RESEARCH ARTICLE

BON VIEW PUBLISHING

Contrivance of Augmented Reality with Interior Designing

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Abstract: In the modern day, design is an integral part of our life, so there is a need of interior design. Interior design is gaining its popularity day by day. But the major problem faced by people while looking for designing any interior is that hiring interior designers and booking design session with them are time consuming and are deemed quite expensive. Hence to eliminate these two pain points, this project proposes the design about a software platform where users can design their own space with the assistance of augmented reality which is a huge contribution to the digital world having a variety of applications. This project includes mainly the process of designing an application that is identifying problem, meeting business requirements, identifying the main users and the tasks they do in this app, building a scenario, creating a task flow for a scenario, and finally presenting main screens of the main task flow.

Keywords: design, user interface, interior, augmented reality (AR)

1. Introduction

AR is the technology that aims to digitally integrate and expand the physical environment or the user's world, in real time, by adding layers of digital information. This integration can be applied to various display technologies capable of overlaying or combining information (numbers, letters, symbols, audio, video, graphics) with the user's view of the real world [1]. The functionality of AR is to actually link the outside existing world with the created graphics to provide a seamless interface which is an integration of both virtual and real environment, or projection of virtual objects in real environment. In general, AR is implemented to get a vision or learn about anything. The study entitled "Interior Design in Augmented Reality Environment" makes AR to display virtual furniture so that it becomes a learning media for interior design. Using Tangible AR and AR Toolkit which still use markers and multi markers [2], having the idea of integrating this technology to app, we produced a prototype of the app in the software Adobe XD, an application designed specifically to create clickable prototypes developed by Adobe Inc. Along with Adobe XD, we used Adobe Illustrator and Adobe Photoshop which are similar Adobe creative cloud software for logo designing and photo editing of the photos used in the app main screens. In photoshop you primarily work with bitmapped digital images. You can also work with vector graphics, which are drawings made of smooth lines that retain their crispiness when scaled [3]. While Adobe Illustrator is a graphic design and drawing software, which is used by creative artists in Hollywood, brochure designers, as well

as casual users turn to Illustrator for its proven ability to create top of the line vector artwork and complex graphic designs [4]. Figma is a powerful real-time collaborative tool that can easily replace several design applications. Figma covers just about everything you need to create a complex interface, from brainstorming and wireframing to prototyping and sharing assests [5].

To sum up, the main purpose of this project was to present a prototype of an app which scans a room and gives design suggestion to decorate the interior of the room. This is designed specifically to work on mobile rather than desktop. Users of this app will design their own room according to their needs and tastes, along with the suggestions and accessories. Volunteer artists can also present their works and can get recommendations. This works both ways where it can benefit both. We hence kept the goal to make interior design more cost effective and less time consuming.

The structure of the project is as follows: Section 2 contains the analysis of similar projects, UI-UX principles we adapted to draft the paper, and all the data which we had collected to develop our application. The principles include color psychology, UI principles, design study of iOS and Android, I design trends, and entire design mapping. Section 3 contains the proposed work, which includes problem statement and the possible solution, business requirement that is meeting client's expectations and identifying the target user that is the main audience who use our application. Section 3.1 contains design strategy a method used to bridge the connection between the user, developer, and client. Section 3.2 is all about design where we designers put ourselves in user's shoes and draft our needs. After this, we create a scenario and draw an action map

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also known as task flow of how user would use the app. Then the final step is to design screens and develop the prototype. Then we conclude the project by what we have delivered.

2. Literature Survey

2.1. Color psychology: color preferences of specific genders

In the book *Mobile Pattern Design Gallery*, Eysenck [6] researched and surveyed a total of 2160 people of different cultures and came up with the conclusion of the hierarchy of the preference of the colors: 1, blue; 2, red; 3, green; 4, violet; 5, orange; and 6, yellow. The order was highly significant and was the same for both genders.

2.2. UI patterns to look out for more interactive design approach

In the book, Mobile design pattern gallery, the following guidelines were followed for effective interaction. As the book itself says "Good navigation, like good design, is invisible. Applications with good navigation just feel intuitive and make it easy to accomplish any task." The following points were taken into consideration while designing.

Thumb-friendly options in the iOS phones, Blackberry, and Web OS are the bottom tabs.

The gallery tab is significant when we display visual content, that is, individual articles, recipes, photos, or products display.

The role of image carousel is for visual attraction; it works best when you have the user focus more on the images and photos than on the content. But it should be considered that these should have visual affordance, that is, symbols like arrows, indicators, or dots so that users get the navigation to access more information [7].

2.3. Designing for iOS and Android following and implementing relevant UI-UX principles

The study analyzed the iOS and Android version of four main available apps on the Google play store. The aim of the study was to compare and contrast the design and interaction of the apps in both. This gave out the following results. Table 1 potrates the look and feel of iOS as well as Android app.

These were conclusions drawn from the study:

1) Navigation: iOS actually prefers to having a navigation bar at the top, while Android provides the same with an action bar instead

of a navigation bar; there are significant changes in the icons: iOS provides a back button, but in Android it is replaced with a button where you can switch up the views. In Android it is also seen that you have action buttons and search button alongside other options.

2) Screen logical regions: Both systems provide the same division, but iOS gives more detailed logical regions where you can come across three divisions of the screen where one is for the navigation bar, the second being the content area, and the third division is a tool area which may hold toolbar, segmented bar, or tab bar. Android is rather simple that has two divisions, one dedicated for action bar and the other for content area, and there is a subdivision which can be utilized further for additional controls. Android also provides drawer option menu for seeing if the menu hides the view.

3) Settings: iOS has a narrower variety of organizing its content. We can see that it distinguishes app settings into two major parts, that is, app settings and app preferences. Preferences include those settings were likely to be changed from time to time and settings contains settings which are set once and are not often changed. Android on the other hand provides only one option of settings, and there is a tab called additional settings which have more of the settings and are not so well distinguished which the user uses more but it relies on what the screen can hold. The rest is moved to additional settings [8].

2.4. The role of typography, color, and imagery in UI design

Typography, color, and imagery are essential components of UI design, as they help to create a visual language that users can understand and relate to. Here's a closer look at the role of each of these design elements in UI design:

1) Typography: Typography refers to the design and arrangement of typefaces, fonts, and text in a UI. Typography can be used to create a visual hierarchy, emphasizing important information and guiding the user's attention to key elements. A well-chosen typography can also help to establish a brand identity and convey a sense of personality.

2) Color: Color is another essential component of UI design, as it can affect the user's emotions, mood, and behavior. Color can be used to create contrast, highlight important elements, and establish a visual hierarchy. When designing a UI, it's important to choose a color palette that reflects the brand identity and is appropriate for the target audience.

3) Imagery: Imagery can be used in UI design to add visual interest, convey emotions, and create a sense of context. Images, icons, and illustrations can help to break up the text, guide the user's attention, and add visual variety. When choosing imagery, it's important to consider the user's cultural background, preferences, and expectations.

Together, typography, color, and imagery can be used to create a cohesive and engaging UI design that reflects the brand identity and meets the user's needs [9].

Table 1
Look and feel of iOS and Android

Apps version considered: (iOS; Android)	Look	Feel
Facebook (v5.0.1; v1.9.10)	The same	The same
Skype (v4.1.1310; v2.9.0.315)	Different	Different
Twitter (v5.0.3; v3.4.0)	Similar	Similar
WhatsApp (v2.8.4; v2.8.5310)	Different	Different

2.5. Stages of interaction

1) Forming the goal: In interaction design the design or the applications goals are considered as the top priority requirements or tasks. Hence these goals need significant work which includes research, analysis, comparison, and presentation. The goal is defined as the need for the user to use the particular interface which drives their further curiosity in using the interface.
2) Forming the intention: The intention is considered as low-level tasks which are done in order to fulfill a high-level task or the goal mentioned earlier. These include mapping features, comparing the mapped features and then looking out for trend, cluster, spike, anomaly, change, outlier, etc.
3) Specifying an action: The user should not feel that he is lost when he is using the application. The user should be able to translate their intention to a specific task in the interface. Hence the design of the interface should make sure that it gives strong affordances or signals to the user about how to interact with interface. This additional suggestion of which operator is best suited for the user to satisfy their intention should also be added in the interaction design interface.
4) Executing an action: Now as the operator, intention is clear: the user should be able to perform the specified task with available input devices for web (mouse and keyboard), or the mobile (gesture or touchscreen). Once the execution of the action is done, a new layout for the interface map should be provided to the user.
5) Perceiving the system state: User now gets the new layout but this should leave him in a state of confusion where they think about what happened to the previous interaction they did to the layout. Here comes the importance of feedback. It should be in such a way that user should be able to understand the update of his previous request.
6) Interpreting the system state: The user should now know that his main intention is satisfied in the interface. Once they get to know, they go with a series of low-level tasks and the interface must be able to provide another task if the user disagrees to perform a certain low-level task. Overall, this stage shows the completion of the intention.
7) Evaluating the outcome: This is the comparison state. Here the answers to question like "Does this seem right?" or "Did I get the answer I was looking for?" the evaluation for this question will lead to restart of the sequence or entering of the customer more times [10].

2.6. User recommendations

In a similar project there was usability test held where we got an insight into how users wanted the app to be designed, so these were taken into consideration.

Many participants put out the need for having more buttons on the Main UI screen.

One of the participants was dissatisfied with not having an undo button while the other complained about having a drag menu instead of clickable one.

The conclusion derived was having an undo button, floating windows for toolbars or menus, clear screen button and tweak tutorials.

This session ended with having the last question as a generalized problem in the application. One of them deemed that the tutorial was too lengthy while the other said that there was a lack of visual indications for the menus in the app. Some also encountered hiccups and lag in the overall performance of the app [11].

2.7. AR and cognitive load

Since AR is a new medium and people are still getting used to it, we decided to test and analyze how much cognititve load would it put on the users and can they read everything present in the app. First, with respect to the many variants of AR in the different studies and a range of results, we find evidence to conclude, that a majority of studies report lower or equal cognitive load with higher performance when compared to more traditional conditions like display-based or paper-based instruction. However, it should also be noted that contradictory results are found, for example, when cognitive load and performance are high or when the AR condition showed the worst performance due, among other factors, to cognitive load [12].

2.8. UI-UX and E-commerce

We researched how to improve our user-experience in order for encourage or navigate users to actually purchase products which are mentioned in the shopping page on the app. And these were the inputs we tried to incorporate in our design. In terms of usability, the user-friendliness of the user interface, the beautification of the product image, and the rationality of the content displayed on the web page all have a positive effect on the user experience during the shopping process. A high-quality user experience can promote users to purchase online. In terms of content, we learned that the level of authenticity of the content displayed on the e-commerce platform and the level of content's detail has a considerable impact on user experience [13].

2.9. Usage of Hick's law while designing options

We were aware of limiting options in showing choices of objects while people are scrolling for their furniture as per the Hick's law, which is one of the few law-like relationships involving human performance, expresses choice reaction time as a linear function of the mutual information between the stimulus and response events. Hence to make sure the user is nor overwhelmed by the number of options and end up not making a decision [14].

3. Proposed Work

3.1. Identifying problem statement and possible solution

The problem statement refers to the significant problem we are trying to find the solution. This we can channel in such a way that our app which we are designing becomes the most relevant solution. Hence for us it becomes significant that we come up with the possible solution with the data collected and having a problem statement.

In India, according to the Livespace, one of designer companies blog, an interior designer charges almost 1.3 lakhs to 2 lakhs INR approximately for interior design [15]. It's also important to keep in mind that interior designing costs should generally be 10%–15% of property cost and for larger homes such as villas, it should be about 30%–35%, according to designcafe blog [16].

This number is expensive to afford in middle class Indian families. And booking an appointment and delivering design is time consuming. Hence, we have a mobile application where user designs the room by themselves after scanning the room. And volunteer artists can show suggestions for better app experience.

3.2. Business requirements

Business requirement refers to those expectations which the client gives out to the designer along with problem statement and solution. There was such one as client, and our supervisor tried to fill that role by putting up some expectations they had on the application. Following requirements were put forth.

1) The augmented reality mode should work both on one side or 360° according to user's choice.
2) Themes and suggestions should be given and there should be a page where the user can explore themes.
3) The app should have links where the user can purchase design materials if he wants to.

3.3. Identifying target user

The target user was taken as anyone who wants to design a closed space.

Artists who volunteer for showcase of their talent and work which can help in their recognition and passion.

3.4. Design strategy-recognizing tasks of user, constraints for app and critical success factor

A design strategy is a scheme usually written or drafted in order to align business needs to user's needs. It is done to ensure that we come to a meeting point to user's and client's interest along with an idea of success metrics. The following strategy was put forth after brainstorming session. Table 2 defines the interior design strategy of the app in detail.

Table 2
Design strategy of interior design app

Executive Intent	In the first month after launching the app there should be 150 visiting users, 30 volunteer artists
Market segments	This app is mainly used by two users: User 1-Volunteer artists/designers User 2-design seekers
General tasks	User 1 • Register, login, sign-in • Upload portfolio • Upload/remove designs/themes • Enable ratings/reviews

(Continued)

Table 2
(*Continued*)

Executive Intent	In the first month after launching the app there should be 150 visiting users, 30 volunteer artists
	• Settings-change password • Profile-account deletion, change demographics • Check other design portfolio • Logout • Contact customer care • Change to design seekers. User 2 • Register, login, sign-in. • Open camera and click photo • Record the desired room in 360° • Open various options-wallpaper, furnishers • Option ton place furnishes (drag and drop) • View symmetric dimensions/disable view • Change color or materials • Option to save design and view it in 360° • Option to create albums for living, bedrooms • View portfolio or ideas to design • Rate or review design • Settings-change password, appearances • Profile-account deletion, change demographics • Logout • Contact customer care • Change to designer
Technical or other constraints	• Augmented reality integration software for the app • Integration of drive or mobile storage to store designs • Should be able to design multiple rooms, multiple designs for single room and have multiple accounts • Legal constraints-plagiarism [patented]
Critical success factor	Entry and retainment of users must be raised by 20% And the exit of users should be lowered down to 7%
Marketing or brand goals	• More designs or themes should be available • Can design any closed space • Can see prices along with designing • Links will be provided for the rest of furnishings, if the user wants to buy

3.5. User profile and persona

User profile is very significant when we have to narrow down our target users. This helps in further designing a platform which caters the taste of a specific target user and this lays a huge impact on the overall look and feel of the app. Table 3 gives the user profile in the interior design app in terms of characteristics, artists and design seeker.

After making user profile we try to make a persona which includes an imaginative person who would be in need of our app (as shown in Table 4). Later scenario is written around this persona.

3.6. Scenario and main task flow

As we have written two personas, we wrote two scenarios: one for the artist and one for the design seeker. But, design seekers are more prominent users compared to design artists.

Below was the scenario done for user 2 – Sheela

Sheela is a middle-aged woman who just brought a new home. She did not want to get an interior designer rather wanted to project her own design along with suggestions. She can then use this to show to workers and get her ideal home. So, she searches a platform where she can scan and design her own room.

Now is the designing of the task flow or the action mapping for the given scenario, so how would the user that is the design seeker will move forward in the app what screens would come after entering one task and finishing one scene.

3.7. Preparing wireframes and developing prototype

Using the task flow as a reference we continued forward in drawing wireframes for the main tasks of the application. It is essential to provide wireframe and prototype as prototyping is the core of the creative process requiring both a highly developed sense of creativity and practicality. While wireframes may sketch out the basic blueprint and flow and mockups present the look

Table 3
User profile of interior design app

Characteristics	Artists	Design seekers
Language	Basic English	Basic English [regional also]
General education	Design-degree certificate	Basic education
Domain expertise	Medium to high	Low to medium
General computer expertise	Not required	Not required
Age/Gender	25% male Age-30–55 75% female Age-30–55 Median age-40	60% female Age 35–55 40% male Age 35–55 Median age-42
Expectations	Easy to operate and design (augmented reality) and easy to see measurements. Should look realistic. Able to look from all angles after designing.	Easy to arrange furnishings, more designs to find with different colors. Should look realistic. Able to look overall or a particular design space after designing

Table 4
User persona of two people who would use interior designing app

| Specifications	User 1	User 2
Name	Kamal	Sheela
Demographics	Age-30 Education- BSc. Interior design, Marital status-single, Country- India, Gender- male	Age-32 Education-MA in psychology Marital status-married with two kids Country-India Gender-female
Things they want to do	• Design the room • Put on the design themes and info regarding it • Look for reviews	• Design their own home • Toggle between a wide range of furniture and select the best suited • Scan the room from any angle • Save the design
Things they want to know	• Room measurements • Design seekers, theme taste	• Look for themes and suggestions • Look for pricing and products if they can afford to buy
Pain points	• They want to build their career • They want constructive criticism to grow • Get media coverage and recognition	• Design their own room • Interior designers hiring is expensive • Inclusive features which most of the apps don't provide

and feel of the design, it is the prototype that either helps or hinders the user experience mission because you won't know if your ideas are valid until a user picks up a mouse and clicks an object or taps on the screen [17]. Wireframes are rough sketch and planning of the screens of the app. These wireframes are then designed in Figma software, a software similar to adobe XD and the screens are then prototyped, that is linking each screen like on which screen we select takes us to other screen. This is done by linking each screen with one another. Here are the wireframes and prototypes of the app.

Though there a lot more screens to design, we have narrowed down to design and prototype the screen according to the given task flow (see Figure 1). The prototype that is the linking of the screens to portray how the app works for the above screens is given below.

Here are the UI screens designed in Figma having the sketch as reference.

First comes the login screen which was not drawn (see Figure 11) where the user logins to the app through any login options. This will take the user to the home screen of the app (see Figures 2 and 12).

Figure 1
Task flow for user 2
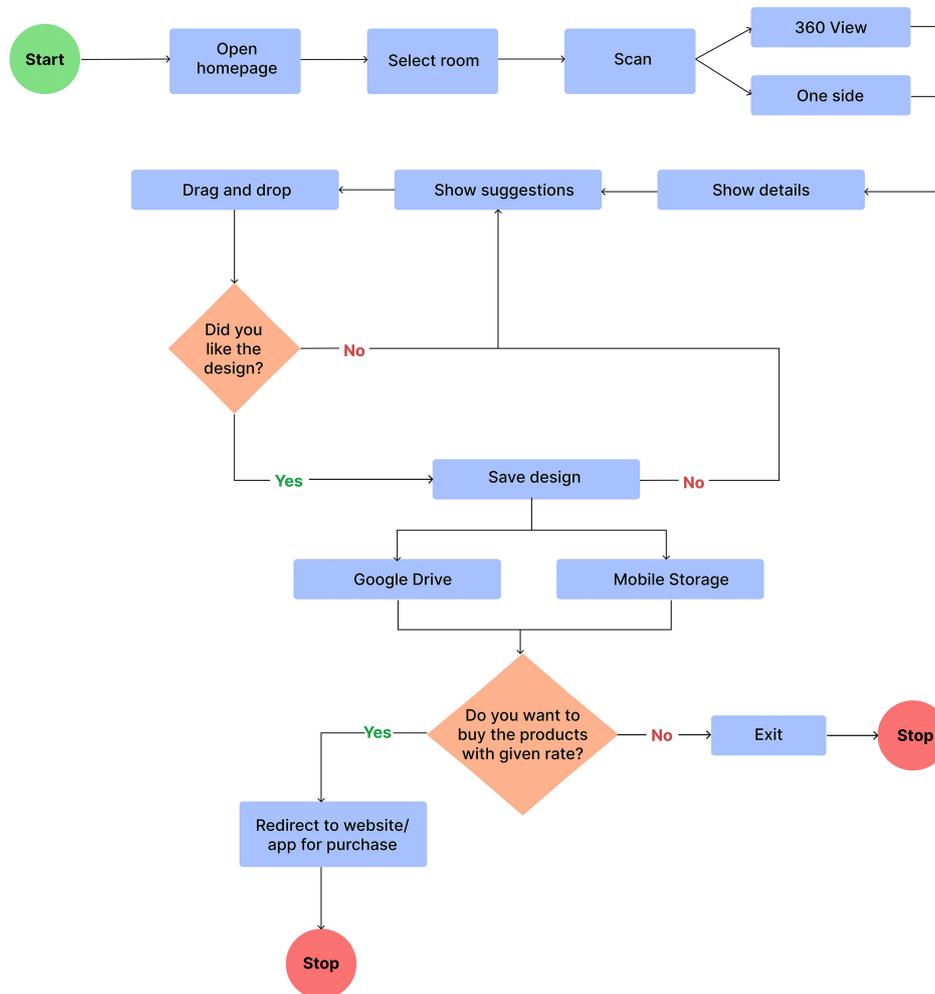
The user now proceeds to scan the room by clicking on the new scan button on the home screen (see Figures 2 and 12).

This click takes the user to the pick your room screen so that the app can load all the relevant items which the selected room wants (see Figures 3 and 13).

After clicking next in pick your room screen (see Figures 3 and 13), the app takes the user to next screen which is the scan screen (see Figures 4 and 14) where the user can scan the room in 360°.

After the scanning the next screen is about viewing the scanned room (see Figures 5 and 15). Note that the user can do many tasks including discarding their scan, viewing the details of the room which is the length and breadth, an option to select where they can either select one side to design or the whole room which is scanned, and they can even save this file and edit later.

So, going according to the task flow (see Figure 1) our user starts to design the room right away. So, they select the next button in viewing the scan screen (see Figures 5 and 15). This option takes them to open the toolbar or the editing screen also known as designing screen (see Figures 6 and 16), here the user can select the furniture or decoration they want for the room along with the description of the selected furniture, there is also search option, and favorites if they have saved any themes and can also look for artist suggestions. They can also check the price of the accessory they place.

The next screen is just to show that if the description box is closed and it cannot make much of space in screen and also that the toolbar is translucent for better convenience (see Figure 17).

Now the user chooses to place a photo frame in their room (see Figures 7 and 17), here they can scale, discard, and rotate the given photo frame.

Now after placing the photo frame, user is now going to save the design, after saving there is a pop-up message saying "hey! your design is saved. Do you want to purchase the items" (see Figures 8 and 18) and this gives the user with two options, a yes or no.

If the user clicks on yes, the screen proceeds to purchase, which then redirects the user to the websites where the products are available (see Figures 9 and 19).
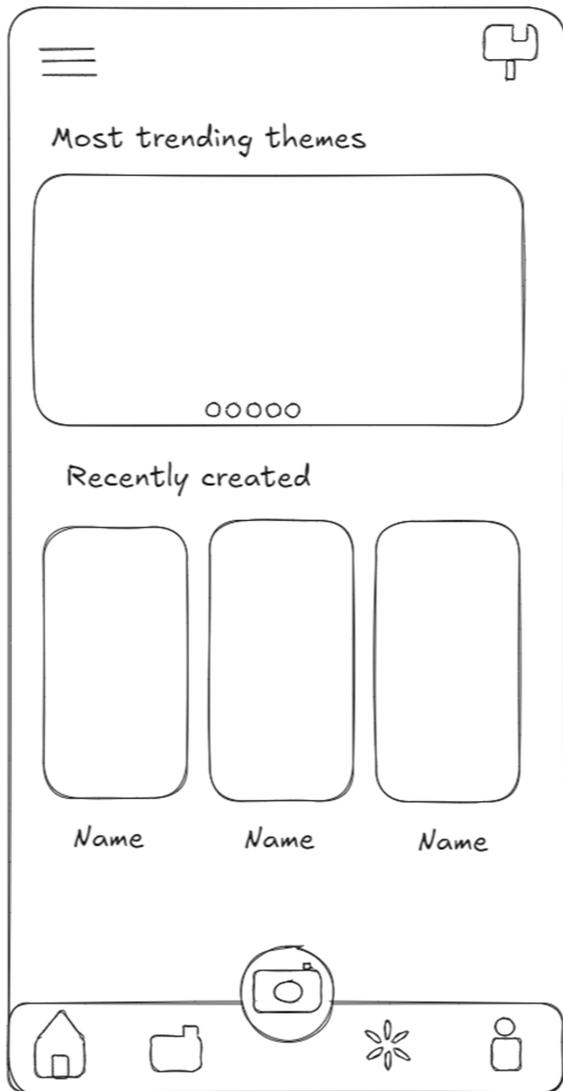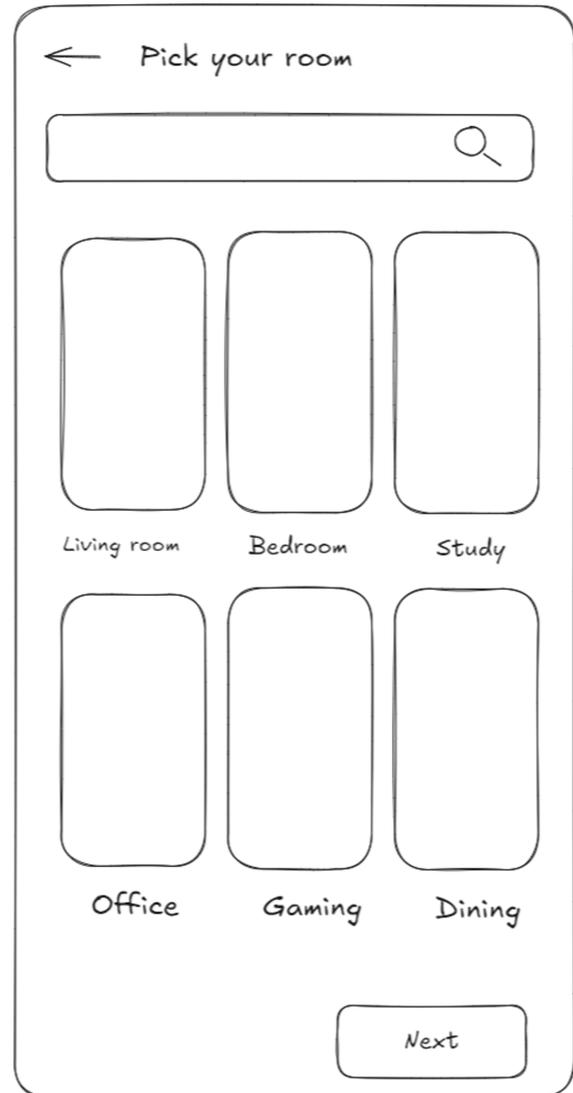
Figure 2
Home screen UI sketch

Figure 3
Screen no. 2 pick your room

If the user chooses not to purchase, they are taken to my albums screen (see Figures 10 and 20) of which icon is present in home screen too. In this screen the user can see that their file is saved and can be viewed here. This is where the main task of the app ends according to the given task flow (see Figure 1).

4. Results and Discussion

4.1. Analysis of similar projects and apps which are already present in the market

In a similar project PARIDA, which is drafted by Ranju Raveedran who stated that people generally do not read instruction that is displayed on the application. This was because in the application the task and the instruction to do the task were given in the same window which made the user to prioritize task first rather than the instruction. This led to misinterpretation of the task and performing the task according to user's mental model rather than the specified instructions. This issue was solved using a separate window for the instructions with the button ok and then leading them to the task window. This point was noted as a designer and was further put into use of our own project.

In the same study, it is also stated that all the applications present in the market provided a realistic view of the 3D objects in the real world. But the major drawbacks were that some application provided pinch sensor for zooming in and out but this may lead to the mis-perception of the sizes of the furnitures and it was also seen that some lacked in providing correct

Figure 4
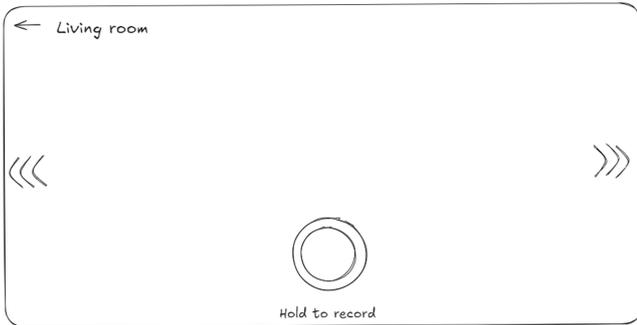**Screen no. 3 scan room (scan in 360°)**

Figure 5
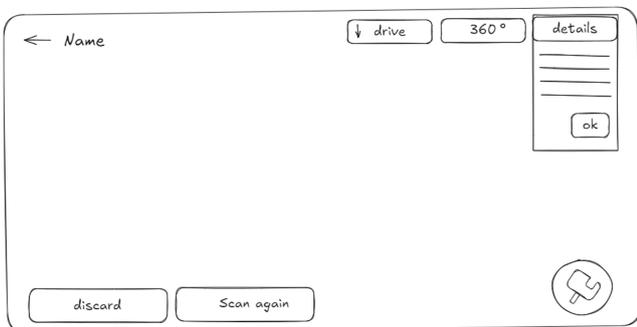**Screen no. 4 the screen to edit or discard scan**

Figure 6
Screen no. 5 the editing screen with toolbar
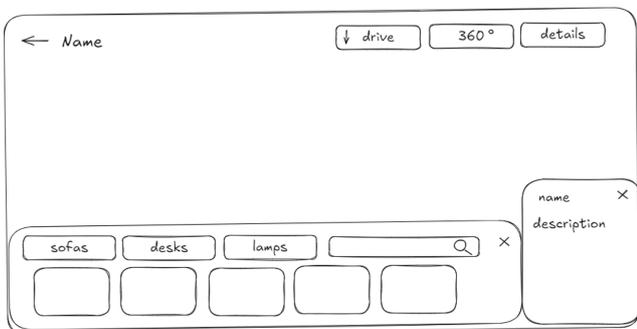

Figure 7
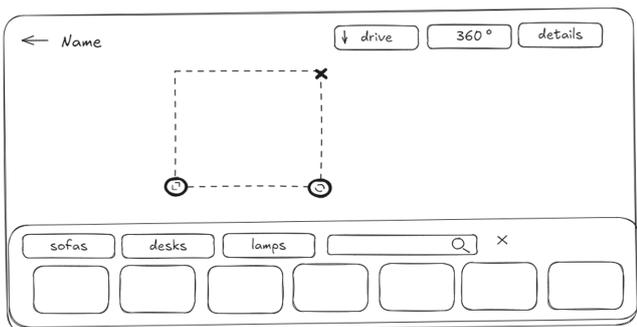**Screen no. 6 the drag and drop of an item**

Figure 8
Screen no. 7 pop-up message either to view the saved file or purchase after editing
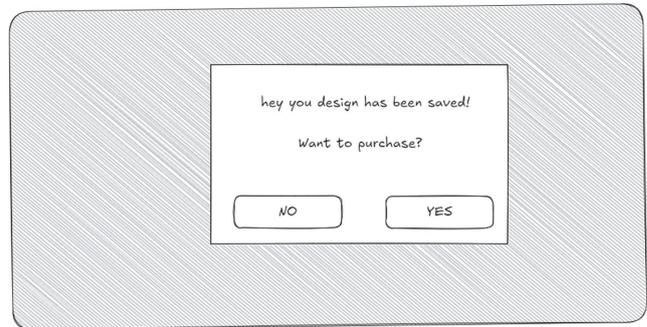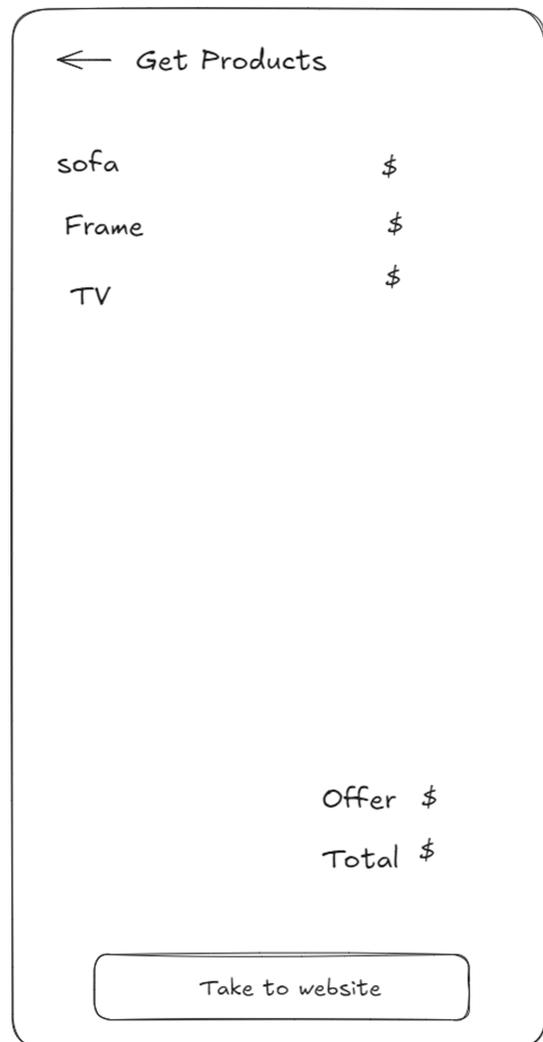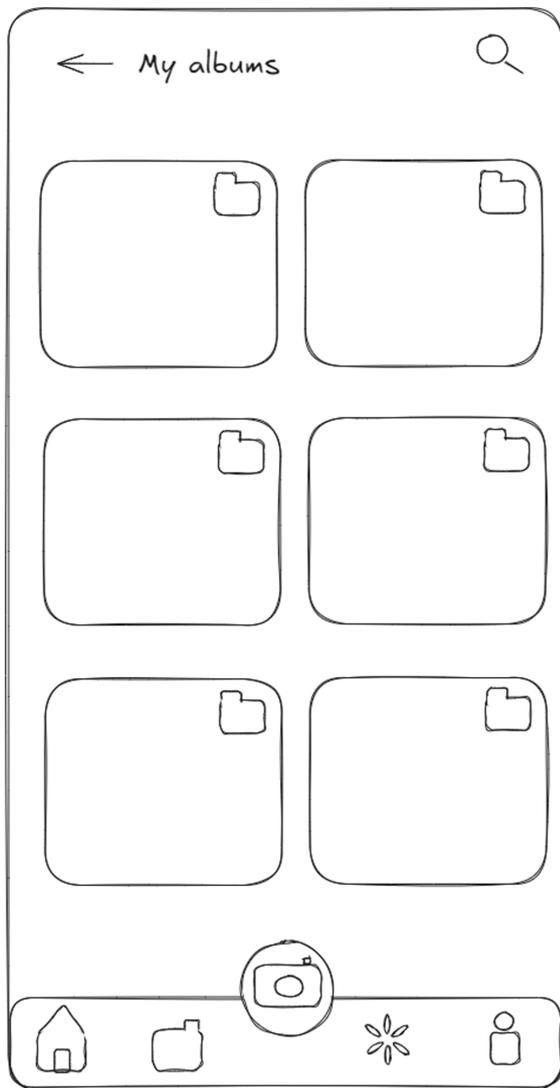

Figure 9
Screen no. 8 purchase screen

Figure 10
Screen no. 9 my albums screen where
your scanned file is saved

Figure 11
Login screen

suggestions and instructions for the users as to where to place the objects. Other options included having options like getting furniture in different colors access of rotation so that the users can place the object wherever they intended it to place as well as it blended the outside light to get a more realistic view [18]. We tried to design a prototype which is inclusive of all the above benefits.

4.2. Overall comparative analysis of the app: results and implementation done after research

There are a few existing or some ideas on the same topic. After going through that, we can see a list of similarities and differences between the systems. We did a thorough competitive analysis to make our app standout from the existing apps. This method is used to determine how a product is performing as compared to existing or competitor's product. The comparison can be of different aspects, for example: their features, their content or the design of the product itself [19]. In Table 5 authors discussed about the similarities and differences in the application in user friendly UI design.

4.3. Comparative analysis of the project with multinational company application: IKEA Place

To elaborate on this analysis, we also took a dive in a real-life augmented reality app IKEA Place. We deep dived into the design and case study of IKEA place to see what makes it distinct than other apps. Explanation of issues faced by the app developed by IKEA are explained in the Table 6.

4.4. Comparative analysis of the project with leading interior design platform: Houzz

The second app which used for the comparative study is Houzz. This was more worthy competition for our product but still we can point few unique points that are different from the two platforms. The issues faced by the app Houzz are discussed in the Table 7 by the authors.
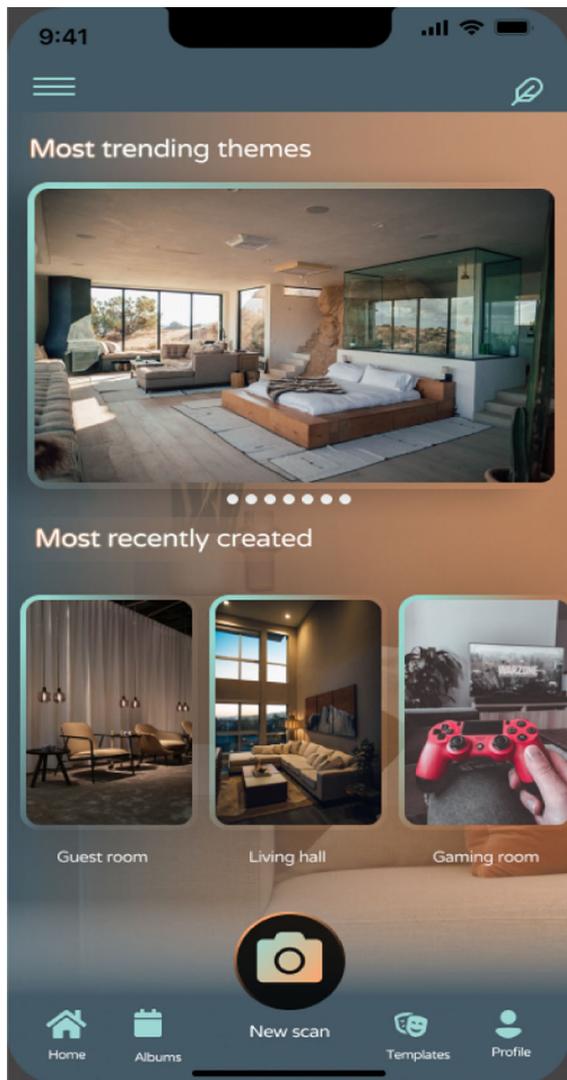
Figure 12
Home screen
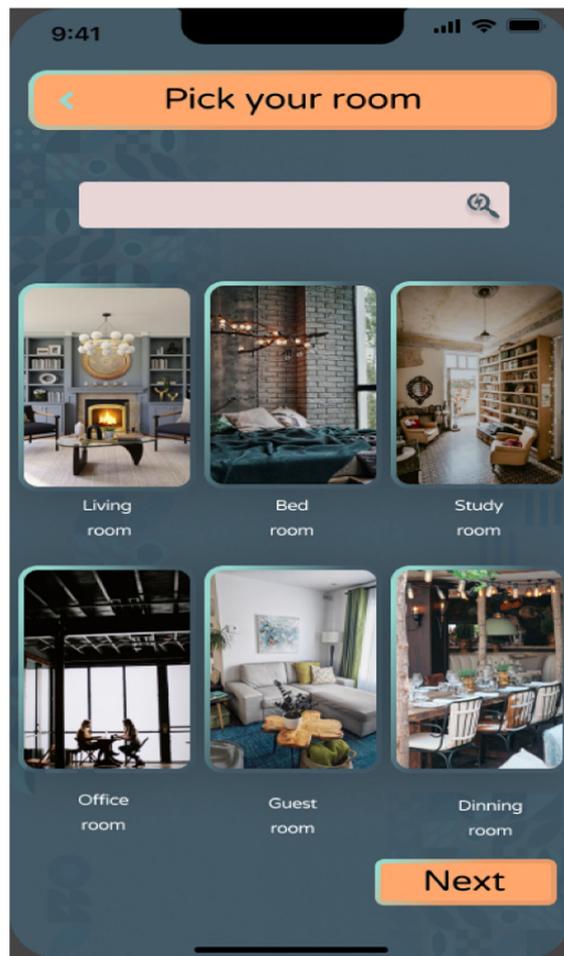

Figure 13
Pick your room screen

Figure 14
Scan your room screen

Figure 15
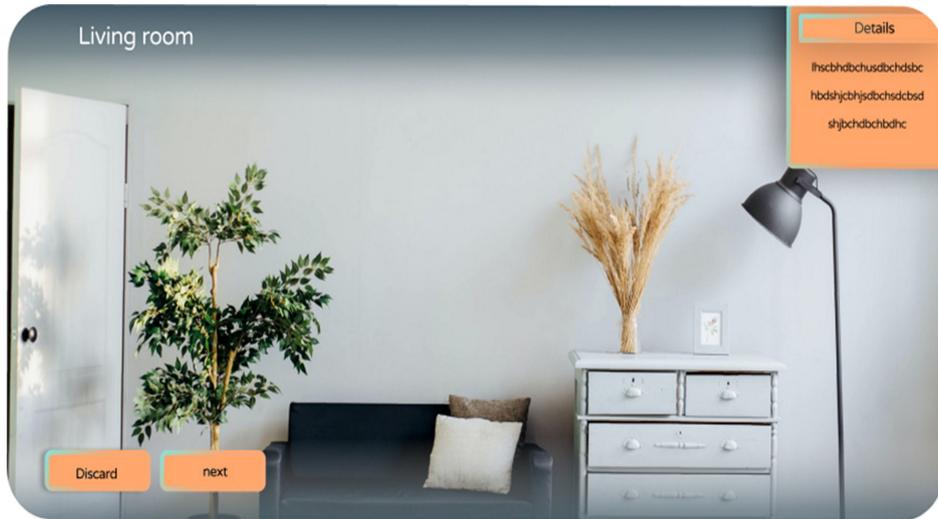**View screen of your scan**

Figure 16
Screen with toolbar for editing
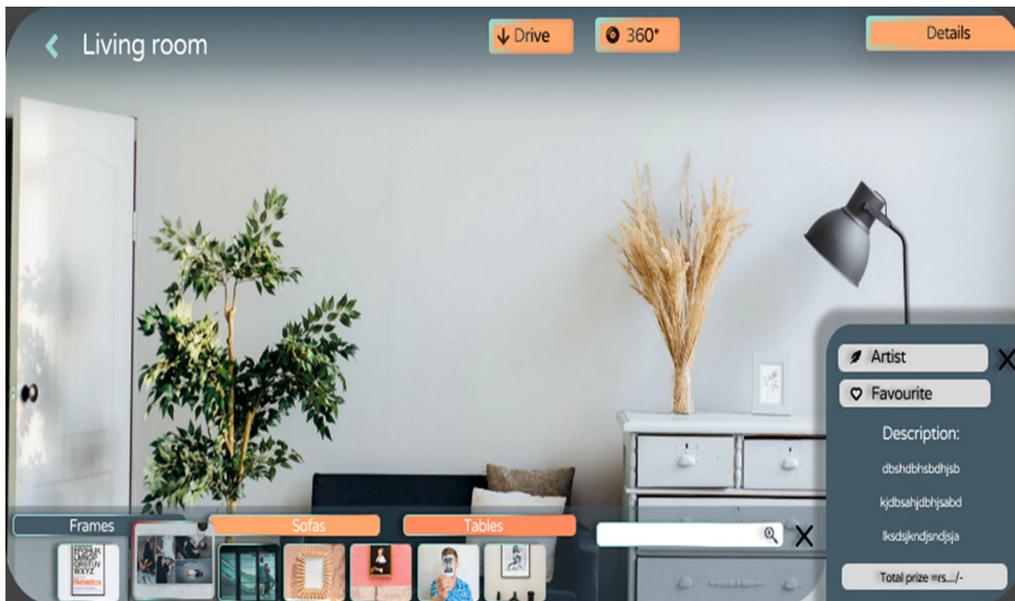

Figure 17
Editing screen without the description box
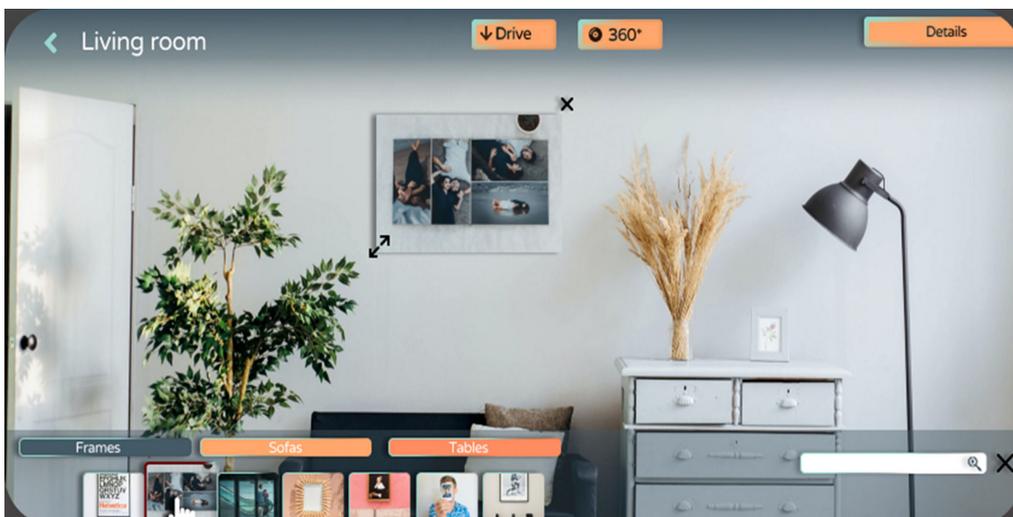
Figure 18
Pop-up message screen after saving file
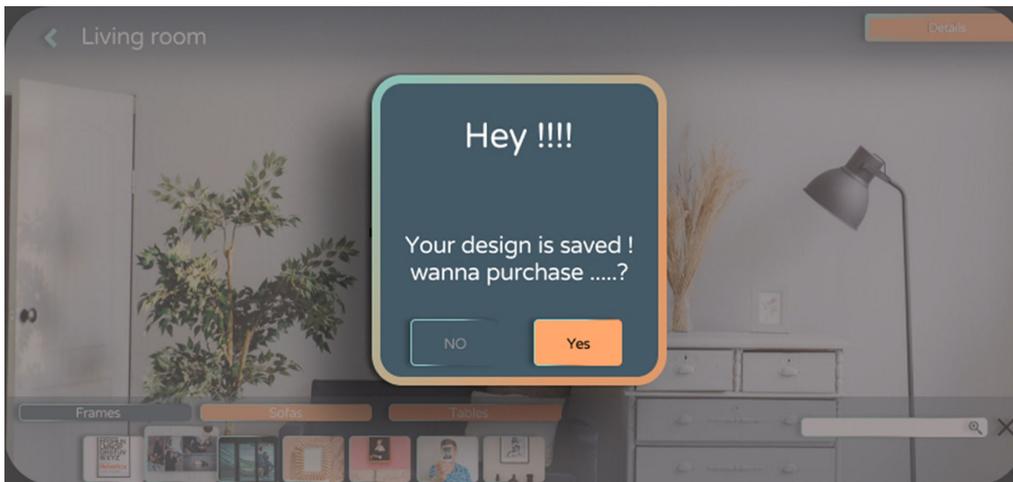

Figure 19
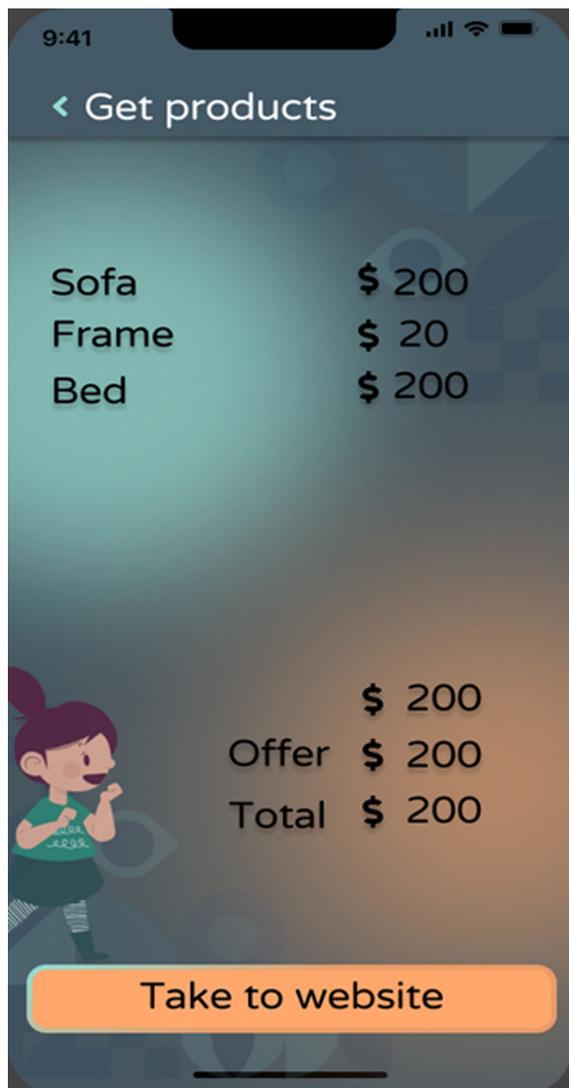**Purchase screen where you can purchase your products**

Figure 20
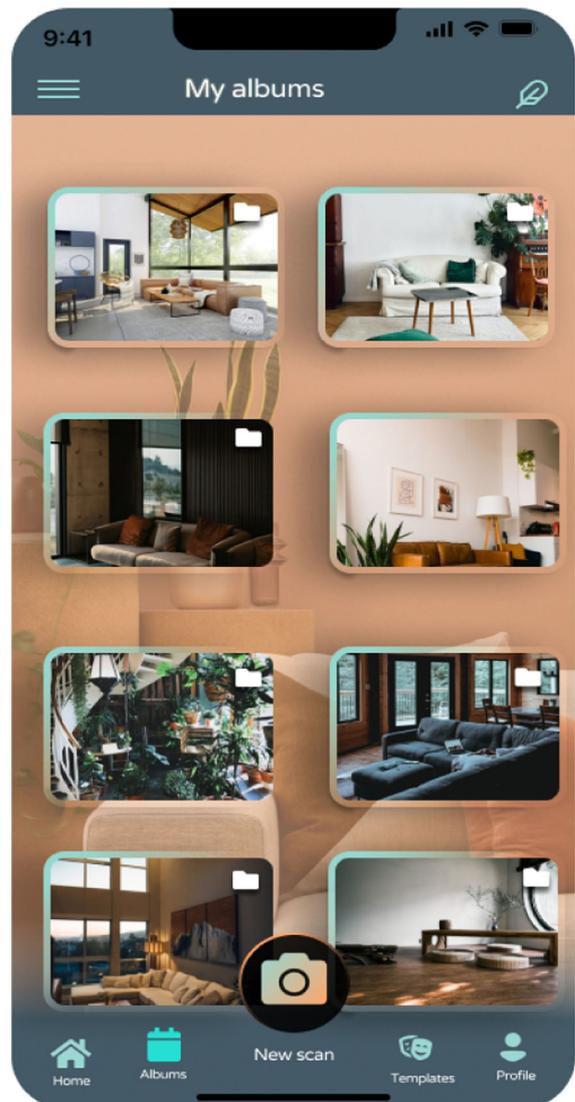**My albums screen where you can see your saved file**

Table 5
Similarities and differences implemented in the application for more friendly UI

Similarities include:	Differences include:
• The toolbar menu is placed right corner according to design standards. Even many existing systems have the toolbar placed at right corner mainly • The options for drag and drop also are inspired by design standards. This is because it was rewarded as better user-friendly technique for many users	• Redirecting to another website. Many platforms ended the interior design process up to designing only and it doesn't have option to redirect to another website for purchase • Integrating a platform for both designers and users. In other platforms there are only mock-ups of designs for users. Here we provide that the designs are tested again by interior designers for better result • Different view panels-usually other design projects have aerial, normal view. We provide one side decoration and 360° view. This helps people for putting what they need along with how it goes well with the design perception

Table 6
Explanation of issues faced by the app IKEA Place, and our innovation for the same issue

Task/issue addressed	IKEA Place	Our project
Lack of fluidity in designing prototype:	The app is customized and designed for iOS and all design is designed according to iOS UI elements. This result in more work to be put in when the app usage becomes more fluid, i.e., when the app will be introduced to Android. Though designing for Android is less complicated, it may not hide the fact that the whole design should be analyzed and mostly remade to fit Android usage.	We started with designing a fluid prototype that works for both Android and iOS design standards. This is to avoid the double work of producing two different prototypes for Android and iOS.
Intuitive User interface	IKEA has detailed instructions to set up the space before aligning the products, it may look like it is efficient, but these result in more time spending on just setting up the room than actually viewing the product in the AR space. This can make users lose interest in the product.	In our proposed project we have mock-ups of error messages and also designed an intuitive design workspace with an option to enable guide for the novice users.
Navigation	It lacks in giving convenient pop-up messages as the design is finished. In a similar use-case study given by Jiang [20] in the medium website, they also address the same issue saying that the app has a huge time for loading and doesn't give any feedback on the buffering that is taking place	In this project you can see there are pop-up messages showing and asking for users' confirmation before going to place the product. And each button has a feedback message stating its function or the change it has done to the page.
Memory load	It doesn't allow viewers to view the same product in different colors. They need to re-do the process again for the same product of different color	In our project we included a properties side menu where the user can view the description and change the color.
Different focus for the main tasks	IKEA puts emphasis on visualizing their product in the user's space. The focus is on the effect and impression of the product in IKEA.	We give importance to designing the room first and purchase of the products is a choice left to the user. Ours focus and impression is on the design and whole renovation of the space rather than a single product.

Table 7
Explanation of issues faced by the app Houzz, and our innovation for the same issue

Task/issue addressed	Houzz	Our project
Different purpose of the main task.	Houzz, similar to IKEA place, uses AR as an option to view the products rather than using for purpose of designing. Hence its task starts from viewing the product then viewing it in AR.	We have skipped this double work by changing the focus on solemnly on designing and then the purchase along with a description menu which can be expanded as a mega menu, so they can view the product if they intend to purchase.
Products display concerning users' positive feedback.	Houzz, has limited number of products to view in AR. Only certain products can be viewed. And it has a list in the Scan room screen, and the objects listed in that list	Hence in our app, all the accessories and interiors are available to view in AR and there are no products which can't be viewed in AR.

(Continued)

Table 7
(*Continued***)**

Task/issue addressed	Houzz	Our project
Memory load	only can be viewed. But when the scenario changes for example, if a user likes a product and wants view it in AR but if the object is not on the list, this may result in users' disappointment. The user should always scan the place again and again for viewing different products. For instance, to view a painting they need scan the wall first then for a ceiling fan they need scan ceiling. If they want both painting and ceiling fan, they are in a tough spot.	This issue was taken into account and that is why we added one side or 360°.Once the scan is done, it is stored and you can always change views and design. Once the object is placed, it won't move or go away when the user goes to place a different product.

5. Conclusion

The best design is the design which goes unnoticed. The design of every day keeps changing and becomes more and more user friendly [10]. We like to conclude that AR app fulfilled its purpose that is having a platform for designing interiors as well as viewing the products if they intend on purchasing, which is contrary to many AR apps on the market. Our project is a new vision because, the app uses AR as a main focus subject rather than presenting it as an option. Many other projects and apps present view in 3D as a secondary option while in this project it is the main task. It is about creating and customizing more than just visualizing. Other than this we like to add that in future, and we would like to add more tasks with more research. We are on the phase of prototyping. As prototyping gives you something to evaluate before you have to commit to resouces to build the real thing [21]. There were some constraints, e.g. we could not meet any developer to take their opinion on our design. The design is still in process hence the other screens would be designed in future. The above tasks would be carried out in future.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Author Contribution Statement

Prajna Hebbar: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization. **B. G. Deepa:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration. **N. Bhuvan:** Software, Validation, Investigation, Resources, Data curation, Visualization. **N. Ranganth:** Validation, Resources, Data curation, Visualization.

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