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# Using Virtual Reality to Pre-Visualize Your Designs.

by Todd F. Edwards, Marko Kojicki and Soren Saunders

Ever since I was a little kid I dreamt of technology to replicate the holodeck from Star Trek. I have had fantasies about being able to transport myself to other places and explore things that I might not otherwise be able to do. The creativity and imagination of creating worlds for plays to reside in was a driving force for my becoming a scenic designer. While we are still a long way away from the holodeck, virtual reality has moved from the fringes into the mainstream. The quality, cost and availability of VR technology has reached a point where it is a viable gaming platform offering escape and enjoyment, and a viable research platform allowing researchers to experience scenarios or practice procedures. VR is now a viable platform for social gatherings, exercise and personal meditation. Architects use VR to see their creations before construction begins... so how can we use this in the theater and live performance industry?

Our goals were multifaceted- (1) to gain an understanding of the technology and how to use it, (2) explore how VR could be used as a tool for designers to pre-visualize their work and (3) explore ways to use VR for the creation and delivery of content and as a device that could enhance the live performance experience through audience members and/or performers integrating it into the overall experience. What we set out to do was not groundbreaking nor extremely exciting, but was in many ways a utilitarian use of this technology. The goal of this project was to determine if the use of VR would aid designers in their process of visual storytelling. We wanted to see if the inclusion of VR in the designer's toolbox would help them work through the complex questions that arise throughout the design process as well as provide a more immersive way to share their designs with the other members of the design team, directors, choreographers, producers and even help those realizing the design to formulate and work through questions before any actual construction or installation began. While it felt like a natural fit for the scenic designer, we wanted to find ways that other designers including lighting, media and even costume and sound designers could use VR in their design process. What we discovered is that while it is a natural extension of the scenic designer, especially one who currently works within a digital framework, VR provides the LD and MD opportunities to see how their content works with the physical environment and the opportunity to pre-cue a production without being in the venue. VR allows costume designers to see how their costumes "live in" the world and provide sound designers the opportunity to experiment with speaker placement and how those choices impact the visual aesthetic of the design and audience site lines.

Through the assistance of the St. Olaf College CURI (Collaborative Undergraduate and Inquiry) program I was able to acquire the funds to obtain the necessary VR equipment as well as bring on two talented student research assistants Soren Saunders and Marko Kojicki. We then spent the summer learning the technology, exploring options and gathering data from surveys sent to designers, directors, performers and producers in the fields of theater, opera, music, dance and live performance. These people polled, being asked questions about their process, how (if) they pre-visualize their work now, what software and technology they use and if they had experience with VR or would be interested and open to exploring VR technology. We then reviewed several options for equipment and software concluding those that we best felt provided the highest quality, best ease of use, cost to acquire, etc... It was our goal to find solutions that could be implemented by large professional organizations, freelance artists, smaller venues, educational institutions and community theaters.

Our original plan called for the purchase of an HTC Vive, Oculus Quest and a basic phone based headset that I had purchased several years ago for less than \$20.00 on Amazon. My researchers and I were to be together for this process where we would evaluate the equipment and the software. Due to Covid 19 our summer program was unable to happen as planned and Marko and Soren returned to their homes. In order for this project to work we acquired two more Oculus Quest systems. The new plan was for me to have access to the Vive, Quest and the original phone based unit and my researchers to have the other two Quest units to conduct our experiments on. This plan was further compromised when Marko's unit never arrived (he is from Serbia) due to international shipping being delayed in customs. As of this writing, his unit is still missing; somewhere between the US and Serbia. In order to explore as many options as possible in both hardware and software, Marko acquired a phone based unit locally and conducted all of our tests on that platform.

### Headsets Used

Pros and Cons of the Oculus Quest	Pros	Cons
Cost to power (20gig \$499 \$999 \$949 \$939.99)	Quick and easy to set up. Great instructions, in-set tutorials. Merit from opening box to being in VR in around 15 minutes.	Not as powerful as HTC Vive.
Not tied to a powerful/expensive computer	Self contained and easy to transport to production meetings- no cables, external power, or computer needed.	Less upgradeable as all power is on the unit itself versus the computer/GPU of tethered headsets.
Can be tethered to a computer basically turning it into an equivalent of the Rift or Vive- also opens up more content allowing it to run most Rift and some Steam content.	High quality and comfortable.	No real support for Mac OS.
Double tap on the visor to get a live view of your space outside of the headset.		Requires an iOS or Android device for setup only.
		Smaller selection of content than HTC Vive and Oculus Rift (Oculus's tethered headset).
		Not as well balanced as the HTC Vive.
		Visor doesn't "tilt up" to see outside of VR. You have to double tap for live view or remove the headset.

Pros and Cons of the HTC Vive Cosmos Elite	Pros	Cons
Powerful.	More comfortable than Quest- Headset but more padding and better balance.	Expensive-\$899.00.
Unit (especially controllers) feel more robust, and well made.	Previous Mac support for some HTC products. Possible but VERY difficult to use with extreme high end Mac running Bootcamp/Windows and external GPU.	Not Wireless w/o Wireless adaptor kit \$294.99 and battery pack \$37.99.
Flip up visor to view outside of VR.		No real Mac support.
		Very difficult to set up. Requires multiple programs to be installed and drivers to be updated. Included instructions were poor and the online manual difficult to follow. Online video helped but still not key steps. From opening the box to being in VR took almost two hours. No easily accessible in-set tutorial or information.
		Not easy to transport. Requires two external sensors to be mounted to the wall or on stands, extension cords, power strips (3 wall warts minimum), several cables and adapters. Computer needs to be very high end laptop to easily transport to production meetings.

Pros and Cons of the X-Wave Black Box 3D	Pros	Cons
One of the most affordable options on the market (\$19-\$15)	Great for watching stereoscopic 3d films	Comes with many limitations
Easily transportable	Doesn't require any powerful machine in order to be used, only device you need is a phone	Does not have a lot of interactivity
Compatible with both Android and IOS	Easy to use	No additional gear such as case, etc.
		Limited by the processing and GPU power of the phone device (you can use only certain apps)
		Harder to navigate within the app due to the limitations of controllers
		Not as comfortable as some higher-end models

### Software and Plug-ins Evaluated

Application/Plug-in	Cost	System Requirements	Ease of Use	User Experience
VR Sketch	Free-\$14 month	(Windows/Mac) VR Headset	Easy	Excellent, feature rich
Sento	\$19-\$149 month. Educational disc	(Windows/Mac) VR Headset	Easy	Very good, feature rich
IrisVR	\$225-\$350 month. No Edu disc	(Windows Only) VR Headset	Moderate	Ok-good, feels a little clunky.
Kubity	\$99 flat fee. Free to edu	(Windows/Mac/Browser) VR Headset	Easy	Excellent, feature rich, extra tools, phone base option.
Simlab*	Free-\$124 flat fee. \$99-\$149 Yr Sub. Free Edu	(Windows/Mac/Browser) VR Headset	Moderate	Excellent, vast of tools, phone base option.
EyeCADVR*	\$225-\$454 Lifetime Educational disc.	(Windows/Mac (No VR) /Browser) VR Headset	Difficult	Excellent. Rendering, requires really high-end specs
ShapesPark	\$19-\$99 month/\$190 perpetual. Edu disc.	Browser based	Easy	Good, comparable with others like it.
InSpace	\$90 month	(Windows Only) VR Headset	Moderate	Good, comparable with others like it

\*These applications are more than just plug-ins for VR. They offer advanced rendering and modeling capabilities in addition to VR integration.



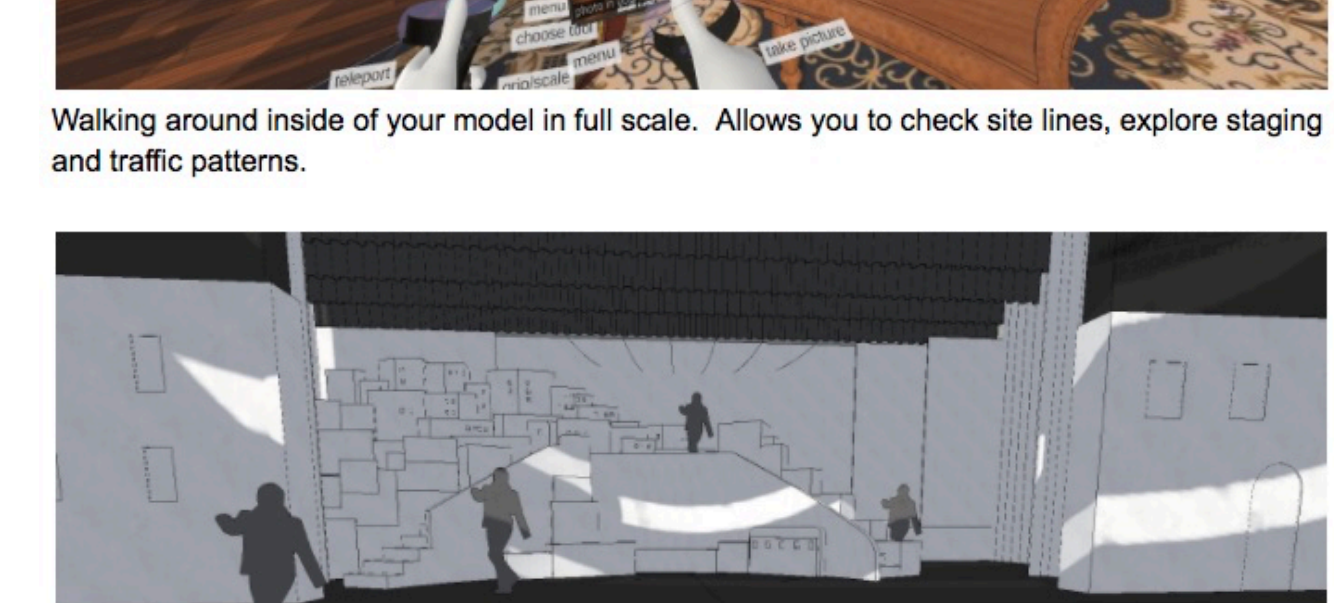
The HTC Vive offers slightly better performance and access to more games but consists of several components, many requiring separate power supplies, two external sensors that have to be mounted to a wall or to tripod stands as well as an extremely robust computer all making for a unit that is very difficult to transport to venues or production meetings.

The X-Wave Black Box 3D is one of several headsets that allow you to insert your Android or iPhone into the unit for 3d stereoscopic viewing. These are higher end versions of the Google cardboard design and while some units may have basic electronics on them, they are not as immersive or interactive as the non-phone based units. These are excellent cost effective ways to see your work in VR, but do not offer the ability to interact with your content like the other units. For previsualization, the designer would create a "walkthrough" that is viewed and not "experienced" in the same way as on the other units. However these phone based solutions are excellent ways to learn and start incorporating VR into your design process.

### Images from Within the Headsets



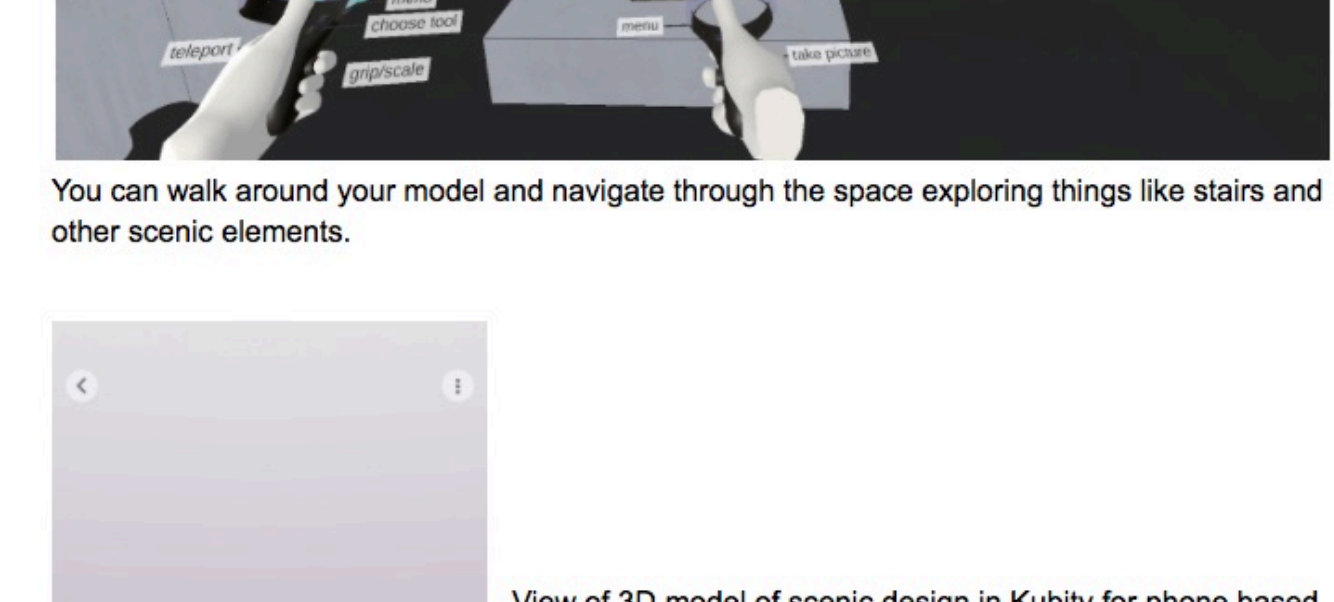
Oculus Quest and VR-Sketch entering into your model. Set Design: Arsenic and Old Lace by Todd F. Edwards.



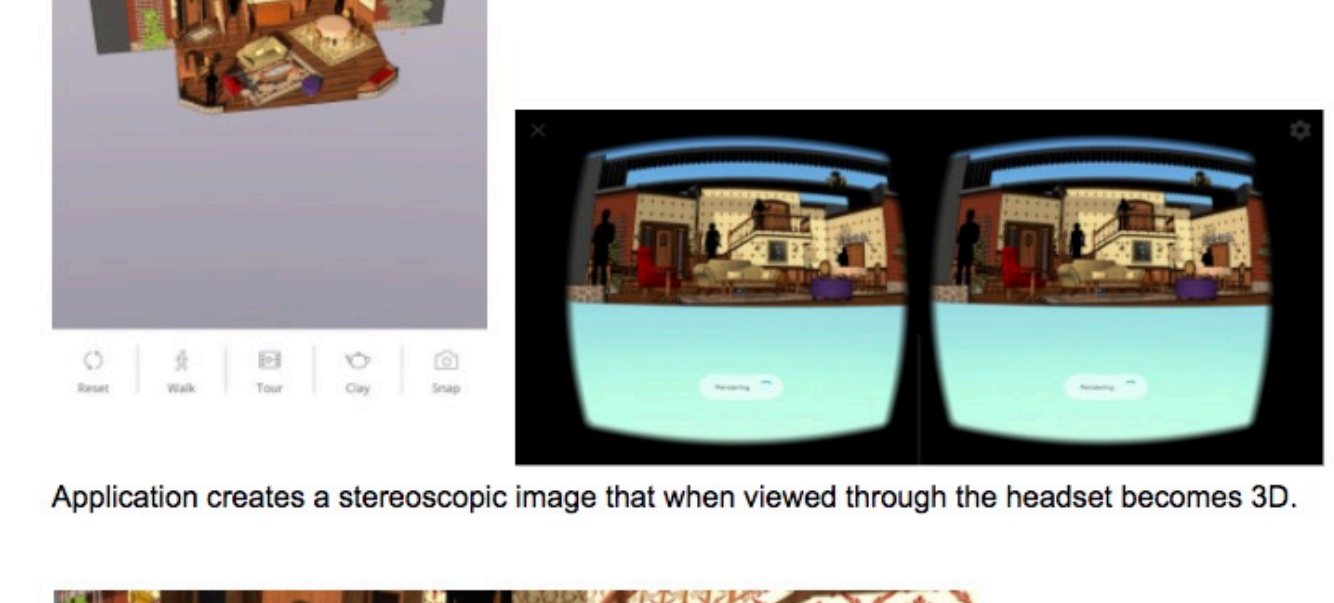
Walking around inside of your model in full scale. Allows you to check site lines, explore staging and traffic patterns.



Use the teleport tool to move around inside your set. Set Design: Mama Mia by Kurt Gough.



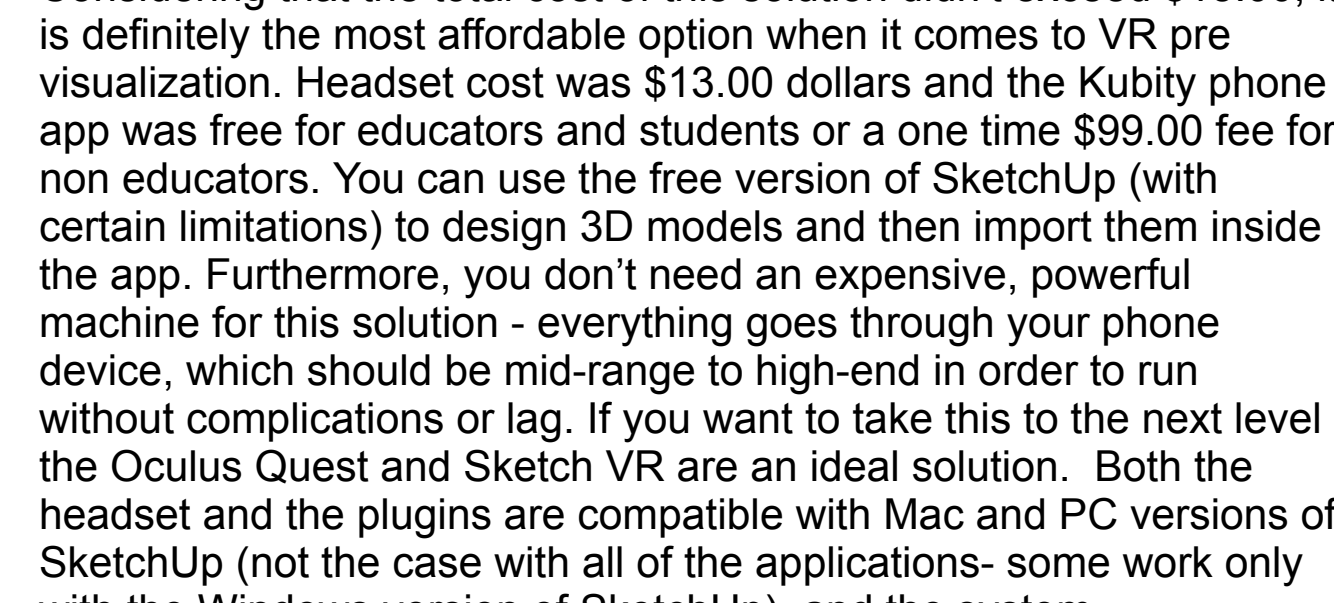
You can walk around your model and navigate through the space exploring things like stairs and other scenic elements.



View of 3D model of scenic design in Kubity for summer based VR exploration.



Application creates a stereoscopic image that when viewed through the headset becomes 3D.



3D walkthrough is more like a movie than an interactive experience as you can "jump" from predetermined scenes within your models.

In conclusion we set out to see if using VR for pre-visualizing designs for live performance was worth the cost of the equipment and the learning curve associated with its use. If your current workflow includes digital 3D models then this is a logical extension of your process. The immersive experience is exciting and really helps answer many of the questions that pop up through the design's evolution. While not as immersive and interactive, the phone based solutions make this type of technology accessible by most everyone. Considering that the total cost of this solution didn't exceed \$15,00, it is definitely the most affordable option when it comes to VR pre visualization. Headset cost was \$13,00 dollars and the Kubity phone app was free for educators and students or a one time \$99.00 fee for non educators. You can use the free version of SketchUp (with certain limitations) to design 3D models and then import them inside the app. Furthermore, you don't need an expensive, powerful machine for this solution- everything goes through your phone device, which should be mid-range to high-end in order to run without complications or lag. If you are to take this to the next level the Oculus Quest and Sketch VR are an ideal solution. Both the headset and the plugins are compatible with Mac and PC versions of SketchUp (not the case with all of the applications- some work only with the Windows version of SketchUp), and the system requirements are moderately low. The Oculus Quest is around \$400.00 and VR Sketch is free to students and educators or as low as \$6.00 a month for non educational access. The HTC Vive is a very nice option, but not worth the extra cost nor frustrations of added components and difficult setup. One thing we want to point out is a phenomenon known as VR sickness. This can make for a very unpleasant experience distracting you and taking your energies away from the actual design process. VR sickness is a form of motion sickness that some suffer while using VR equipment. There are things that can ease this like Dramamine or motion/morning sickness bands like Sea-Band or PSI Bands.

Epilogue... What is next? We are continuing our research into the use of VR in live performance and will be using Lidar scanning and photogrammetry to create more realistic and accurate models of performance venues and exploring how we can use VR to create content for production use and for directly contributing to the audience experience. [ ]

### Links to resources

- SketchUp-<https://www.sketchup.com>
- Oculus-<https://www.oculus.com>
- HTC-<https://www.vive.com/us/>
- Sidequest-<https://sidequestvr.com>
- VR Sketch-<https://vrsketch.eu>
- SentoVR-<https://www.sentoivr.com>
- IrisVR-<https://irisvr.com>
- Kubity-<https://pro.kubity.com>
- SimLab-<https://www.simlab-soft.com>
- EyeCADVR (Amazing rendering, extremely powerful computer to run)-<https://eyecadvr.com>
- ShapesPark (Web based)-<https://www.shapespark.com>
- InSpace-<https://www.inspacevr.com>
- PSI Bands-<https://www.psibands.com>

Link to an online presentation we made of our findings. [https://drive.google.com/file/d/1bR75aXicK7\\_5pJAc0bMIA9eJk36298/view?usp=sharing](https://drive.google.com/file/d/1bR75aXicK7_5pJAc0bMIA9eJk36298/view?usp=sharing)

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