



Game Accessibility: Practical Visual Fixes From EA's Madden NFL Franchise

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What Is Accessibility?

- Disability is a mismatch between a person and their environment
- Accessibility is the correction of this mismatch





Accessibility Is Also A Mindset

- It involves all lifecycle stages
- It's cheaper to plan it in than tack it on as an afterthought
- Small changes can have a big impact on your audience





Audience – US Numbers

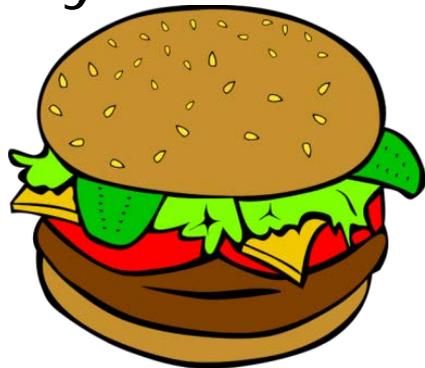
- 19% of US population have a disability
- 25% of today's 20 year olds will be disabled by retirement
- 25 million are visually impaired
 - Plus 10.5+ million men are color blind





Audience

- 60% of able-bodied people use accessible features, when they are made available
 - A muted TV to avoid waking a baby
 - Enlarge captions on a small TV
 - Not wearing eyeglasses
 - Occupied hand





Accessibility Settings

- Many games have accessibility settings already, such as volume control
- Watermarks can be used to indicate if visual settings are turned on 
- Settings can prevent altering the original game experience while still allowing for a more expanded audience





Accessibility Settings





Considering Size

- Text and icons should be large, legible, and have sufficient contrast
 - Minimum 4.5:1 contrast ratio, 7:1 ideal
 - 1080p text ideal: 30 pixels tall, 4 pixels wide
- Tools & resources linked on appendix slides





Enlarge Off





Enlarge On





Default Dynamic Kick Meter





Large, Fixed Position, Kick Meter





Reception

As a visually impaired person, this may be the best news from EA on Madden before CFM.

[@ea_accessible](#) I want to thank you for these additions. I've struggled with telling the difference between circle and square, but no longer.

Great addition. I don't have the best eyes anymore so this makes me very happy.

[@EAMaddenNFL](#) I'll be using them new features even though I didn't have a problem before

[@ea_accessible](#) now my cousin can't use the excuse of I didn't see the icon pop up! [#BigIcon](#) [#Madden17](#)





Power of Post-Processing

- Common visibility features can be implemented across the entire screen, without requiring asset changes
 - Colorblind filters
 - Brightness
 - Contrast

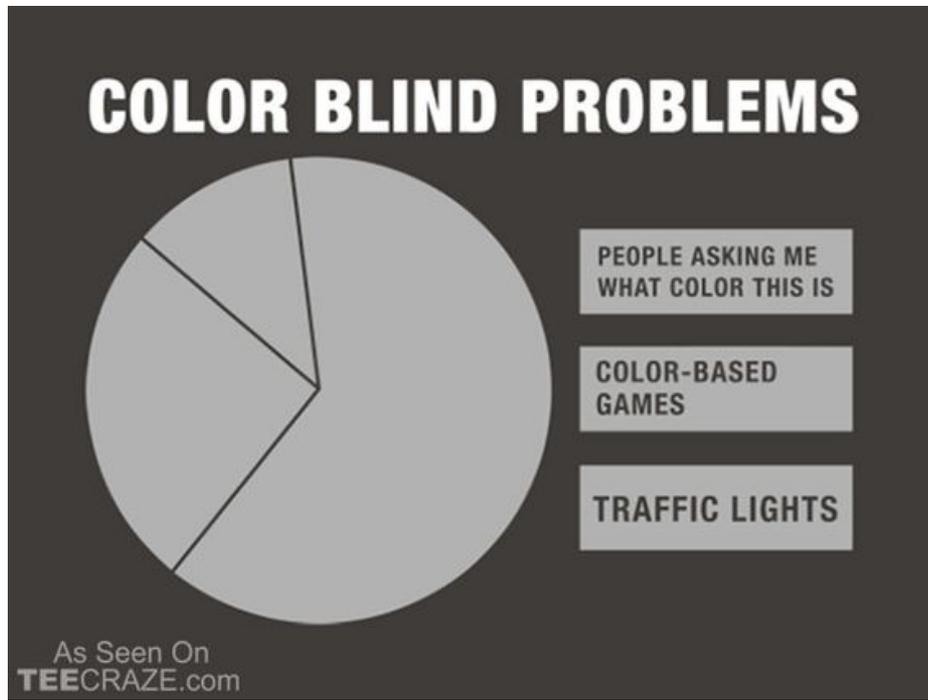




Color Blindness

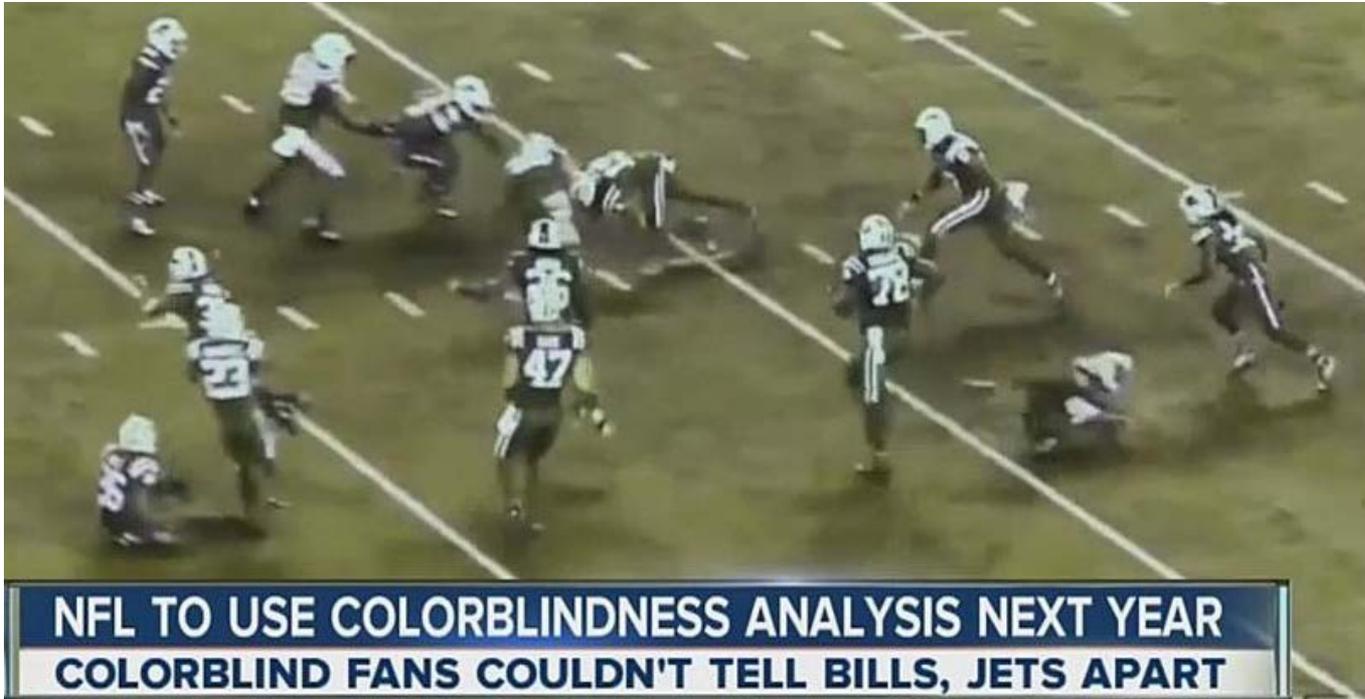
Affects:

- 1 in 12 men
- 1 in 200 women
- Over half a million Madden users



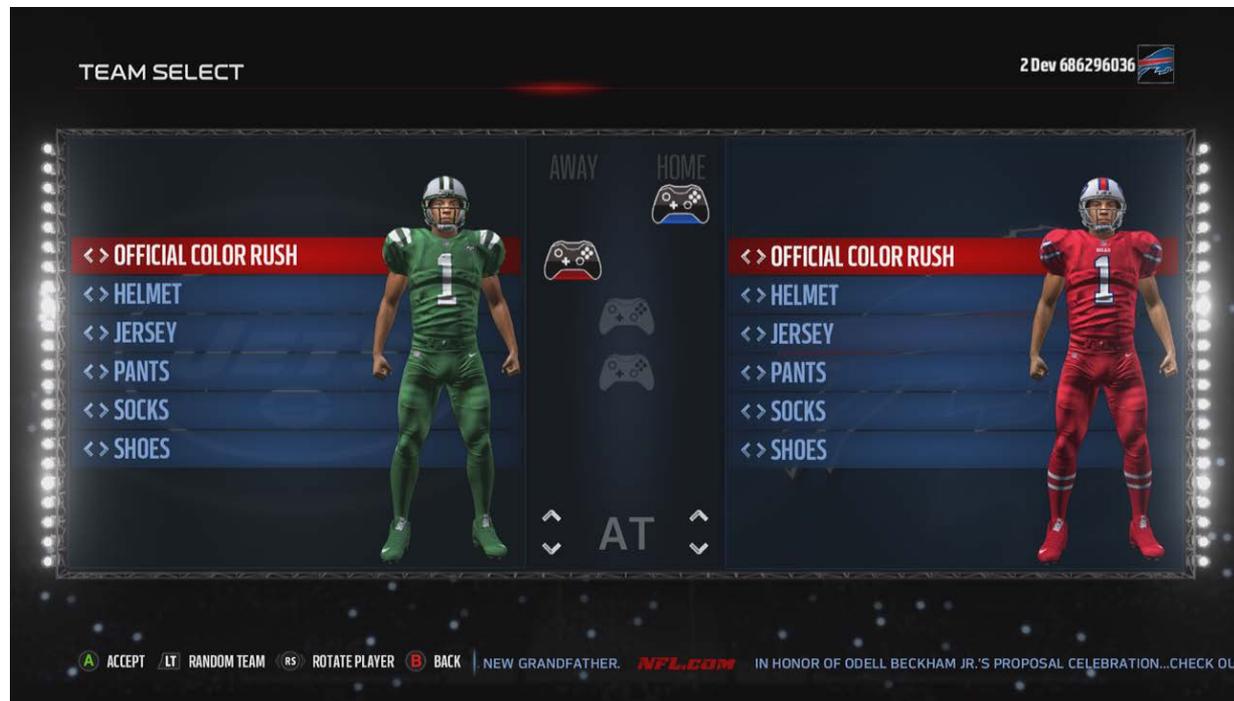


NFL Nike Color Rush



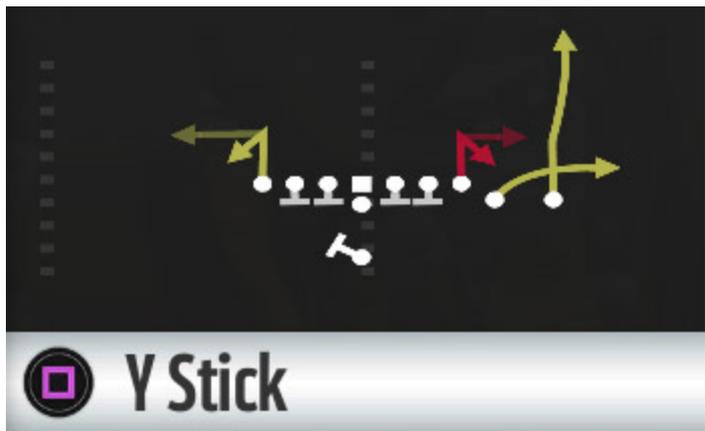


Madden NFL 17 Nike Color Rush





UI Color Blindness





Fixing Color Representation

- Primary goal: improve visibility
 - Primary color text loses brightness for those with similar weakness
- Secondary goal: improve color distinction
 - Color distinction is critical when color is the only way to easily tell game elements apart
 - Shades of red, orange, yellow, and green are the most common colors confused





Gameplay Colors





Math Fix: Daltonization

- Potential to prevent art changes
- Shifts colors from areas of weakness to areas of strength
- Original version is great for real-world, but not ideal for games that love to use multiple bright colors, thus many shy away from Daltonization





Modified Daltonization

- Can better handle similar luminosities by reducing color shift and increasing contrast simultaneously
- Negligible hit on game performance
 - Math equation is optimized and fast
 - Did not require additional render passes (Madden uses it on FXAA and UI)
- Bonus: comes with brightness/contrast support





Madden – Modified Daltonization



Y Stick



ck



Y Stick





Madden NFL 17 – Protanopia Filter





Reception

This is a minor thing to most of us but to people with color blindness and eye troubles it's huge.

@EAMaddenNFL @EASPORTS_MUT THANK YOU! Sincerely, thank you.... I have been color blind my whole life.... You guys are the best 👍

@EAMaddenNFL @EASPORTS_MUT @DylanDobrasz @matt_faso @SaldoZer @PapaChrisCanada YALL SEE THIS!!! COLOR BLIND SUPPORT!!! YASSSSSS

I'm colorblind, so I found this addition 1. funny and 2. awesome 🍌





Brightness





Contrast





Recap

- Accessibility is a mindset, not a feature
- It's possible to have big wins cheaply
- Engage your audience



Brandon DiGia @accessiblegamer · Jun 11

@ea_accessible just wanted to say thank you so much for existing.





Questions?

- kstevens@ea.com
- AccessibilityFeedback@ea.com
- Twitter: @ea_accessible – follow for updates
- Additional slides provided in this deck
 - Tool & reference links
 - Colorblind code & usage instructions





Resources

- Contrast tool: http://www.snook.ca/technical/colour_contrast/colour.html
- Contrast examples: <http://trace.wisc.edu/contrast-ratio-examples/>
- Contrast formula: <https://www.w3.org/TR/2008/REC-WCAG20-20081211/#relativeluminancedef>





Resources

- Additional general information:
 - <http://www.includification.com/>
 - <http://www.color-blindness.com/>
 - <http://www.ablegamers.com/>
 - [https://msdn.microsoft.com/en-us/library/aa291864\(v=vs.71\).aspx](https://msdn.microsoft.com/en-us/library/aa291864(v=vs.71).aspx)
 - <http://game-accessibility.com/>





Daltonization, Brightness, & Contrast

- Shader code is in the notes – e-mail kstevens@ea.com for additional info / support
- Set color blind factors to turn on support, set Daltonization to 0.9 at the same time
- Colorblind code comes with brightness and contrast support, which is optional to use. Passing zeroes disables this feature.
 - Suggested brightness factors: -0.1, -0.05, 0, 0.05, 0.11
 - Suggested contrast factors: -0.25, -0.12, 0, 0.2, 0.4
- Pass in color to `AccessibilityPostProcessing` for final color



```

/*H*****
/
/*!
  \File AccessibilityPost.fhx
  \Description
    Accessibility support library for shaders, covering brightness, contrast, and color blind.
  \Copyright
    (c) 2015 Electronic Arts Inc.
*/
/*****H*/
/** Include files *****/
#include "tibdefs.fhx"
/** Variables *****/
float colorBlindProtanopiaFactor    : presentation = 0.0; // pass in 0 or 1 to turn on support
float colorBlindDeuteranopiaFactor  : presentation = 0.0; // pass in 0 or 1 to turn on support
float colorBlindTritanopiaFactor    : presentation = 0.0; // pass in 0 or 1 to turn on support
float colorBlindDaltonizeFactor     : presentation = 0.0; // pass in 0 or 0.9 for best results
float accessibilityBrightnessFactor : presentation = 0.0; // zero is no effect
float accessibilityContrastFactor   : presentation = 0.0; // zero is no effect

// suggested brightness factors: -0.1, -0.05, 0, 0.05, 0.11
// suggested contrast factors: -0.25, -0.12, 0.25, 0.5

/** Methods *****/
// Shifts from rgb to luminosity color representation. The magic numbers
// are standard conversion values used to do this.
// see https://en.wikipedia.org/wiki/CIE_1931_color_space for details
float3 RgbToLms(float3 color)
{
  float l = (17.8824 * color.r) + (43.5161 * color.g) + (4.11935 * color.b);
  float m = (3.45565 * color.r) + (27.1554 * color.g) + (3.86714 * color.b);
  float s = (0.0299566 * color.r) + (0.184309 * color.g) + (1.46709 * color.b);
  return float3(l,m,s);
}

```

```

}

// Shifts from luminosity to rgb color representation. The magic numbers
// are standard conversion values used to do this.
// see https://en.wikipedia.org/wiki/LMS\_color\_space for details
float3 LmsToRgb(float3 color)
{
    float r = (0.0809444479 * color.r) + (-0.130504409 * color.g) + (0.116721066 * color.b);
    float g = (-0.0102485335 * color.r) + (0.0540193266 * color.g) + (-0.113614708 * color.b);
    float b = (-0.000365296938 * color.r) + (-0.00412161469 * color.g) + (0.693511405 * color.b);
    return float3(r,g,b);
}

// Shifts colors based on color blind color weaknesses to areas where user can better see.
// The magic numbers model the way the human eye works when affected by different color
// deficiencies. They will never change.
// see http://www.daltonize.org/search/label/Color%20Blindness for details
float4 Daltonize(float4 color)
{
    float3 colorLMS = color.rgb;
    colorLMS = RgbToLms(colorLMS);

    float3 colorWeak;

    colorWeak.r = (2.02344*colorLMS.g - 2.5281*colorLMS.b)*colorBlindProtanopiaFactor + colorLMS.r*(1.0-colorBlindProtanopiaFactor);
    colorWeak.g = (0.494207*colorLMS.r + 1.24827*colorLMS.b)*colorBlindDeuteranopiaFactor + colorLMS.g*(1.0-colorBlindDeuteranopiaFactor);
    colorWeak.b = (-0.395913*colorLMS.r + 0.801109*colorLMS.g)*colorBlindTritanopiaFactor + colorLMS.b*(1.0-colorBlindTritanopiaFactor);

    colorWeak = LmsToRgb(colorWeak);

    colorWeak = color.rgb - colorWeak;

```

```
float3 colorShift;
colorShift.r = 0;
colorShift.g = colorWeak.g + 0.7*colorWeak.r;
colorShift.b = colorWeak.b + 0.7*colorWeak.r;

color.rgb += colorShift.rgb;
color = clamp(color,0.0,1.0);

return color;
}
// applies brightness, contrast, and color blind settings to passed in color
float4 AccessibilityPostProcessing(float4 color)
{
    //apply contrast
    color.rgb = ((color.rgb - 0.5) * (1.0+accessibilityContrastFactor+colorBlindDaltonizeFactor*0.112)) + 0.5;

    //apply brightness
    color.rgb += accessibilityBrightnessFactor-0.075*colorBlindDaltonizeFactor;

    // apply colorblind compensation algorithm
    color = (Daltonize(color)*colorBlindDaltonizeFactor + color*(1.0-colorBlindDaltonizeFactor));

    return color;
}
```