The Concept and Possibility of an Everyday Virtual Reality Operating System
James Kraemer
CS-150 VRS
jkraemer@cs.tufts.edu

Abstract
Operating systems today are created for two-dimensional systems. Virtual reality is the most logical possibility to replace current systems. Virtual Reality must prove to be a useful alternative that offers a more powerful way of interacting with the computer. The VR operating system has special design considerations. To create the system would cost an extravagant amount of money. The VR operating system needs to merit the financial capital to build a functional prototype. Sufficient research is required to justify such a venture. The system must be designed to deal with a virtual world where the user is a participant and not the sole source of input. Current applications need to be transported to the new three-dimensional model. Alternatives to current applications can be created for the VR operating system that takes advantage of the more powerful system. Users would have to accept this as a new way of everyday computer interaction. A VR operating system offers special advantages but it is hindered by conceptual problems. These considerations must be addressed in VR systems to determine the probability of the success of the system. The conceptual system offered is a sufficient design scheme that demonstrates the pros and cons of a VR operating system to demonstrate to the reader the possibilities that are offered.

Introduction
Computers have become a natural part of everyday life. Interacting with a computer to write a report or work on a spreadsheet has become the standard. Typewriters are basically obsolete except to the old fashion users who are unwilling to change their ways. This report focuses on the next logical step from everyday PC use. The next evolution to standard interaction with a PC is to a standard interaction with a virtual reality (VR) system. The thought of no longer going to work and sitting down next to a PC is an inconceivable thought. Thirty years ago the thought of writing a document on anything else other then a typewriter was just as inconceivable. Obviously technology has not reached its peak, so it is unreasonable to say that interaction with a two-dimensional system is how it will be for centuries to come. Virtual reality seems to be the next logical step. The step from two-dimensional to three-dimensional will seem to the programmer of the system as more of a giant leap. The time and money to design such a system is huge. Research must be done in order to prove if interacting with a computer in three-dimensional is favorable to interacting with a two-dimensional monitor. A virtual reality operating system might not be accepted and it is crucial to determine if it ever can replace the PC on an everyday basis.

History
Ivan Sutherland, a graduate student at MIT, was the first to open the doors to virtual reality in 1965. Hardware technology has grown much since then. A true VR system
allows a user to look in any direction and updates the users view point. Such current systems are created through HMDs (Head Mount Displays) and CAVE (CAVE Automatic Virtual Environment) systems. Other VR systems can be displayed through a two-dimensional monitor. Systems like these are not true VR. An example of this is Fish Tank VR where the user sees a three-dimensional world through a two-dimensional window. Faster computers are allowing for useful virtual reality systems to exist. Virtual reality has proven useful in bio-medical applications. Virtual Reality is an excellent medium for simulations. Flight simulators are a good example of this. Simulators have proven that VR can be useful commercially. Commercial success leads to more development due to the possible capital in future applications. VR simulators are useful in recreating conditions that are essential to learn in. Using a monitor and a keyboard is not the best way to teach a pilot to fly an F16. Here virtual reality has succeeded in the past. Faster computers have opened the door for future advances. The movies have placed VR years in the future to the average person’s perceptions. The rendering of graphics is still slow and the more complex the scene the more difficult it becomes to render everything in real time. If the scene does not move in parallel with the user’s head “simulator sickness” may occur. Insufficient hardware and various problems have held back the introduction to VR to the everyday user. VR is a young field that with a shaky future. VR has not solidified itself as a replacement for the PC. It is a field with unlimited conceptual possibilities but little historical proof on its usefulness.

**Concept**

Virtual Reality is difficult and expensive to construct. Logical models must be created to predict where VR is useful. The concept of a VR operating system is a possible future for the direction of virtual reality. This report is offering a conceptual model of what a “virtual reality office” might look like. The chance to explore new ideas is way to see where VR is merited.

When you go to the office today the standard is to sit down at a PC. The two-dimensional monitor interaction has proven useful to users. Microsoft, Macintosh and Sun have created highly popular human interaction techniques that make their operating systems useable and useful. The WIMP (Windows, Icon, Mouse, and Pointer) interaction is implemented and has become standard for users. The goal is of this report is to offer an alternative.

A VR operating system would have a user strap on a HMD and enter a “virtual office”. In the environment there is access to applications and processes. This is similar to turning a computer on and entering the desktop. A virtual desktop would need the ability to get to files and to run programs. There are many possible ways for this to look like. Virtual reality strives to mimic the real world. So the logical simulation is to place the user in a virtual office at a virtual desk. Here they can access their programs and interact with the system. A virtual keyboard can be offered as an input device. The hand can be a pointer to complement the virtual mouse. With precise eye tracking the focus of the user’s
attention can even be a pointer. This system as a whole offers the user with total immersion into the computer.

Many standard applications and icons mimic real world things. For instance, files, folders, the recycling bin, windows and the clipboard are names of two-dimensional computer applications that have real world names due to their similarities with the object. These are real world objects that were transported to the computer because intuitively they were easy to understand. It only seems natural to visualize them in a virtual office. Whatever is on the clipboard can actually be on a virtual clipboard. The user picks up what is there with their hands and brings it to the desired destination. Files and folders can be represented in a file cabinet with actual virtual files in virtual folders. The virtual office will have one cabinet that can hold all the folders, sub-folders and files in memory. The user can flip through with their hands and find what is needed. What is no longer needed can be picked up, crumpled into a ball and thrown into the recycling bin. The system should do everything possible to mimic the real world.

The user can have a virtual CD player in the office and can choose song files to be played. The song files would look like a CD and can be placed into the virtual CD player. The same concept can be used for media files. The media file, depicted as either a DVD or cassette can be accessed by loading it into a virtual television. In this model, the user will be surrounded by the virtual simulations of the CD player and television as if immersed in an actual room. Pictures can be viewed as if they were a stack of developed photos. Many operating systems allow users to pick their own wallpaper. In the virtual office the user can design any type of room. The user can pick wallpaper paper for the room and have a grandfather clock in the corner or a digital clock on the desk to tell time. Emails would arrive in a virtual mailbox in the corner of the room and delivered in a sealed envelope. Having the user believe that they are immersed in a realistic simulation is a major goal of all VR systems.

Conceptually harder, will be the transfer of other computer applications into a VR system. Applications such as, word processors, spreadsheets and databases are created with for a two-dimensional platform. It is not impossible to create them in three-dimensional. The easiest way is simply display the programs on a virtual monitor. This seems like a waist of the three-dimensional environment. A word processor can be displayed on virtual sheets of paper. The user could pull out a blank piece of paper and begin typing. This seems like an appropriate way to mimic word processing. The actual look of a real sheet of paper that is separated from the monitor is limitation to the two-dimensional environment.

Certain two-dimensional user interaction components have proven extremely useful in current operating systems such as the use of windows. Since windows have proven so useful in the past it would seem reasonable to carry over the basic idea into the virtual office. The word “window” is two-dimensional. If windows were transported into the VR system they could be represented as cubes that are sitting on the virtual desk. To access the cube the user would touch it or pick it up and the cube would open up into the application.
Considerations in Designing the Virtual System

A true virtual reality system needs to be truly immersive. A believable environment needs to render proper three-dimensional cues and interactive three-dimensional graphics. Necessary hardware is important to submerge the user into the virtual environment. VR is dependant upon input and output hardware. The use of a HMD is a standard VR hardware component that simulates immersion. With the addition of data gloves the user can have a sufficient immersion into the system. The HMD gives the user approximately 120 degrees of vision. An advantage of VR is the amount of information that can be displayed to the user. Proper stereo is needed in the HMD. It would be beneficial for the CD player to become louder as the user approached the virtual sound source. Basically sound intensity decreases by the square of the distance from the source. Without proper sound the user loses the sense of actually being there. Many VR systems fudge the graphics to accurately render real time graphics. The virtual office is an operating system that should be exact. The information should be constant. There must be considerations on where graphics can be ignored so that the system is never displayed ambiguously or wrong. If a file is in a folder and the user is thumbing through the folder quickly, then all the files should be rendered. In an operating system there can not be room for shortcuts.

Another consideration is what senses should the output focus on. Most of the resources should be focused on visual graphics. Image processing of the system is vital to its value. With a HMD the images can be represented in stereo. This renders two different images for the left and right display. To make the system even more realistic eye tracking can be used as a source of input. The VR system can track the point of focus and use that as an input instead of a mouse click. Sound would be the next important sense to focus attention on. It would be desirable for the sound to become more intense as the user approaches the source. A slight sense of touch is an important focus of mimicking the real world. Most importantly, the sense of touch on the finger tips. Most users value the feel of interacting with a keyboard. If a small amount of pressure could be achieved through the data gloves then the user could be given a sense of pressing buttons. This would dramatically add to the immersion into the user’s virtual office.

In current operating systems a WIMP interaction is used. This has proven successful when the input is a keyboard and mouse. The input to a VR system is different. The user will be giving the system eye tracking input, data glove input and HMD input. The data glove can be separated into 10 different actions for the fingers. The head might be pointing one way and the eyes might be focused in the other direction. This input is continuous and probabilistic. A non-WIMP system would best utilize this system’s full potential.

If desirable, the VR operating system could be striped down to tokenize the input and take priority over different input channels. This would give the system a serialized queue of data that is necessary for a WIMP system.
Another design consideration is multiple threads. Multiple events make it difficult to implement a WIMP design. The virtual office would most likely have parallel asynchronous inter-threaded events. If physics is a permanent constraint then gravity should be applied to the virtual object. Dropping an object leads to another process of monitoring what happens to the object. The user might be dropping an object and pressing the play button on the CD player at the same time. These are parallel events that must occur simultaneously regardless of one another. If the virtual office is realistic enough then the dropping of an object onto a virtual keyboard should activate the keyboard. The user is no longer directing the system through explicit commands. The user has become a participant of the virtual office where the user’s actions are no longer the sole source of input. The object that fell on the keyboard is the object that entered the input, not the user.

**Advantages of a VR operating system**

VR must have merit in order to surpass a two-dimensional system. There needs to be certain advantages to VR to make it more desirable to the user. Most of what has been implied by this report has just been fancy three-dimensional versions of current applications. A VR operating system must have some advantages that make computing more powerful to merit its development. It cannot just be a three-dimensional version of a two-dimensional system. If that is true then the amount of energy to create a virtual office is not warranted. The key is to design the virtual office to be the more powerful alternative.

VR has certain advantages to two-dimensional displays. The field of vision is dramatically improved. The issue of space is a problem in two-dimensional applications. Toolbars and program options can take over the limited space meant for the main application. In a VR system the user has plenty of room to access the program. In the HMD there is approximately 120 degrees of vision. The VR world is 360 degrees and the HMD can access a larger portion of it. If a monitor tried to mimic the three-dimensional world it would only be able to capture 10-20 degrees of vision. The virtual office has the potential to display more active applications that are hidden in two-dimensional displays. Multiple screens can be visible to the user that would normally take too much room in a two-dimensional display. It would be comparable to having multiple monitors to increase the display range of system information in current operating systems.

In theory, a two-dimensional system is allowed an infinite plane of flat space to use. This has proven unusable and most operating systems do not allow the user to access the two-dimensional plane that is outside the monitors view. Humans lose that sense of space when allowed an infinite plane to work with. Information that is found outside the view of the monitor is forgotten or lost.

The main advantage to VR is it gives users a sense of space which is advantageous to searching. The system is limited to a 360 degree display around the user. A full rotation will return the user to the starting point which provides a sense of immersion. This allows for better searching and allows the system to utilize space that is not visible to the
user. For example, the system can permit the user to go in for a closer inspection of a
text document without the problem of losing the users orientation when they pull away.
It is difficult to find a sense of place when in a two-dimensional system. Searches in an
immersive environment tend to be easier when searching for items that are not there.
Redundant searches are avoided because the user has a better model of the space. The
system can utilize more space because the user is capable of determining the current
location in the simulation. With the addition of navigation aids the system can be
assured of the user’s ability to search throughout the system.

**Problems with a VR operating system**
The goal of the VR operating system is for a user to prefer a virtual operating system
compared to a two-dimensional operating system. The development time is not merited
if the public does not choose the virtual operating system for everyday use. It is hard to
conceive an office floor filled with HMDs rather then computer screens. This is not the
natural way of conducting everyday business. With a virtual desktop user information is
difficult to be displayed to a group. Two people can look at the same monitor but only
one person can wear a HMD. There would need to be additional HMDs for every group
member to enter the system. Additional HMDs are expensive. An alternative is a
monitor that displays what the user sees. A two-dimensional rendering of a virtual three-
dimensional environment might become confusing. All the advantages of the virtual
office would be lost to the additional viewers.

The current hardware to process this amount of data is not sophisticated enough. Years
of hardware development are needed to make a VR operating system and economic
alternative. The level of complexity of the system is crucial. The user should not find it
difficult to adjust to the three-dimensional environment. Searching for an item on a
grocery shelf might be difficult in a virtual world but to be an effective system the search
time should be the same.

Screens and two-dimensional monitors are easier to work with. There is no need to strap
on equipment. The interaction is more passive and less input intensive. The complexity
of the VR office is hard to learn. A three-dimensional rendering would be more complex
making the interaction with the simulation difficult to master. Psychologically, humans
might have a problem going into an office where all the employees are wearing HMDs.
This would change the entire social aspect of the everyday job which might possibly lead
to losing the benefits of team cooperation.

**Conclusion**
A virtual office can prove more intuitive since the system is modeled to mimic the real
world. The greater complexity to the system has the possibilities of giving experienced
users much more power. Tasks can be completed faster and in parallel. Monitors have
proven to be a powerful medium to interact with computers. Older generations could
never have imagined everyday interaction with computers would become so common
place. Predicting the next generation of human-computer interactions is difficult to
foreshadow. Using virtual reality is a power alternative. Slowly introducing VR operating systems to the next generations is the only way immersive systems can take the place of two-dimensional systems. The current public is set in its ways and it would be too difficult to change to a new way of everyday work methods. By slowly letting VR systems seep into everyday use, one day VR operating systems have the opportunity to become the standard.

**Articles:**

1) Exploration of large image collections using virtual reality devices; Robert van Liere and Wim de Leeuw; *Proceedings of the workshop on new paradigms in information visualization and manipulation in conjunction with the eighth ACM international conference on Information and knowledge management*, 2000, Pages 83 - 86

2) Quantifying immersion in virtual reality; Randy Pausch, Dennis Proffitt and George Williams; *Proceedings of the 24th annual conference on Computer graphics & interactive techniques*, 1997, Pages 13 – 18

3) Interface design for inducing and assessing immersion in virtual reality; Michael S. Miller, Deborah M. Clawson, Marc M. Sebrechts and Benjamin A. Knott; *Proceedings of the conference on CHI 98 summary: human factors in computing systems*, 1998, Page 343

4) Immersion in desktop virtual reality; George Robertson, Mary Czerwinski and Maarten van Dantzich; *Proceedings of the 10th annual ACM symposium on User interface software and technology*, 1997, Pages 11 - 19