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AI TOOLS ENHANCING CLIENT VISUALISATION IN INTERIORS

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ABSTRACT
The shift in interior design is dynamic. The designers now have strong computer software to design beautiful 3D models and realistic images of rooms but there remains a huge issue. The clients tend to fail to comprehend the meaning of those pictures. They are not able to feel what the size of the actual room will be like, how the light will appear, or whether a sofa will be excessively huge or excessively small. This disparity between the designer and the client causes confusion, last-minute alteration, and wastage of time. This study paper suggests a new and exciting work method, which is the application of Virtual Reality (VR). As opposed to presenting clients with a two-dimensional image on a screen, VR enables them to equip a special headset and literally walk around the room as though it already exists, at real-life scale. Meanwhile, the designer is able to do any changes in real time, to move furniture, to change colours, to change the lights, etc. and the client sees all the changes appear immediately before their eyes. This produces a two way and live dialogue between the client and designer which is much more efficient and rewarding as compared to the old system. In this paper, the authors discuss how this VR-based workflow can help save on revisions, accelerate the design approval, enhance communications, and achieve better results among designers and clients

KEYWORDS--*Virtual Reality (VR) · Interior Design Workflow · Client Visualization · Spatial Cognition · Real-Time Collaboration · Immersive Design · User Experience in Design*

1. INTRODUCTION

When you get an interior designer to reshape your house what makes you sure that you will like it? Under the ancient method of working, a designer would present you with drawings on a flat surface, three-dimensional computer pictures or painted photographs of what your room could appear like. Such images may be beautiful - yet they may be deceptive.

A room may be spacious in a computer picture but small in real life. The colour of a wall can be outstanding on the screen and yet appear to be entirely different in natural sunlight. This is not what the designer did. There is an issue with tools used. The conventional interior design process follows different steps, first, 2D drawings are drawn with the help of the software, such as AutoCAD. Then a 3D model is built. Then it is sent into a rendering program that creates real life images.

All these phases involve the application of a different software tool, consume a huge amount of time to accomplish, and each time the client wants to request a change, he has to start the entire process afresh. The outcome is a slow, disjointed, and very frustrating process to all those involved. The designers waste hours coming up with revisions to issues that might have been solved minutes.

2. PROBLEM STATEMENT

The issue that arises in the modern interior design is extremely easy to explain and incredibly hard to resolve: the designer and the client are not focused on the same thing. The designer operates in a technical environment where models are in 3D, everything is measured, and the software is complicated. A client can just see the final product, a rendered image or a short-pre-recorded animation, and cannot really interact with it, The clients are too uncertain since they are unable to envision the completed space. And the misunderstandings are only made evident once the building is begun, before changing it is costly and even physically impossible.

This however is very exciting with the way technology is transforming it. Virtual Reality or VR is a technology that puts an individual in a three-dimensional environment that is entirely digital. With a headset, the user is able to see the surrounding in all directions, be able to walk within a space, be able to see things to an up-close distance, and be able to feel like they are physically standing in the room. The technology is already being used in changing the spheres of medicine, military training, engineering and education.

It can now change the interior design as well. The proposed VR-based workflow discussed in this research paper introduces the designer and client to the same digital realm simultaneously. The client perceives the space in real-life proportions by using VR headset. It is at a control interface that the designer can make live changes and the client can watch those changes take effect immediately. No more misunderstandings. No more guessing. Simply, immediate.

explore it or feel the space with his/her own hands. This discontinuity brings about a gulf in comprehension.

One can have a client who views a rendered picture of his or her future living room and believes it to be beautiful. Nevertheless, they are not in a position to determine whether the ceiling is too low when they are under it, whether the kitchen island is located in an inconvenient place to cook, or

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whether the bedroom receives the warm morning sunlight as they hoped.

It is the things that can be only felt and experienced, they cannot be conveyed by a picture. Due to this loophole, customers usually accept designs without having a real idea about the design. It is only after the design is tangible that the actual issues arise and at this time changing anything in it is not only expensive but time consuming. Building may be forced to halt.

The ordered materials may have to be returned. Furniture that has been bought may be returned. All this causes a lot of stress and unwanted cost to what would otherwise have been a pleasant and easy designing process. The second critical issue is also that there are currently no good tools that enable the interactive work of the designer and client during the actual design process.

The process is virtually unidirectional the designer makes, the client responds, and the designer makes. The client cannot say easily and efficiently what would happen should we shift that wall a little to the left and instantly view what it would appear. It is one of the biggest inefficiencies of the current interior design system due to the lack of live and interactive feedback.

3. LITERATURE REVIEW

To comprehend why VR is the appropriate solution to interior design, it is useful to consider what has already been learned by researchers about the conventional methods of design and about the immersive technology.

A. Issues of Conventional Design Processes.

Studies have always indicated that the norm CAD-to-rendering process is among the largest contributors to inefficiency in interior design. Each time a file is exported out of one program and imported into a different program, there will be a possibility that something will go amiss. Each render requires hours to render. And each amendment request by a client implies having to redo part of the process. It is also found that the untrained clients tend to grossly miscalculate room sizes, ceiling height and furniture proportions presented flat images. This is not an intelligence failure, but just the way the human spatial perception is. It is when we are physically within space that we comprehend it.

B. The Way of Improving Spatial Understanding.

A variety of research studies have demonstrated that individuals entering a room in VR are much more accurate in estimating the size, layout, and characteristics than those who view the same room in a conventional rendering. The brain perceives the environment in VR as it perceives the environment in a real physical space. All the aspects of depth, distance, scale, and proportion are seen in a normal manner without any technical training or abstraction. VR users create better design problem identifiers - and they can create this problem before a nail is hit.

C. When the Clients are involved, they are more satisfied.

Human-computer interaction research demonstrates that the best design tools are tools that have immediate feedback. When an individual is able to view the outcome of change upon making it, they make a more confident decision and are more contented with the decision. During a VR-based design session, it would be possible to say: make this room warmer, and the designer can switch the lighting in real time, which will result in an actual discussion of the space, not a sequence of guesses.

D. When the Clients are involved, they are more satisfied.

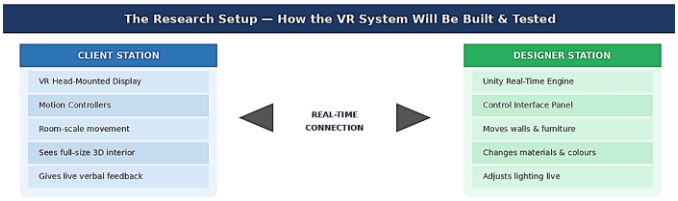
As user-centred design research indicates, when clients are actively involved in the design process as opposed to being presented with a completed product, the level of their satisfaction grows to a considerable degree. VR produces what it has been called by researchers, presence - the real experience of being there. This mental involvement makes the clients more involved, more expressive, and capable of being really satisfied with the end design.

E. The Gap in Current VR Use

All these benefits notwithstanding, nowadays VR is applied to interior design in a highly minimal manner, as a marketing instrument to amaze the clients when all the decisions are already taken. The application of VR as live-working design platform in which both the designer and the client co-create the design at the very start of the process has not been researched. It is the gap that is being filled by this research paper

4. THE PROPOSED VR BASED WORKFLOW

The simplicity of the core idea of this research is so potent as it does not present a client with a complete picture of what his or her future space would look like, but makes him or her go inside of it, even before it is constructed, and allows exploring it, responding to it, and collaboratively forming it in real time. The following is the step-by-step explanation of how it works:



I. The designer designs a comprehensive 3D digital representation of the interior space in the regular design software of AutoCAD, SketchUp or 3ds Max - as they would in any other workflow.
II. Under the Unity game engine or another 3D engine, this 3D model is converted into a full-fledged interactively engaging VR game with realistic lighting, materials, and space characteristics.
III. The client wears a VR headset, which resembles a huge pair of goggles, and is immediately immersed in the virtual reality of his future room. They are able to look in all directions, walk around as well as look at the space as though they are physically present in the space.
IV. During the exploration process, the designer sits at a computer with some special control interface. They are able to make nearly any adjustment in the room

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immediately, through this interface, either by moving a wall, or by switching the flooring, or rearranging the colour of the sofa, or adjusting the lighting, or even adding a bookshelf.

V. The designer can see every modification he does reflected in the VR device of the client. The client watches the room change in real time, literally in front of his/her eyes and he/she provides his/her verbal feedback: I love that but maybe the sofa should be a bit to the left.

VI. This goes back and forth - an actual live discussion regarding the space - till each is fully content with the design.

VII. The resulting agreed design is closed, documented and forwarded to construction, where both the designer and client are entirely sure that nothing is out of the ordinary

5. METHADOLOGY

A. Building the Virtual Reality Prototype

The first thing to do is to build a test version of the virtual reality design system. This will be made using Unity, which's a professional program that is already used a lot to make video games and architectural designs. A sample room, like a living room and kitchen will be built inside Unity with looking materials, furniture and lighting. This room will be used to test the virtual reality system.

B. Setting Up the Hardware

The virtual reality system needs two parts. First there is the headset that the person wears, which shows them the room in 3D. When the person moves their head the view changes just like it would in a real room. Second there are the controllers that the person holds which let them point at things interact with the room and move around. The designer uses a computer with a keyboard to make changes to the design in real time.

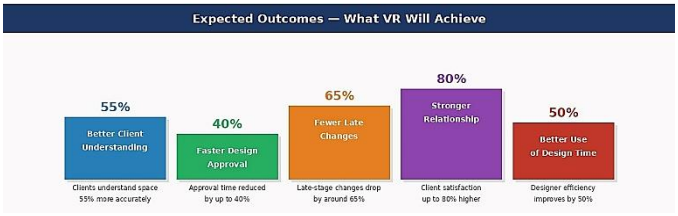
C. Testing and Collecting Data

The virtual reality prototype will be tested with groups of people some of whom will be acting as clients and others as designers. They will work on design projects like arranging furniture and picking materials.

After each test the people will answer questions. Talk to the researchers about what they thought of the experience how comfortable they were and how happy they were, with the virtual reality system. The virtual reality system will be tested to see how well it works for virtual reality design projects and the researchers will use the reality prototype to collect data and learn more about the virtual reality workflow.

6. EXPECTED OUTCOMES

Based on the research and the main idea of the Virtual Reality workflow, we can expect significant improvements and more efficient outcomes across various stages of the design process. It enhances visualization, allowing designers and clients to better understand spatial relationships and design concepts before execution. Additionally, it supports faster decision-making and reduces errors, ultimately leading to more accurate and innovative design solutions.



A. Better Client Understanding of Space

The big benefit is that clients will have a much better understanding of the space they are designing. They will not have to imagine what a room will look like from a picture. They will actually experience it in Reality. They will know how big the kitchen feels when they are standing in it. They will see if the bedroom gets light in the morning. They will know if they can move around easily in the living room. This kind of understanding is something that no picture or drawing can give them no matter how nice it looks.

B. Faster Design Approval

When clients really understand the space, they can make decisions quickly. They can ask all their questions like "what if we use a sofa?" or "what if the wall was a colour?" and get the answers right away in the Virtual Reality session. This will save a lot of time. We think it can cut the time it takes to get from the first design idea to the final approval from several weeks to just a few days.

C. Fewer Late-Stage Changes

One of the costs, in design projects is making changes at the last minute after the construction has already started. With Reality all these changes can be made virtually before anything is built. We think this will reduce the number of changes, which will save time and money for the client and reduce delays for the designer.

D. Stronger-Designer-Client Relationship

When clients feel like they are really involved in the design process they trust the designer more. This leads to clients being happier leaving reviews and being more likely to recommend the designer to others and come back for future projects.

E. Efficient Use of Design Time

For the designer Virtual Reality means they can spend less time making multiple drawings and more time on the creative part of design. Of making five different drawings to show five different sofa options they can just switch the sofa in Virtual Reality while the client is watching. This makes the design process more efficient which means designers can take on projects and give better service to their clients.

7. LIMITATIONS

Although VR-based workflow has numerous thrilling benefits, it should be noted that the challenges should be mentioned. No emerging technology has real drawbacks and a responsible research study should be known to have these drawbacks clear instead of just stating the positive side.

A. High Cost of Equipment VR equipment remains rather costly.

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One of the most successful VR headsets, motion controllers, and a high-performance computer with the capacity to operate real-time 3D settings can be quite expensive. This could be a great investment worth undertaking in case of large design firms that are established and can cover this investment in just a few projects. However, to small independent designers, recent graduates or studios operating in a region with smaller budgets the initial cost might be a severe adoption barrier. This limitation should decrease as the VR technology is becoming more mainstream and is becoming cheaper, which has already started to do so at a very high rate. However, it is still a short-term issue. The designers should have an approximate learning curve of

B. The designers used to work with AutoCAD

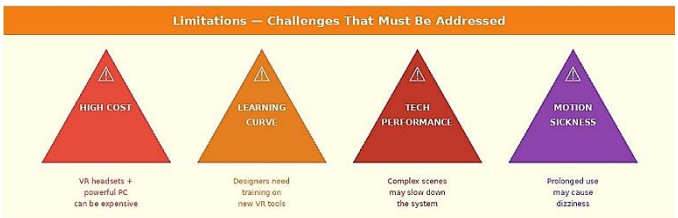
3ds Max or SketchUp during years will have to use another set of tools to be effective in a real-time VR world. The transition period requires time and training in this learning process and can never be productive in the short term. Design schools will have to introduce VR in their curriculum, and design firms will have to dedicate investments in their staff training programmes. It will be necessary to have the assistance of the industry associations and software developers to develop the easy-access training materials.

C. Technical Performance Issues.

In real time, it is a very intensive computing power to create a very detailed, photo realistic interior and that updates instantly when the designer changes anything. Some very complicated scenes that contain numerous detailed objects, complex light simulation as well as high-resolution textures can lead to slow down or stuttering of the system. This may ruin the illusion of immersion to the client, one of the best attributes of the VR experience. Finding the correct balance between the quality of the visuals and the real-time performance is a true technical issue that the developers will have to overcome, probably with the help of the ingenious optimisation methods, as well as the progress of graphics cards.

D. Motion Sickness and Physical Comfort.

Certain individuals get sick when wearing VR headsets especially when they do not take breaks after long hours of use. Symptoms may include eye strain, nausea and dizziness. It implies that VR design sessions might have to be handled with a lot of care - frequent breaks, comfortable user interfaces that cause minimal discomfort and ergonomic design of headset. To the majority of individuals, current VR systems can produce the least amount of discomfort, particularly when they have been effectively designed - though this is something that has to be carefully considered.



8. FUTURE SCOPE

The workflow suggested in this paper is VR-based in nature but is just an initial step. With constant improvement in the speed of technological advancement, the future of this system holds a number of exciting and transformative possibilities in the development and enhancements of this system.

A. Artificial Intelligence Assisted Design.

Consider an example of a VR design meeting, where the client is walking around the virtual room, and an artificial intelligence assistant, by default, creates smart suggestions. Depending on how well you like warm colours and wide formats, three of these furniture layouts suit this space well. Based on the behaviour of the client when in VR, what they spend most time in, what they look at most, what they apparently enjoy, the AI could use this data to make immensely personalised design decisions. The latter type of AI-assistance would allow the process to be quicker and more individualised and assist designers in making more informed decisions significantly earlier in the project.

B. Multi-User VR Collaboration At this moment

The suggested VR system can accommodate a single designer and a single client. However, multi-user VR multi-user VR Multi-user VR is a principle in which a virtual space is shared by two or more individuals at the same time, irrespective of their physical location: it has already become technically feasible, and it is quickly evolving. There may come a time when a family in various cities comes to see their new home in VR. A designer in Delhi can take a client on a tour through a place and a specialist lighting consultant in Mumbai will join them to provide real time advice. Such multi-user functionality would make the whole process of designing more inclusive, flexible and in fact global.

C. Building Information Modelling (BIM) Integration.

Building Information Modelling or BIM, contains all the technical data concerning a building in a single large digital model - load-bearing capacities, electrical routing, plumbing systems, structural constraints. VR designing systems may be linked to BIM data in the future. In VR, moving a wall would automatically be verified by the system on whether a wall can be safely moved based on the structural needs of the building. Such integration would fill the gap between the art of interior design and the reality of construction reality and this would not only make the projects more beautiful, but also more technical and able to be built safely.

D. Extensions of Augmented Reality (AR)

Whereas VR substitutes the real world with the digital one, Augmented Reality (AR) superimposes a digital information on the real world. One day a client would be able to use an AR headset or even their smartphone camera and see how a piece of furniture would fit in their real and existing room - at real size, in real time. This would render design technology even more accessible and practical and the benefits of immersive design applicable to both the design studio and the everyday life.

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9. CONCLUSION

The world of interior design has always revolved around one thing and that is assisting people to achieve a space of comfort, happiness and home. However, the mediums by which design concepts are shared such as drawings, computer images, rendered animation has over decades posed a frustrating and sometimes expensive distance between the vision of the designers and the reality the clients see. The present research paper has come up with an easy going, practical and, above all genuine exciting solution to that gap.

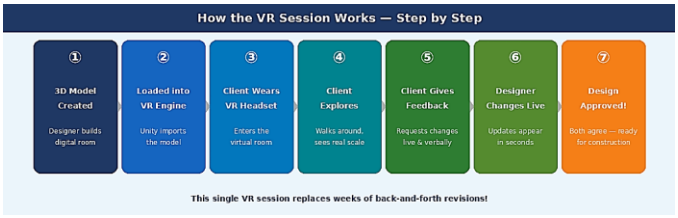
The proposed workflow redefines the process of interior design by including design formulation, visualization of the client, and decision-making in one immersive VR environment, which revolutionizes the interior design process in both initial and final stages. Rather than demonstrating the clients how their future room may look, VR enables the former to do it in a real way, i.e. to walk into the rooms, feel the real proportions, react to the ambiance, and make the changes in the meantime. The advantages are extensive and immense. With more understanding of the space, the clients make more confident decisions since they actually know the space before committing to the space. Designers waste much less time in cyclic revision, and they waste much less time doing meaningful creative work. The projects are approved at a faster rate; they are taken to construction at a reduced surprises and delivered on time and budget at a far greater rate.

At the end of the process, the designer and the client come out to be more satiated, closer, and more assured of the end product. The obstacles it faces are not insurmountable - the price of a piece of equipment, the skill curve of new technologies, the technical side of working in real-time 3D, and comfort aspects of VR application. However, these are issues that technology is already addressing and those are overshadowed by the game changers that VR brings. And when we look further on the possibilities become even more exciting.

AI-generated design suggestions, multi-user collaborative globally, a natural connection with construction data systems, and extended use of augmented reality are all signals of a time when even the gap between design and reality will continue to be closed to the point that there is almost no differentiation between the two. The core of interior design is human because it is all about the creation of spaces that enhance the lives of the people. The most human-centred design tool ever created is Virtual Reality, but it should be implemented intelligently and carefully.

It makes the client the centre of the process, the invisible visible, and guesswork into real experience. The thesis of this research paper assumes that VR adoption in interior design cannot be a technological upgrade. It is a radical change of direction into a more truthful, open, cooperative and, ultimately, more fulfilling approach to designing spaces in which we live.

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