

Project Spearhead

Post Mortem - Art Tests

Note: The testing done by the Spearhead team is by no means scientific. We aren't researchers, we're game designers attempting to learn as much about a new device as possible in a 6 week crunch period. As a result much of our data is incomplete and many of our conclusions rely on anecdotal evidence. Please feel free to disagree with our conclusions or better yet, continue our testing and refine our methods and results.

Overview

The Oculus Rift is unlike any display on the market today. Not only does it (at least in it's current 'dev kit 1.0' iteration) suffer from a limited resolution, just 1280x800 total or 600x800 per eye; but it also has to contend with the fisheye effect forced on it by its lenses. Another issue that must be taken into consideration is that the 3D effect often makes it difficult for the user to calibrate the device just right, leaving them with a slightly blurry or out of focus image. Because of these limitations we decided to investigate exactly what was visually possible when designing for the Oculus. Each of these tests would be completely subjective and the data would be gathered directly from the users. Our first experiment was the Color Test which dealt with the peculiar situation where large amounts of certain colors used on the Oculus would cause discomfort in the user. Our second test focused on how small you could make text on the Oculus before it became unreadable, furthermore it explored different font types and whether they would impact readability. The next issue we tackled was 'text placement'; basically we tested which areas of the Oculus's screen would cause problems for text. And lastly we experimented with several styles of textures and whether or not they would affect perception in a 3D environment.

Test #1

Color Test

Hypothesis:

Certain colors at certain brightness levels will cause an Oculus user discomfort.

Description:

The user will be testing Gray, Blue, Teal, Green, Yellow, and Red variants all at 5 different levels of saturation and brightness. Each color will be placed on a plane in Unity in front of the camera. A paragraph of text will be applied to the plane and the test subject will be asked to read it. Different shades of gray will be used to ensure the text contrasts the base color properly. The user will report on whether the background color causes them discomfort and this will be recorded.

AS FAST AS THOU SHALT WANE, SO FAST THOU GROW'ST
IN ONE OF THINE, FROM THAT WHICH THOU DEPARTEST
AND THAT FRESH BLOOD WHICH YOUNGLY THOU BESTOW'ST
THOU MAYST CALL TIME WHEN THOU FROM YOUTH CONVEYEST
HEREIN LIVES WISDOM, BEAUTY, AND INCREASE;
WITHOUT THIS FOLLY, AGE, AND COLD DECAY;
IF ALL WE WERE MANDERD SO, THE TIMES SHOULD CEASE
AND THREESCORE YEAR WOULD MAKE THE WORLD AWAY
LET THOSE WHOM NATURE HATH NOT MADE FOR STORE
HARSH, FEATURELESS, AND RUDE, BARRENLY PERISH;
LOOK WHOM SHE BEST ENDOWED, SHE GAVE THE MORE
WHICH BOUNTIFUL GIFT THOU SHOULDEST IN BOUNTY CHIEF
SHE CARVED THEE FOR HER SEAL, AND MEANT THEREBY
THOU SHOULDEST PRINT MORE, NOT LET THAT COPY DIE

FOR SHAME DENY THAT THOU BEAR'ST LOVE TO ANY,
WHO FOR thy SELF ART SO UNPROVIDENT.
GRANT, IF THOU WILT, THOU ART BELOVED OF MANY,
BUT THAT THOU NONE LOVE'ST IS MOST EVIDENT:
FOR THOU ART SO POSSESSED WITH MURDEROUS HATE
THAT 'GAINST THY SELF THOU STICK'ST NOT TO CONSPIRE
SEEKING THAT BEAUTIFUL ROSE TO RUINATE
WHICH TO REPAIR SHOULD BE thy CHIEF DESIRE.
O CHANGE THY THOUGHT, THAT I MAY CHANGE MY MIND;
SHALL HATE BE FAIRER LOGGED THAN GENTLE LOVE?
BE, AS thy PRESENCE IS, GRACIOUS AND KIND,
OR TO THYSELF AT LEAST KIND-HEARTED PROVE:
MAKE THINE ANOTHER SELF FOR LOVE OF ME,
THAT BEAUTY STILL MAY LIVE IN THINE OR THINE.

FOR SHAME DENY THAT THOU BEAR'ST LOVE TO ANY,
WHO FOR THY SELF ART SO UNPROVIDENT.
GRANT, IF THOU WILT, THOU ART BELOVED OF MANY,
BUT THAT THOU NONE LOVE'ST IS MOST EVIDENT:
FOR THOU ART SO POSSESSED WITH MURDEROUS HATE
THAT 'GAINST THY SELF THOU STICK'ST NOT TO CONSPIRE
SEEKING THAT BEAUTIFUL ROOF TO RUINATE
WHICH TO REPAIR SHOULD BE THY CHIEF DESIRE.
O! CHANGE THY THOUGHT, THAT I MAY CHANGE MY MIND;
SHALL HATE BE FASTER LODGED THAN GENTLE LOVE?
BE, AS THY PRESENCE IS, GRACIOUS AND KIND,
OR TO THYSELF AT LEAST KIND-HEARTED PROVE:
MAKE THINE ANOTHER SELF FOR LOVE OF ME,
THAT BEAUTY STILL MAY LIVE IN THINE OR THINE.

IS IT FOR FEAR TO MEET A WIDOW'S EYE,
THAT THOU CONSUM'STST THY SELF IN SINGLE LIFE?
Ah! IF THOU ISSUELESS SHALT HAVE TO DIE,
THE WORLD WILL WAIL, THINE LIKE A MARRIED WIFE;
THE WORLD WILL BE THY WIDOW AND STILL WEEP
THAT THOU NO FORM OF THESE MUST LEFT BEHIND,
WHEN EVERY PRINATE WIDOW WELL MAY KEEP
BY CHILDREN'S EYES, HER HUSBAND'S SHAPE IN MIND:
LOOK WHAT AN UNTHRIFT IN THE WORLD DOETH SPEND
SHIFTS BUT HIS PLACE, FOR STILL THE WORLD ENJOYS IT
BUT BEAUTY'S WASTE MATH IN THE WORLD AN END,
AND KEPT UNUSED THE USER SO DESTROYS IT,
NO LOVE TOWARD OTHERS IN THAT BOSOM SITS
THAT ON HIMSELF SUCH MURDEROUS SHAME COMITS

MUSIC TO HEAR, WHY HEAR'ST THOU MUSIC SADLY?
SWEETS WITH SWEETS WARE NOT, JOY DELIGHTS IN JOY
WHY LOV'ST THOU THAT WHICH THOU RECEIVEST NOT GLAD
OR ELSE RECEIVEST WITH PLEASURE THINE ANNOY?
IF THE TRUE CONCORD OF WELL-TUNED SOUNDS,
BY UNIONS MARKED, DO OFFEND THINE EAR,
THY DO NOT SURELY CHIDE THESE, WHO CONFOUNDS
IN SINGLENESS THE PARTS THAT THOU SHOULDST BEAR
MARK HOW ONE STRING, SWEET HUSBAND TO ANOTHER
STRIKES EACH IN EACH BY MUTUAL ORDERING;
RESEMBLING SIRE AND CHILD AND HAPPY MOTHER,
WHO, ALL IN ONE, ONE PLEASING NOTE DO SING:
WHOSE SPEECHLESS SONG BEING MARY, SEEMING ON
SINGS THIS TO THEE: THOU SINGLE WILT PERVE NON

All of the different colors that were used during this test.

Results:

Color	# of users who found it uncomfortable (of 12)
Blue	
000033 (Darkest)	0
000066	1
0000aa	6
0000ff	2
969bff (Lightest)	2
Gray	
333333 (Darkest)	0
666666	1
aaaaaa	3
dddddd	2
ffffff (Lightest)	3
Green	
003300 (Darkest)	4
006600	6
00aa00	3
00ff00	5
79ff92 (Lightest)	4
Red	
330000 (Darkest)	3
660000	6
aa0000	8
ff0000	7
ff7f76 (Lightest)	4
Teal	
003333 (Darkest)	1
006666	3
00aaaa	4
00ffff	9
aaffff (Lightest)	3
Yellow	
333300 (Darkest)	1
666600	3
aaaa00	5
ffff00	7
fffe71 (Lightest)	4
	3.67 Average

The standard deviation of the data set was 2.28 so with rounding any color that received 6 or more reports of uncomfortable is considered to cause issues with Oculus users; any color that received less than 1.5 reports, so 1 or 0 reports is considered to be a great color to use with the device.

Test #2

Font Size and Type

Hypothesis:

Compared to a normal screen at the same resolution as the Oculus, font choices and sizes will be more limited.

Description:

The user will be shown a series of text walls, each with a different sized font on it. All the letters are spaced equally and are written in Droid Sans on a 1280x800 texture and placed on a plane in unity so that the entire texture is just visible to the Oculus Unity camera. The font starts at 100pt and shrinks to 10pt. The user will read off the letters to the best of their ability and the accuracy will be recorded. The second part of this test is a single texture, 1280x1280 with several fonts on it. Each font is written at 30pt size and the plane will be placed at the same distance as the Font Size plane. The user will attempt to read each sentence and report whether they are struggling to read the words, unable to make sense of the letters, or can read everything with ease. The Oculus camera will scroll vertically so that each sentence will be exactly in the center of the Oculus Camera when being read, this will eliminate any blur from the OR's fisheye lenses.

Results:

Font Size	Average	Percent Missed
100pt (Out of 15)	15.00	0.00%
75pt (Out of 16)	16.00	0.00%
50pt (Out of 24)	23.83	0.69%
30pt (Out of 21)	20.83	0.79%
20pt (Out of 29)	27.50	5.17%
15pt (Out of 14)	11.17	20.24%
12pt (Out of 18)	12.08	32.87%
10pt (Out of 12)	3.08	74.31%

Font Type	# users who had trouble reading (out of 11)
Droid Sans Mono	2/11
Times New Roman	1/11
Arial	0/11
DJ Gross	7/11
Alien Encounters	2/11
Papyrus	1/11
Old English Text	0/11
Dunkin Sans	0/11

Test #3

Text Placement

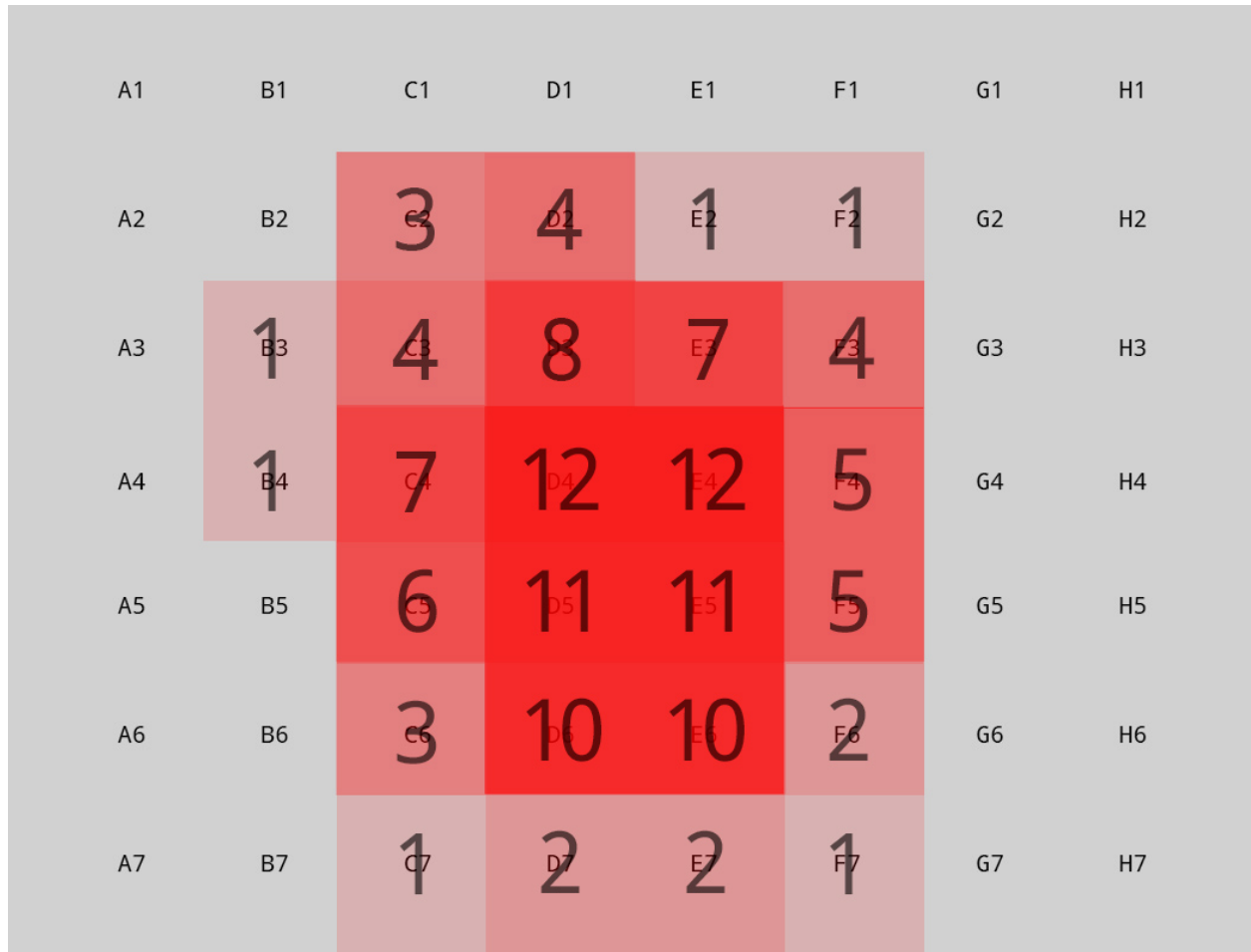
Hypothesis:

Tilting the plane on which text lies towards the Oculus's in-game camera makes it easier to read text nearer to the edge.

Description:

The user will first view a grid of 20pt text on a 1280x800 texture (again placed at the same distance of the last 2 tests) and report on the coordinates that they can read comfortably. The grid will then be tilted towards the bottom of the in-game camera. The user will be asked what coordinates they are able to read comfortably on the new grid.

Results:



Number of users (out of 12) that reported they could read each coordinate.

A1	1	2	2	2	2	1	H1
A2	4	3	5	6	3	2	H2
A3	3	7	8	7	7	2	H3
A4	3	8	11	12	8	2	H4
A5	2	8	12	12	7	1	H5
A6	1	6	11	11	5		H6
A7		1	5	5	1		H7

The results from the same test after the bottom of the plane was pivoted towards the camera (the #5 row was the pivot point and stays the exact same distance in both tests).

Test #4

Textures and Perception

Hypothesis:

Due to the Oculus's 3D nature some textures will cause issues with a user's perception of distance.

Description:

The user will be placed in a virtual room textured with a specific art style. 5 units in front of them will be a block 1x1x1 units. 100 units in front of them will be another block. On key press a third block will spawn in the middle (at a random distance between 10 and 90 units from the user) and the user will be asked to guess the distance the block is away from them. Then the next texture will be applied. They will not be made aware of how far away the middle blocks actually were until the end. The four styles of textures are Borderlands, Counter-Strike, Pixel Art, and Doodle Art.

Results:

Twelve users completed this test and these are the averages of the guesses, the actual distance of the spawned block, and the averages of differences.

	Borderlands: Guess 1	Borderlands: Actual 1	Difference	Borderlands: Guess 2	Borderlands: Actual 2	Difference
Averages	51.25	46.08	12.50	44.17	38.67	7.67

	Counter-Strike: Guess 1	Counter-Strike: Actual 1	Difference	Counter-Strike: Guess 2	Counter-Strike: Actual 2	Difference
Averages	40.50	34.42	9.08	44.17	35.50	10.50

	Pixel Art: Guess 1	Pixel Art: Actual 1	Difference	Pixel Art: Guess 2	Pixel Art: Actual 2	Difference
Averages	57.50	51.08	10.08	51.67	42.25	9.92

	Doodle: Guess 1	Doodle: Actual 1	Difference	Doodle: Guess 2	Doodle: Actual 2	Difference
Averages	55.17	44.25	11.75	71.83	62.33	13.00

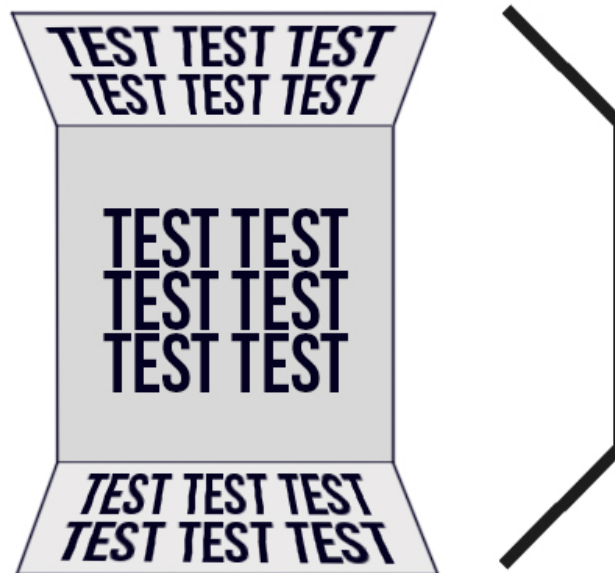
Art Tests Conclusion:

The main point of these tests was to learn practical lessons about the nature of creating art for the Oculus Rift. The first of these tests focused on colors and whether or not certain colors would cause discomfort for users to view on the Oculus. We found that a few colors caused enough users discomfort to warrant caution when using them in excess. These colors are listed above in detail, but we will state generally that the problem lies in any color of extreme saturation. Light and dark colors typically did not cause any problem, especially towards the extreme ends of the brightness values. However, when a color is fully saturated it can cause problems. As for hues, red was the worst of all with three levels of brightness causing issues with at least 6 users. And while we actively avoid the 'problem colors' we've listed, we want to point out that our testing was using an entire wall of each color. Using red for a few game objects is not an issue, but we'd recommend staying away from red menu and start screens.

Font size and type was a test that is possibly only relevant while the Oculus is stuck at 1280x800 resolution. That being said we still learned that small font is possible, but the cut off size is a steep curve. We started to have issues around 20pt font, but they were minimal. At 15pt font the users were missing every 5th letter. In regards to font types, no one font was

considered to be unreadable, but more intricate fonts caused issues for the users. During our work with our prototypes we've learned that kerning plays an important part in whether or not a font is readable. If the letters are too close together the font will be unreadable on the Oculus. We've found that it's best to make the text look just a little bit too spread out on our regular monitors, this usually results in readable text on the Oculus.

More importantly than text size and type is the placement. Our third art test found that usable area on the Oculus for displaying text is very small. For absolute reliability you want to stay to a central area with a radius of about 12% of the device's total FOV. You could double that without too much of an issue, but text outside that second range is going to be completely unreadable. This means that the standard way of approaching UI (placing vital information around the edge of the screen) is no longer a viable way of designing UI. We have found that if you tilt the plane on which the UI lies in relation to the bend of the Oculus's fisheye lenses you can push the text nearer to the edge of the display while still maintaining readability.



A representation of how best to display textures on the Oculus. The texture planes near the edge of the display should be tilted towards the in-game camera.

One thing we didn't manage to test was creating curved text planes that exactly offset the fisheye lens curve. We hypothesize that this would increase readability on the edge of the display even further, but unfortunately we did not have time to test this.

Our final art test attempted to find a correlation between certain types of textures or art styles and a drop in the accuracy of a user's depth perception. Between the four styles we tested there was almost no change in accuracy. From what we can tell your depth perception is completely unaffected by texture on the Oculus Rift. However we did discover that textures that are rather intricate succumb quickly to aliasing on the Oculus's display. The low resolution and fisheye effect combine to cause issues with anything but simple types of art styles.

