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Getting up and running with virtual reality

Space and technology considerations

The University of North Florida (UNF) Carpenter Library opened its Virtual Learning Center (VLC) in March 2021. The primary purpose of VLC is to enhance student learning and support faculty instruction using virtual reality (VR). It took 19 months to renovate existing library space, select and set up the VR hardware, and collaborate with the university's Information Technology Services (ITS) department during the ongoing COVID-19 pandemic. The process of preparing the physical space may appear to be as simple as buying and configuring the computers and VR hardware; however, it does not illustrate the complete picture. This article discusses the choices we made for our implementation with a focus on renovation, equipment selection, setup, and initial operations. Other recent articles address broader concerns.[1]

Environmental scan

During our initial planning phase, we conducted an environmental scan seeking additional information about VR space setup and uses.

Within UNF, the Construction Management program had already started using VR to allow students and faculty to look at building models in an immersive space. They selected HTC Vive Pro VR kits for this purpose. The Vive Pro kit includes a head mounted display, hand controllers, and exterior tracking lighthouses. They were also experimenting with using Microsoft HoloLens for augmented reality (AR) applications. One application of AR for this department includes walking through a building site and being able to see visual representations of the plans versus the reality of how a site was being developed.

Externally, members of the implementation team visited two universities that have VR spaces. The first was Florida State University's (FSU) Innovation Hub, which has a wide array of collaborative and creative spaces independent of their library.[2] We were concerned about glass windows causing interference with the tracking of the VR components in the UNF space, since vendors have documented issues.[3] FSU has many windows in its space, and this alleviated our concerns, but we later discovered care must be taken with play areas very near windows. The University of Florida (UF) also has VR equipment that is loaned to affiliates, and they have computers set up to use the headwear in the Made@UF space.[4] Sam Putnam, former engineering librarian at the UF Marston Science Library, shared many experiences with us. He emphasized the need to trust students with the VR equipment rather than fear them damaging it.

Our implementation goal differs from the other neighboring institutions in that we will use the space for both general instruction and in supporting individual users. Existing literature demonstrates many educational uses for VR in higher education.[5] To accomplish this goal we needed a space that supported multiple VR stations.

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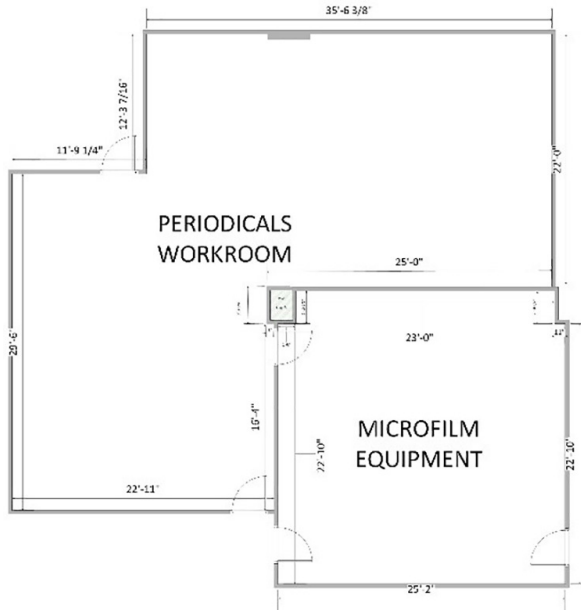
Renovation

The area chosen for renovation was formerly a periodicals workroom on the third floor of the library. This space was chosen because UNF no longer processes a significant amount of paper periodicals, and it was large enough to accommodate an instructional space. During the renovation phase, the plan was to deploy 16 computers with accompanying VR headsets in the former periodicals workroom and to use the microfilm equipment space for later expansion.

In addition to a new coat of paint, removal of cabinets, and new flooring, we addressed several other issues. This space was ill-suited to accommodate 16 computers, so data ports were installed. Electrical capacity was also a concern. Our selected computers' power supplies were rated at 850 watts, which is higher than a standard desktop. Planning had to ensure adequate power would be available to support the equipment.



Floor plan of space to be renovated.

The library worked with the UNF Campus Planning department, which collaborated with an architect and a general contractor to renovate the space. The architect determined that another egress door was needed to safely accommodate increased room capacity. The HVAC system was also evaluated to ensure that it was sufficient to service an instructional space rather than a staff workroom. An electrician added the necessary electrical capacity. The renovation was completed in September 2020.

VR equipment selection

After consulting with our ITS department and several UNF colleges, we developed the following goals.

First, we wanted to allow students to use the equipment to help create their own environments and software. The Construction Management department was actively using HTC Pro kits to build structures virtually. We knew there were potential uses for other students and majors to develop their own creations.

Second, we wanted to ensure we could operate a classroom of equipment in the same space simultaneously with positional accuracy and without interference. It was unclear if some equipment on the market would work in a multiple-headset environment. Reviews of inside-out tracking technology were mixed. A recent study measured the accuracy of tracking methods, and Steam VR outside-in tracking is the "most accurate consumer-grade solution."[6]

Third, we wanted any headsets that were for standing stations to be wireless to reduce any possible trip hazards.

Given the needs of the space and usage, the Vive Pro was selected over other headsets. Despite the Steam Index headset having better technical specifications, such as higher refresh rate, field of view, and resolution, the HTC headset has wireless capability. The wireless feature mitigates trip hazards in our space and was thus a deciding factor. Moreover, the index simply wasn't available in the volume we needed to outfit this space. In addition to the wireless capabilities, the tracking technology used by the Vive Pro is Steam VR tracking, which ensures high accuracy.

The acquisition of the HTC Vive Pro hardware was significantly more challenging than initially anticipated. The first equipment selection was made in November 2019, but the Vive Pro was discontinued

right before our purchase was finalized. At the time, HTC had a very extensive product range, and they chose to discontinue the Vive Pro in favor of their newer Vive Pro Eye line.[7] With the discontinuation of this line, the Vive Pro Eye became the best option.

Supporting hardware selection

In addition to the VR kits, we purchased three Vive wireless modules that needed adapters to function with the Vive Pro Eye headsets. The wireless option was important for our three designated standing stations. Three 55-inch displays were mounted above the standing stations. These allow observers who are not actively using VR to be able to see what the VR user is experiencing.

We also purchased a mobile touch display. This display can be used by faculty to instruct students and can also be used as a secondary VR display. VR equipment can be placed on the display cart for use as a mobile station for library events.

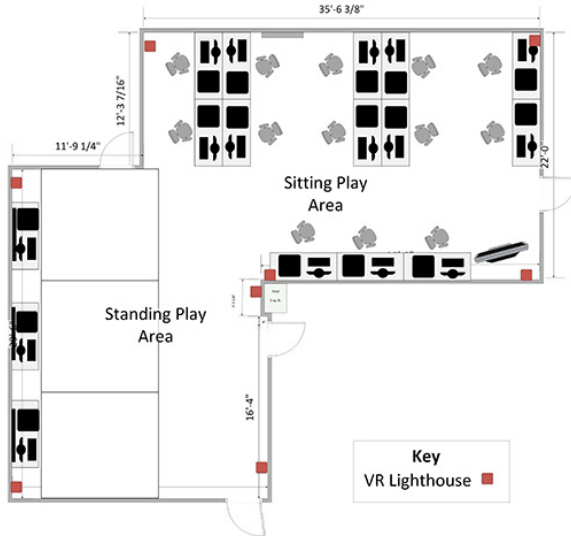
The computers we chose to use with our VR equipment were Precision 5820 Towers. We chose this PC primarily because the hardware was covered under the current four-year support agreement that our ITS department has with Dell. Additionally, the configuration we selected was VR ready.

Equipment setup

After renovation and equipment selection, it was time to set up the VR space. One of the most important considerations was base station setup. Please note that base stations are also referred to as lighthouses. The lighthouses are used to triangulate both the headsets and controller positions in the play area. Many products that have external tracking still come bundled with 1.0 lighthouses that are more limited than the 2.0 lighthouses. If a space is greater than five meters by five meters, then 2.0 base stations are required.

Vive indicates that individual play spaces need to be divided. The size limit for a 2.0 Steam tracking play area is ten meters by ten meters using four base stations.[8] VLC uses two large play areas with eight lighthouses to support the VLC space. Vive support indicated that:

"You'd need to make sure you had partitions and walls up. The partitions need to be made of material that is completely opaque to ~850nm IR light. The lasers that the base stations emit are pretty powerful and one possibility is that they're penetrating the partition or are bouncing off surfaces, such as the floor. IR light interacts with materials so differently than visible light that these types of issues can be hard to diagnose without knowing what types of materials are in your environment." We found this not to be true in practice for VLC and avoided the need to physically divide our space into two play areas. Originally the plan was to put physical dividers between our standing wireless play area and sitting wired play area. The headsets had no issue functioning with more than four tracking lighthouses in view. The setup of the lighthouses is shown in red.



Layout of equipment in VLC without barriers between play areas.

To minimize tracking interference and reduce UV light in the space, which can damage headset lenses, the exterior facing windows have semi-transparent shades. We discovered that interior windows can also cause tracking issues. Our primary concern was exterior windows due to sunlight, but windows themselves can cause motion tracking errors, since they can reflect IR light. At times we have tracking

issues on one standing station closest to an interior window. Adjusting the angle of the lighthouse minimizes this issue but does not eliminate it. Reducing the play area size to keep the play area two feet away from the interior window reduced issues significantly.

After library personnel set up the play areas, the computers were imaged by the ITS team. The computers have Deep Freeze software installed, so the operating system drive is not able to be modified. Steam VR programs are stored in a hidden unfrozen drive, which allows updates to run and users to load their own software, if needed. To manage library software licenses, we chose the Steam PC Café Program. We selected the configuration that allows lab users to access their own Steam accounts so they can use content they purchased. Another possible option allows only institution-purchased software to be used. This avoids the need to have users sign in with their own Steam accounts.

Opening and initial operations

VLC opened on March 4, 2021. Now that the space is operational, the library instructional team oversees the day-to-day operations, and the systems unit supports the space primarily by maintaining VLC's technology. Individual users can book stations up to seven days in advance via the Springshare LibCal seats module. The library requests that professors who wish to use the space for instruction provide three days' notice to reserve the whole lab.

To keep the headsets clean, which is especially important during the COVID-19 pandemic, student workers disinfect the headsets between uses. Student workers also provide initial VR orientations to new users and ensure users are staying within their defined play areas.

The UNF Campus returned to normal operations fall 2021, and there has been a significant increase in use of the space. From August 23, 2021, to September 22, 2021, 33 individual users have used our space.

More significantly, between July and September 2021 the virtual learning librarian has led four group sessions in the space: one group tour, two classes, and one workshop. Also, they hosted four research consultations and six faculty tours of the space. These sessions account for 64 individuals. The instruction team is working to integrate the space into various courses and foster faculty research using VR equipment.

Now that the space is seeing further use, this project feels like a success. It is enjoyable to witness the "wow" moments of users. For instance, a faculty member having their first VR experience provided an impromptu tour of the archeological site that their PhD thesis was based on. Librarians observed what the faculty member was experiencing via a wall-mounted display. As VLC use increases, we hope to see many more users have positive experiences in VR.

Notes

1. D. Gillian Ellern and Laura Cruz, "Hardware Is the Easy Part: The Gray Areas of Integrating VR in Libraries," *Computers in Libraries* 41, no. 2: 14–17, https://www.infotoday.com/cilmag/mar21/Ellern-Cruz—The-Gray-Areas-of-Integrating-VR-in-Libraries.shtml.

2. Florida State University, "Florida State University Innovation Hub," accessed April 30, 2021, https://www.innovation.fsu.edu/.

3. Valve, "Index Base Station & Lighthouse Tracking: General Troubleshooting," accessed December 18, 2020, https://support.steampowered.com/kb_article.php?ref=7897-DHKB-9990.

4. University of North Florida, "Made@UF," last modified January 8, 2021, https://guides.uflib.ufl.edu/made.

5. Jaziar Radianti, Tim A. Majchrzak, Jennifer Fromm, and Isabell Wohlgenannt, "A Systematic Review of Immersive Virtual Reality Applications for Higher Education: Design Elements, Lessons Learned, and Research Agenda," *Computers & Education* 147 (April), https://doi.org/10.1016/j.compedu.2019.103778.

6. Scott Hayden, "Vive Cosmos Rated Least Accurate Among Top Headsets in Controller Tracking Test," Road to VR, August 6, 2020, https://www.roadtovr.com/htc-vive-cosmos-accuracy-test-controller/.

7. Ben Lang, "HTC Discontinuing Vive Pro and Vive Focus in Favor of Newer Iterations," Road to VR, March 9, 2020, https://www.roadtovr.com/htc-discontinuing-vive-pro-and-vive-focus-in-favor-of-newer-iterations/.

8. Vive, "Setting Up a Wireless Multiuser VR Environment," accessed April 9, 2020, https://www.vive.com/us/support/vive-pro/category_howto/how-many-base-stations-can-i-use.html#:~:text=to%20Steam-VR%20Beta%3F-,How%20many%20Steam-VR%20Base%20Stations%202.0%20can%20I%20use%20in,x%2032%20ft%2010%20in).