



UTM
UNIVERSITI TEKNOLOGI MALAYSIA

FACULTY OF COMPUTING
UTM Johor Bahru

SECP 1513: Technology Information System

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PROJECT PROPOSAL

AI-Powered Virtual Interior Design system

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Client Name:

1. Interior design company
2. Furniture company

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Introduction

Human beings love to personalize their space to suit their needs. We know that even small changes to our surroundings compound into greater effect and influence on us. However, the design that we envision in our minds doesn't always reflect in reality because of the limitations of visualising it. To push this limitation forward, we are proposing a system named AI-Powered Virtual Interior Design System.

Our proposed system is designed to address the issues of inaccurate product representation and enhance the customer experience for companies in the interior design industry. As most furniture purchases begin online, it is important to note that the risk of misleading product representation is a serious concern [3]. Inaccurate representation of products causes unrealistic expectations followed by customer dissatisfaction which leads to high return rates of furniture [1]. This could severely harm the company's reputation. Furthermore, customers with an ideal interior space plan envisioned in their minds find it hard to visualize their plans in real life. While they may have a rough idea, executing the plan and selecting the right size, hues, and materials that suit the space without the help of an expert or a tool is challenging. A similar issue is also faced by designers with clients who can't visualise their ideas [2]. Although designers find ways to cope with the problem, the proposed system would effectively treat the issues.

The primary technology used to visualize the interior design product is Augmented Reality (AR). AR is a technology that integrates digital information to create interaction with users in real-time environment [4]. We also incorporate AI technology for real-time suggestions for interior design enhancement. The system consists of two main components. First, a portable projector with a CPU, infrared sensors, and a projection lens. Next, an AI-powered software that is compatible with both mobile devices and computers. The CPU serves as the core of the system that processes data of all furniture from the AI-powered software and spatial data from the measurement of infrared sensors. This processed data is distributed to the projection lens for 3D Projection and to the AI-powered software back. The software in turn analyses the processed data and provides real-time feedback for interior design plan improvement. The

software also comes with an interactive interface for customers to engage with the visualisation.

The proposed system offers significant benefits for both the customer and the company. This system will give a great immersive showroom-like experience. Customers can see how the furniture fits well in their intended space or how the chosen wallpaper suits the surroundings through real-time 3D projection. This saves a lot of the customers' time and energy while contributing to better decision-making. The real-time AI feedback will guide the customers with quality suggestions so customers do not regret their decision later. This will significantly increase customer satisfaction which leads to good credibility for the company that provides this service. High-quality 3D product visualization has the potential to boost conversion rates for the company [3]. Plus, the system is a one-time investment where companies can generate a Return On Investment (ROI) through service fees charged to customers for each use [3].

There are many researches regarding furniture visualisation conducted and some successfully turned into a product. One of the research proposed an idea for a markerless tracking method to be used in furniture visualisation which is Simultaneous Localization and Mapping (SLAM) [4]. Markerless tracking method is applied in IKEA Place which is an application that can overlay 3D furniture models into real-world spaces [5]. There is also another tool called Room Planner [6] which is a software that allows users to create 3D floor plans. However, what makes our system stand out is the 3D projection created by our system projects in real-time in the real world, 360-degree, without any blind spots. Plus, our system has an advanced feature of real-time AI feedback that gives tailored suggestions to users to enhance their designed floor plans.

2. Existing System

This is important to judge and analysis the possible problems our clients face. When we find out they meet the problems, these will be the key point of our team should focus on and propose a specific solution to integrate them into our system. After discussion, we discovered that people who intend to make a virtual interior design for their new houses might meet the problems. There are several solutions that address the needs of virtual interior design by using augmented reality (AR) technology. However, these systems have also certain limitations that reduce their usability for users .

One well-known example is the IKEA Place [7], an augmented reality application developed to let their customers use their own smartphones to see furniture in their homes, offices, schools, or even studios. Customers can overlay 3D furniture models onto their real-world spaces using this application. However, this software reduces users' immersive experience by limiting user work on a small screen. Besides that, the lack of certain advanced functionalities, including real-time AI feedback and suggestions for better layouts or other furniture options, limits the software to basic visualisation. This makes the lack of cross-operating-system compatibility some users not sure which style of furniture is suitable for their houses, and that causes them to not know what furniture to choose even if they can see how the furniture looks in their houses using phones. Moreover, IKEA Place is only available for iOS devices, which restricts the accessibility for Android users. This undermines the potential of the IKEA Place for widespread professional adoption.

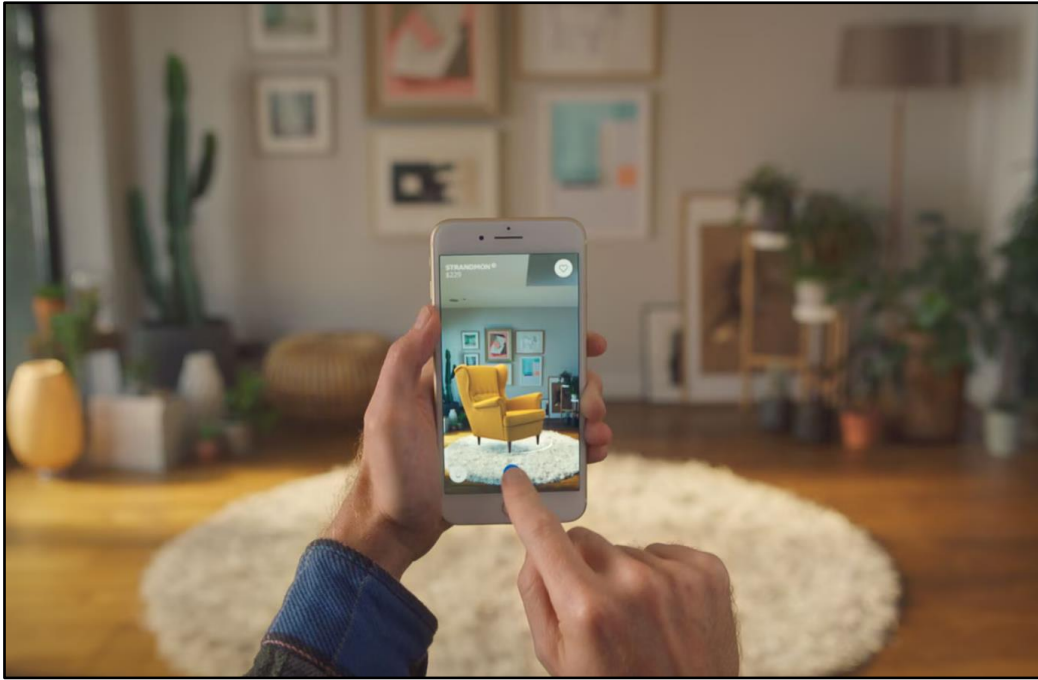
Another prominent tool is Room Planner [6], an interior design software designed to create 3D floor plans of the room layout, provide a library of 3D furniture models from popular interior stores, and allow users to drag and drop the furniture. It also provides the template of the complete design that showcases the whole room layouts for users, attracts the casual users who seek an easy solution for basic room planning or gets inspiration for their

base design. However, the functionality of adding furniture is not particularly convenient because it is difficult for users to precisely modify furniture size or adjust angles as desired. Users can adjust the size no matter how much bigger it is, creating uncertainty about whether the chosen dimensions are realistic or feasible in actual spaces. In addition, Room Planner also does not provide a function to overlay 3D furniture models onto users' real-world spaces, users can only place the 3D furniture in a floor plan..

In conclusion, companies or firms that use these tools face limitations, such as insufficient immersion, lack of customised recommendations, lack of cross-operating-system compatibility, and limited features of these tools for professional use. These limitations highlight the necessity for a more complete solution, and that comes to an AI-Powered Virtual Furniture Display System, which is designed specifically for interior design and 3D furniture display to repair these limitations and replace existing systems by offering life-sized 3D projections, real-time AI feedback and cross-platform availability, providing an all-in-one solution for companies that can improve their customers' comfort.

Features	IKEA Place [1]	Room Planner
Real-Time AI Feedback	No	No
Overlay 3D Furniture Model onto Real-World Space	Yes	No
Provide Design Template	No	Yes
Platform Availability	iOS Only	Multi-Platform

IKEA Place App



https://www.ikea.com/global/en/images/484828_b4450698dc.jpg

Room Planner App



<https://play.google.com/store/search?q=room+planner&c=apps>

3. Proposed system

3.1 Design and Features of the 3D Projection Machine

The proposed 3D projection machine is designed as a rectangular prism. Its unique design includes 3D projectors installed on all sides except the bottom, ensuring comprehensive, seamless projection. Each projector is internally connected via wires to a central CPU housed within the device. The CPU serves as the data processing and distribution hub, managing both the projector output and other functionalities.

Additionally, the machine is equipped with eight miniature infrared sensors mounted around its external frame. These sensors are responsible for measuring the dimensions and distances within the room, providing spatial data critical for accurate furniture placement. Like the projectors, the sensors are also wired to the CPU, which processes the spatial data and transfers it to an integrated AI software for analysis.

The purpose of these projectors and sensors is to enable the real-time, 360-degree projection of 3D furniture models without any blind spots. The CPU plays a dual role:

1. Receiving furniture data from the AI software and transmitting it to the projectors for rendering.
2. Processing spatial data from the infrared sensors to provide accurate room layouts for the AI software.

Despite its advanced functionality, the machine is designed to be lightweight and portable, allowing users to easily move it between locations.

3.2. AI Software Integration

The proposed system includes a powerful AI-driven software, provided as part of the product package. This software is available for download on both mobile devices and computers, ensuring user convenience and accessibility.

The software offers several key features:

- Furniture Selection: Users can browse through a wide variety of furniture types, styles, and designs to suit their preferences.
- Room Analysis: Leveraging the infrared data, the software automatically analyzes the room's size, dimensions, and layout, ensuring the suggested furniture fits perfectly within the space.
- Interactive Room Layout Interface: The software provides a detailed 3D visualization of the room's layout, allowing users to observe and interact with the projected setup in real-time.
- Real-time AI feedback: User can get a real-time AI suggestion when design on the template.AI technology will always show some suggestion or element for the user to provide some idea for the user.

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User role

	Role
Admin/User	<ul style="list-style-type: none">- Have a highest and complete access right, allowing them to manage all aspects of the application- responsibility to maintain whole system and manage the entire platform.- Can edit , add and delete project in the system,- Display the final project with the customer via projector.
Interior designer	<ul style="list-style-type: none">- Provide design plans that fulfilled all the requirements of the customer.- Keep update and modify the design plans once receive the feedback from the customer- Provide the final design plan to the admin then the plans are added by the admin on the AI system for display via projector.- Communicate with the admin in greater detail to provide a more realistic visual impact for the customer when display the interior design plan.

HOW TO USE

The main function of this projector is displaying the furniture or interior design inside the room simultaneously. The system can include some pre-designed templates, allowing user to add their furniture or make modifications directly to the templates. This approach significantly reduces the company's time costs. Each template represents different design style so this can allow user show different design style in the same room. Thus , this can provide a great visual impact for their customer and provide them with numerous options.

The projector is equipped with built-in infrared sensors, enabling user to place the projector on the floor to scan the room's dimensions. The collected data is then transmitted back to the system for immediate use in customizing furniture or designing rooms. This helps save both time and costs when measuring the size of a room.

The projector is easy to carry and can be conveniently repositioned during use to showcase designs. User can simply upload the completed design plans to the system, and the projector will display it as needed. During the process, users can directly modify or remove elements in the system, with the changes instantly visible in the projection.

Users simply need to press the "Start" button, triggering the projection machine to render the chosen furniture setup instantly. If users wish to explore alternative furniture styles or designs, they can press the "Cancel" button to reset the projection and select new options.

Prototype



-This body of prototype is made up of cardboard.

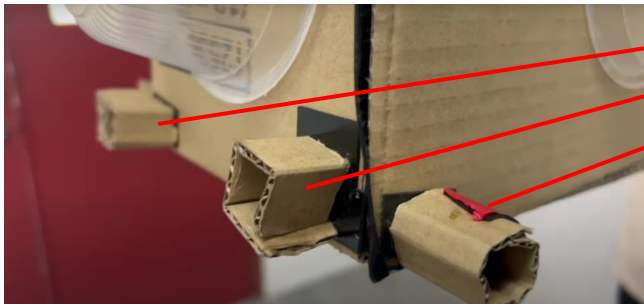


-We use plastic bow to represent the projection lens, it consists of five projection lenses to ensure there are no blind spots.



CPU of the projector

-We use cardboard to represent the CPU of the projector, the function of this CPU is to receive the signal form software.



Infrared sensor

-This infrared sensor is used to determine the length and the size of the room.

Final prototype



Project Schedule

Start day : 25 Dec 2024

End day : 27 Jan 2025

Task	Date
Discuss about the idea of design thinking	25 Dec 2024
Meeting (discuss some feature that include in the system)	28 Dec 2024
Design prototype	29 Dec 2024
Report	30 Dec 2024 - 27 Jan 2025
Record Demo and presentation video	16 Jan 2025
Edit demo Video	19 Jan 2025 - 21 Jan 2025

Conclusion

The report highlights the process of the project and it show the issue and problem that are currently facing in furniture and interior design industry. Therefore, we also provide some suggestion and idea to overcome the problem. Throughout the report, we also provide the prototype to give a deeper understanding.

The design thinking project provided us a great opportunity to showcase our innovative ideas and also fostering our teamwork skill . It encouraged us to think creatively and critically to solve the problem. Throughout the project, every group member is contributing effectively to their respective roles and they show a great productivity in this project. This project not only enhanced our technical abilities but also strengthened our creativity and communication skills.

References

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Appendices

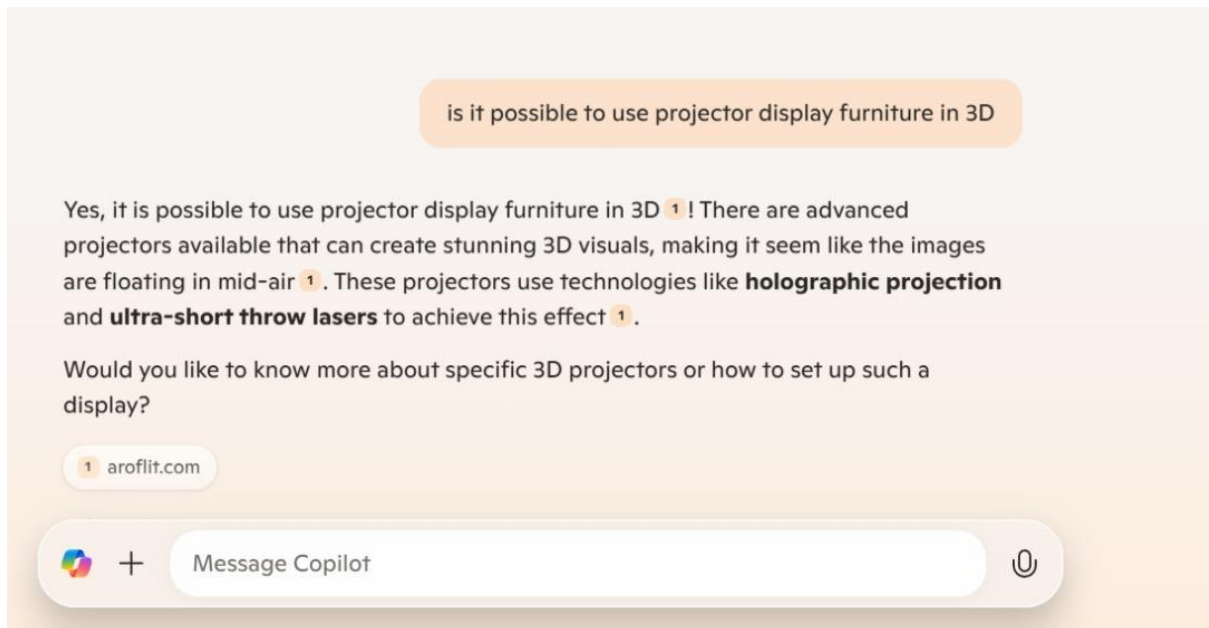


Figure: Screenshot generative AI (Copilot)

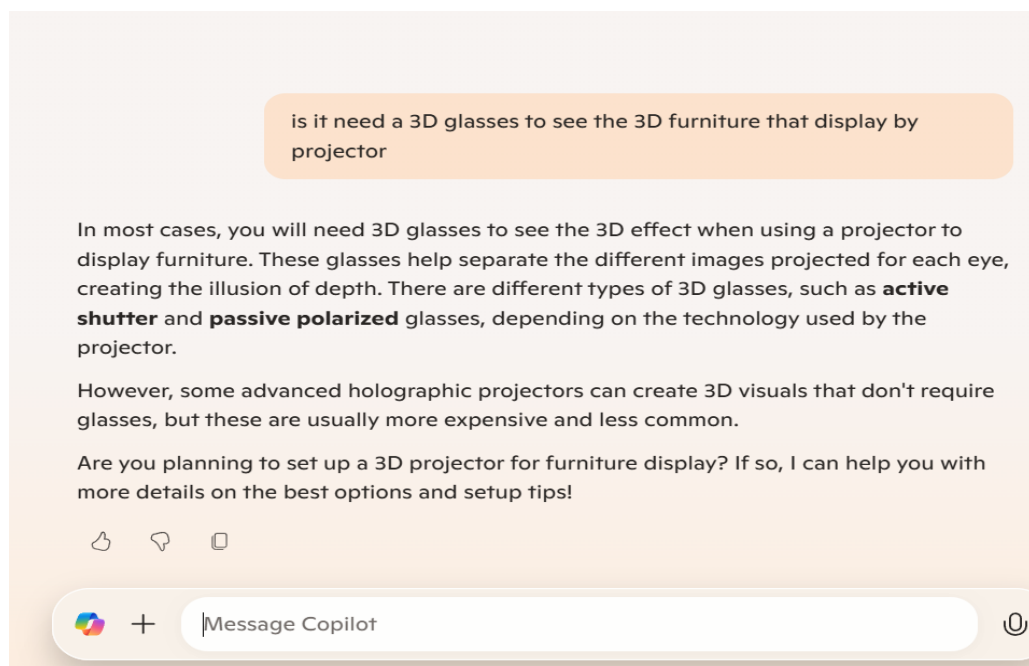


Figure: Screenshot generative AI (Copilot)

<https://g.co/gemini/share/62c19404474b>

This hyperlink will show how generative AI (Gemini) answers the question about the type of infrared sensor that can be used for our project.