

Progress Report for Noctilucent VR

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I. PROJECT RECAP

Noctilucent VR will allow users to view and manipulate point-cloud data in virtual reality. It will be a free and open source software solution that draws upon several existing open source frameworks in order to display point cloud data via most virtual reality headsets. In addition, Noctilucent VR will accept user in order to measure and manipulate the point-cloud data from within the virtual reality environment. Our goals for Noctilucent VR are as follows:

- 1) To run on the Windows operating system
- 2) To display point-cloud data in a wide range of virtual reality headsets
- 3) To allow the measurement and manipulation of said data in real time
- 4) To display said data at a framerate and detail level suitable for virtual reality

II. PROJECT STATUS

1) *Fall Term:* As of the end of Fall Term, Noctilucent VR has barely begun. We have checked and re-checked our design, and picked out the software frameworks that work best for the intended use of our project. With any luck, we will begin Winter Term prepared to start on the project without further delay. Our current choice of point-cloud viewing software is CloudCompare, though this may change in future depending on our needs. Potree Viewer is an attractive alternative, but we will not know which suits our needs more until we do a closer examination next term. OSVR is currently our virtual reality solution of choice, and barring any unforeseen developments in technology, it will remain ideal to our purposes. Our current status is: highly prepared.

2) *Winter Term: Week 6:* We are currently at the end of week 6. As of right now we are stuck on the OpenGL demo portion of our project. For more details view the problems section. We are currently working on creating an OpenGL VR Point Cloud viewer. To accomplish this task we are planning to take an existing OpenGL VR program and insert our cloud viewer code. Additionally to this, we are also working on modifying the Oculus VR support that exists inside of Cloud Compare to be more robust and support OSVR. On top of that we are also looking into WebGL as a potential alternative to Cloud Compare.

3) *Spring Term: Week 6:* As of Week 5 of Spring term, Noctilucent VR has been completed in time for the Engineering Expo. We have created a virtual-reality extension for Potree Viewer that displays the data in a stereoscopic 3D view. We are working on adding head tracking and orientation for the OSVR HDK, but the software currently supports the Google Cardboard.

III. PROBLEMS

1) *Fall Term:* As work has not yet begun we have not yet run into any problems, however there are some potential problems on the horizon that will need to be addressed. The main problem that we foresee in the future is whether or not CloudCompare will be capable of rendering large point clouds in VR. Several other people who have attempted a similar project with cloud compare have found that CloudCompare showed stress and rendering issues with VR. Because of this issue we will need to put time into figuring out if CloudCompare is even capable of handling this project. In the event that CloudCompare is incapable of handling this issue we will need to do one or two things. The first option is we implement Octree datastructures in CloudCompare. This solution could work as other, not Open Source, cloud viewing softwares utilize Octrees and have superior performance. The problem with this solution is that it could be timely. An alternate solution is to create an auxillary program that operates separately from CloudCompare. Ideally neither of these approaches will be necessary but it is something that we need to think about.

2) *Winter Term: Week 6:* As was mentioned in the Winter Term Week 6 section, we are run into a couple issues with the OpenGL demo we wanted to make. Unfortunately VR is a very poorly documented field, this includes peoples custom made demos. The demo's people have made require a number of dependencies to actually work, but the process of installing them all and just trying to get everything to work is proving quite troublesome. At this point we really just need to move on from this demo because it's sucking up a ton of time and we could be doing something better elsewhere.

3) *Spring Term: Week 6:* Our only problems this term were in finishing our plugin before the code freeze of week 4. We still have some problems getting Potree Viewer to display in the OSVR HDK, but that is a problem on the OSVR end, and one we plan to address. Other than this, there is a minor visual glitch in the current release of Potree viewer that causes an odd vibration of the data set. This could cause nausea, but it is nothing we can address, as the problem is with Potree Viewer itself. It was never a problem with previous versions, so it will most likely be fixed in the next release.

IV. WEEKLY ACTIVITY SUMMARY

A. Fall Week 3

On our first week, we met our client (Matt O'Banion) and were introduced to the project and its goals. We viewed the current setup, and discussed what the end result would look like. We set up weekly meetings at a time that worked for all of us (1400 on Tuesdays), and have stuck to that time since. We were introduced to an issue that may come up to plague us later, namely that CloudCompare may not be capable of rendering large-scale point clouds at a framerate that works for VR. CloudCompare's creator offered to work with us to remedy this issue, so we shall see.

B. Fall Week 4

Nothing whatsoever of note occurred this week, aside from writing an abstract for our project and brainstorming good names. We had a slight scheduling hiccup near the week's end, but we addressed it and do not anticipate more problems in future. Mr. O'Banion was out-of-town this week, so we decided not to meet.

C. Fall Week 5

We began writing the Requirements Document this week, and met with Mr. O'Banion to discuss a schedule of deliverables for the term and align our schedules with his. We learned of several alternatives to the proposed software frameworks that we could use if necessary.

D. Fall Week 6

Once we had finished interpreting the IEEE-1998 standard, we were able to finish up the Requirements Document and planned to start in on the Technology Review on week 7. The testing setup in the Geomatics lab began acting up when we tried to get the positional tracking camera to work with it.

E. Fall Week 7

We divided up roles for the Technology Review, and researched our alternatives throughout most of the week. Mr. O'Banion was quite helpful, and pointed out a number of lesser-known and in-development programs that we probably would not have found otherwise. Once the Technology Review was submitted, we began deciphering the IEEE-1016-2009 standard. It took nearly twice as long to interpret as the IEEE-1998 standard, as it was quite a bit longer and had a number of extraneous sections that needed to be weeded out.

F. Fall Week 8

We laid an outline of the Design Document this week, and set up the required section headers. I managed to isolate the IR tracking issue and confirm that the hardware was not at fault.

G. Fall Week 9

This week Mr. O'Banion left for New Zealand to run Lidar scans on the results of the recent earthquake, and that combined with the long Thanksgiving weekend meant that very little got done.

H. Fall Week 10

We finished up the Design Document at long last. The actual writing took very little time at all, once we knew what we were doing. Mr. O'Banion was still in New Zealand, and was unavailable to sign the Design Document. We began the Progress report on Friday, eager to be done for the term.

I. Winter Week 1

We met early in the week to try and get all the VR headsets working. We were partially successful in this effort, but are still unable to run anything but the official OSVR Palace Demo. We also began working on getting a workable OpenGL demo. Josh tried to create something himself but it didn't ultimately end up being as simple as previously thought. From here we looked into already existing demos.

J. Winter Week 2

We started looking into some engines and things would be necessary to get a working demo. We began to have serious doubts as to the feasibility of CloudCompare due to the "second pass" it uses when rendering point clouds. We also began some working figuring out how we wanted the UI to be structured.

K. Winter Week 3

This week we found some OpenGL demos that exist inside of OSVR already. The next steps became looking into how to compile and get these demos working. The goal was that once we got these demos working we would inject our code and it would work. On top of this we set up the dev environment for Cloud Compare.

L. Winter Week 4

This week we spent just trying to get something to compile. Our goal was to create a working cube in VR. We began to consider WebGL as one of our possible options due to the WebVR project. It would be far easier for the user to setup than CloudCompare.

M. Winter Week 5

We continued working on trying to get a working demo. There was a family emergency this week and one of our members needed to go home, so we were a bit stalled this week.

N. Winter Week 6

This week we continued trying to get something to compile. We also worked on our Progress Report, Revisions, and Presentation.

O. Winter Week 7

After consultation with our client, we chose to switch the focus of our project from CloudCompare to Potree Viewer. It required another switch in focus, to WebGL. We committed to developing a virtual reality plugin for Potree Viewer using the experimental WebVR API.

P. Winter Week 8

This week we familiarized ourselves with WebVR and discovered an essential file named three.js. Getting this file to work with Potree Viewer soon became our highest priority.

Q. Winter Week 9

We finally got around to removing the CloudCompare fork from our Github this week, and continued working with three.js to create a VR mode for Potree Viewer that could be activated at the press of a button.

R. Winter Week 10

After several promising starts, we ended up having to reset to square one this week. Problems with version conflicts led to us to move to a completely different version of three.js and switch between several different browsers.

S. Winter Week 11

This week we took to finish up our documentation before the break. We met several times to record for the final presentation.

T. Spring Week 1

In the first week of Spring we focused on getting the viewer component of Potree Viewer working in the headset. Taylor was in Canada this week, so we were a man short.

U. Spring Week 2

The logistics of expo was this week's concern. We realized that it would not be possible to run a VR demo at expo due to health and safety concerns, and scaled back our plans.

V. Spring Week 3

We debated taking an Incomplete grade this week, and decided that if we couldn't get the project working over the weekend we would ask for one. Fortunately for us, we were able to get it working in a limited state over the weekend.

W. Spring Week 4

We managed to get our demo to the state where it satisfies most of what we set forth in our Requirements document in Fall term. We added a README and further documentation before the code freeze.

X. Spring Week 5

This week we spent trying to get the code working for OSVR specifically, but we weren't sure whether it was our code or OSVR that was failing. We were unsuccessful this week, but not for lack of trying.

Y. Spring Week 6

This week we spent on documentation, recording for our midterm presentation and writing this.

V. RETROSPECTIVE

TABLE I
NOCTILUCENT VR RETROSPECTIVE

Positives	Deltas	Actions
Made clean problem statement	Get practice with OSVR	Finish OSVR Demo
GitHub set up		
Decided on requirements		
Decided on technologies used		
Created design for future		
Met with client weekly		
Experienced the current setup of 3D TV		
Experienced OSVR headset with small demo		
Divided the project into parts		