commerce Website

### 1.3.2 Problems in the existing system

Laurel & Mike (2004) states that Project management tools also have limitations. For the reason they use crucial path method schedules, those tools do not display the 3D space and the fourth dimension of time, it is difficult to visualize and communicate the schedule and analyze the sequence of construction.

There are some problems of e-commerce website. Sometimes people prefer onsite shopping instead of e-commerce and online shopping due to the limitation of 2D printed images or picture. Lack of product's information make shopper not relieves to buy the product especially for products like ornaments, clothing and furniture. People may worry the product is not suitable after bought and this is really wasting time and money. For the reason of that, AR has been applying to E-Commerce system. By using an AR in E-Commerce system, sales people can promote the product by display the virtual model of the product. It mixes a 3D virtual model with real environment. However, through the feedback from the consumers, some mentioned that the AR E-Commerce system is not stable. People also give the response that sometimes can't see the virtual object. Hence, there is still needs some improvement on the e-commerce website.

Based on the IKEA Catalog as showed in Figure 1.7 and 1.8, there are some printed 2D pictures with the description of the products. Some users may want to read the content of the catalog to get more detail information. But majority of the people do not want to read the content of the catalog as there are too much information such as the catalog in Figure 1.8. That type of catalog contains a lot of text and font size is small. This makes the catalog difficult to read especially for elderly. However, there are some of the catalog that is well design which can deliver the appropriate information to the users such as the catalog in Figure 1.7.

Other than that, the production cost of a catalog is high. Furniture Company normally needs to print up to thousand of the catalog once a year. In order to lower the production cost, Furniture Company will decrease the number of pages of the catalog. By doing this, more product need to place on the same page of the catalog. Display the few images of the same product in a page of catalog is necessary. Hence, this cause the catalog is hard to accommodate the images for other types of products and descriptions. And it would be such a waste of space to display the few images of the same type of product.

Many catalogs that obtain from the public are not attractive enough. Although some catalog have nice and colourful design, but the picture printed on the catalog is stark and lifeless, that is difficult to attract user's attention. This end up with lot of

people throws off the catalog. Other than that, much AR application is only focus on augmenting the visual sense. It is not attractive enough if the application is just augmenting with visual sense. It is important to consider other sense such as hearing. This is to enhance the real world for better human experience. Nowadays, many systems have indicated auditory AR environments.

Next, there are not a lot of standalone applications for interior design using augmented reality. Most of the application required good internet connection to view auras. If people are often in areas where there is no internet connection. The standalone application can be very useful. That must be an application that can stores the more relevant information on tablet or mobile phone. User can update the information of the application once there is Wi-Fi connection. Hence that is no need to connect to the web to view auras.

User need to install plug in order to achieve Augmented Reality in a browser. There are many current web browser required download and install the web browser plug-in in order to load, show and render live 3D models. User need to install plug-in to view the 3D models. Several plug-in, for example, Flash, dedicated plug- in, and others actually brings a huge amount of weak point to the system such as the loading rate are slow and requires client site installation.

Last but not least, most existing AR systems are difficult to use or in other words, not user friendly. This can be seen in application of uDecore and SnapShop Showroom. Through the researches of public reaction, there are some of the users gave feedback that do not know how to use the application. As we all know, AR applications become well-known in the market of design field, the systems not just used by the expert users but also non-expert users. Hence, this AR application should be easily to use and easily to setup. If the users do not know how to start to use the application, they will not use the application no matter how good the application is. Hence, it is very important to develop an easy to use application to let the user feel comfortable when using the application. Ronald, Yohan, Reinhold, Steven, Simon and Blair (2001) state some research trends support the need of calibration-free and auto calibration algorithms for both sensor processing and registration.