Negative Polarity

An introduction to Dark mode visual design

Introduction

NEGATIVE POLARITY:

A UI/UX design configuration characterized by contrasting light-colored text on a near-black background; This design configuration was first implemented natively to early computers in the 1970’s. Over time, this format was then replaced with the advent of emulated paper GUIs occurring during the mid-1980’s; Negative polarity has since experienced a resurgence after the release of Windows 10 in 2016. This design system was primarily built for reducing glare in low-light environments & addressing accessibility requirements.

Overview

- Research and Academic Performance
- Marketing and Implementation Statistics
- Benefits & Considerations
- Visual Impairments
- Color Palettes
- Contrast Ratios
- Modular Grid
- Type Families
- Design Resource Use

Research & Academic Performance

User Performance Research:

- https://www.ijetch.org/2024/IJET-V16N2-1256.pdf
- https://pubmed.ncbi.nlm.nih.gov/40283833/
- https://www.sciencedirect.com/science/article/pii/S2451958821000555
- https://dl.acm.org/doi/10.1145/3715669.3725879

E-Learning Industry Research:

- https://arxiv.org/abs/2409.10895
- https://elearningindustry.com/dark-mode-in-elearning-designing-for-user-comfort

Visual Impairment Considerations:

- https://www.spectracheck.co.uk/blog/dark-mode-accessibility-dilemma
- https://www.smashingmagazine.com/2025/04/inclusive-dark-mode-designing-accessible-dark-themes/

Dark Mode Usage Statistics:

- https://gitnux.org/dark-mode-usage-statistics/

E-learning Relevant Statistics

- Dark Mode reduces blue light emission, which can improve melatonin secretion by 20%
- Dark Mode can save up to 63% of battery life on AMOLED displays at 100% brightness
- 58% of U.S. adults report experiencing digital eye strain which Dark Mode claims to alleviate
- People with cataracts find negative polarity (Dark Mode) easier to read by a factor of 1.4
- Dark Mode minimizes "pixels lit" count by up to 70% on simplified interfaces
- 93% of users prefer Dark Mode when viewing video content
- Adobe Creative Cloud apps defaulting to Dark Mode increased average session length by 12%

Marketing Research:

- 9% of design systems explicitly define semantic colors for elevation in Dark Mode visual design (dark greys vs. pure black)
- 81.9% of Android users use Dark Mode on their smartphones
- Approximately 37% of iPhone users utilize Dark Mode natively
- 91.8% of software developers use Dark Mode in their IDE environments
- 88% of top 100 websites now support `prefers-color-scheme` CSS media queries
- Only 9.3% of users report never using dark mode on their smart phones/devices
- Dark mode usage increased by over 30% regarding global search volume between 2019 - 2020
- 64.6% of users expect websites to automatically apply dark mode based on system settings

Benefits

- Eye strain reduction
- Improved Concentration
- Increased efficacy at task completion and visual acuity
- Lower power draw on student and staff equipment
- Improved visual acuity for the visually impaired, particularly those with developing or post-op cataract surgery
- Studies show that the visually impaired student on average exhibit a preference for dark mode visual design on personal devices
- Dark mode offers modern and positive brand perception and recognition
- Students exhibiting color blindness may benefit from lower brightness

Considerations

- Subtler choice of color in color palettes to provide balanced contrast
- Multimedia content must take dark mode visual design into account to ensure smooth transitions from dark to light
- Red / green & Blue / Purple systems rely on both hue and luminance. In dark mode, these colors often collapse toward similar brightness, making differentiation difficult.
- Color alone may not be relied upon for indication. Dark mode visual design must utilize additional design strategies, such as texture, patterns, iconography, or shapes to cue information
- Ideal contrast should be above minimum for light mode visual design. Negative Polarity visual design should aim between 4.5:1 minimum for large text and 7:1 for body text
- Customization and Student feedback is necessary for fine-tuning and offering maximum accessibility.

Visual Impairments

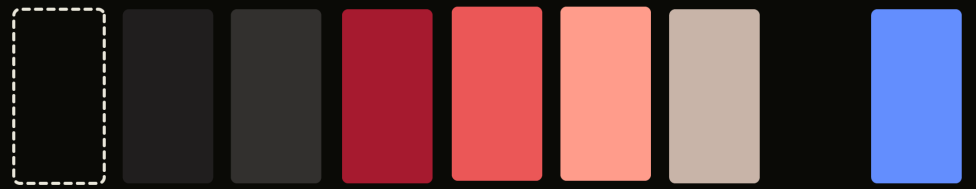
- Night Blindness - Variable; Can induce both Increased or Decreased Contrast Sensitivity
- Astigmatism - Increased Contrast Sensitivity
- Cataracts - Decreased Contrast Sensitivity
- Glaucoma - Decreased Contrast Sensitivity
- Age-related Macular Degeneration - Decreased Contrast Sensitivity
- Retinitis Pigmentosa - Decreased Contrast Sensitivity
- Diabetic Retinopathy - Decreased Contrast Sensitivity
- Presbyopia - Decreased Contrast Sensitivity
- Myopia - Decreased Contrast Sensitivity
- Protonopia - Red Light Deficiency
- Deuteronopia - Green Light Deficiency
- Tritonopia - Blue Light Deficiency

Color Palettes:

Bronze-Gold Universal

This color should be used for indication of positive feedback, confirming a successful KR, completion of a section or test, etc.

Acquisition Red



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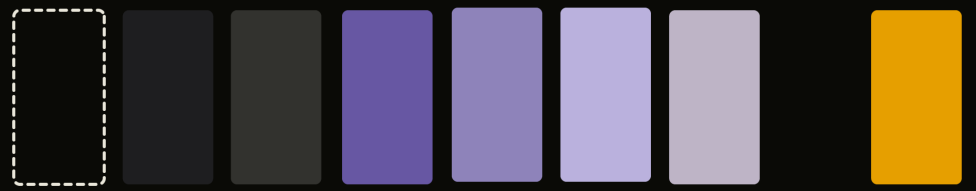
University Blue

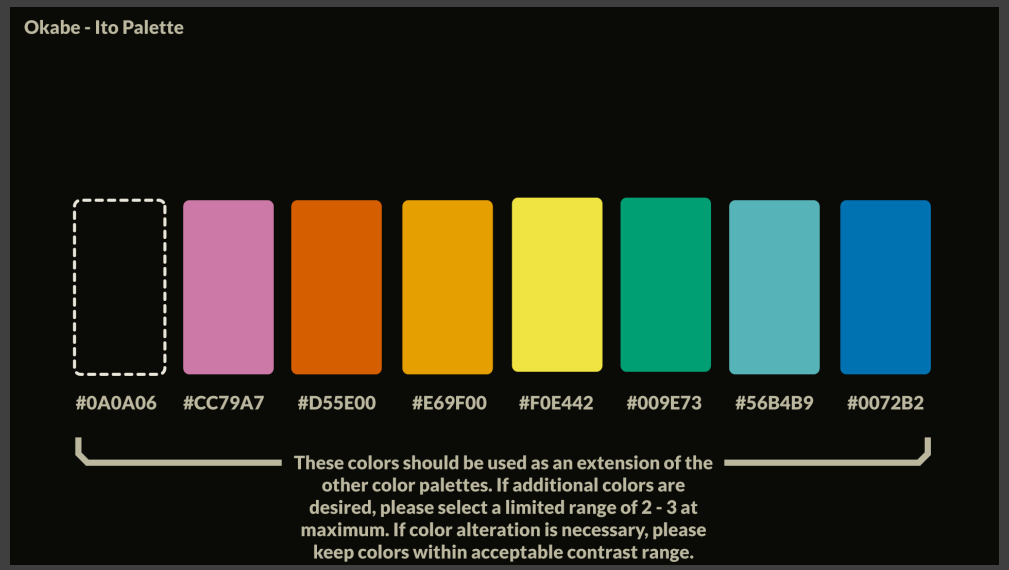
This color should be used for indication of positive feedback, confirming a successful KR, completion of a section or test, etc.

Framework Purple



This color should be used for indication of positive feedback, confirming a successful KR, completion of a section or test, etc.

Color Palettes Cont'd:



https://jfly.uni-koeln.de/color/#pallet

In addition to the other color palettes, the Okabe-Ito color palette has been included as a supplementary color palette to all others. This color palette was designed by Masaka Okabe and Kei Ito originally in 2002 and modified in 2008 for the sole purpose of developing a palette viable for all forms of colorblindness. As the 4 original color palettes provide a contrast and value range sensitive to visual impairment and color blindness, the Okabe-Ito Palette serves to supplement those ranges with additional color in the event designers or developers would like further customization. While this palette has been well-tested, please keep in mind that any additive color mixing or other color combinations should still be verified for contrast.

Contrast Ratios

WCAG AAA Standard:(7:1):

While not all e-learning environments require to design for AAA web-accessibility compliance, this ratio still provides a relevant ceiling for ideal contrast range when considering negative polarity design. With the contrast range of 5.75 - 7:1, using these ratios help develop an understanding of staging or staggering contrast in order to create visual hierarchy of information, a sense of depth in lieu of the ability to use drop shadows effectively, and help the student intuitively prioritize important content displayed to the recipient in a dark mode UI.

5.75:1:

The median ratio between AA - AAA standards; this ratio gets closest to finding a balance in contrast which appeals to negative polarity design and both increased or decreased contrast sensitivity visual impairments; where applicable, default to this value or use it as a baseline for the negative polarity contrast range.

5.75 - 7:1:

The ideal range for the intersection of compliance with baseline contrast standards, develop successful negative polarity design, and account for a variety of visual impairments.

Contrast Ratios Cont’d

WCAG AA Standard:(4.5:1):

This contrast ratio is the minimum requirement for body copy designed to support visual impairments. For type at or above a weight of 18 pt or 14 pt bolded, iconography, and interactive portions of media or interface must be displayed at this lower contrast ratio for WCAG compliance. As described in WCAG 1.4.11:"If a graphic is needed to understand the content or functionality.." the contrast of these items needs to meet these constraints at a minimum.

3:1:

This contrast ratio is an exception in design for negative polarity. For both positive & negative polarity design, large or bolded type, iconography, and interactive portions of the media/interface *can* be displayed at a lower contrast ratio when featured on a larger visual surface area. As this contrast ratio does not comply with the WCAG AA Standard, use this ratio sparingly with peripheral elements to supplement the negative polarity design and prioritize the visual hierarchy of information.

10:1:

While negative polarity design often relies on a contrast ratio of 7:1 to meet WCAG AAA Standard, many negative polarity interface designs supersede this standard with a contrast ratio of 10:1. In designing for both the widest applicability for varying contrast sensitivity \& negative polarity design, this ratio is too high for increased contrast sensitivity impairments like astigmatism. Use this ratio sparingly with peripheral elements to supplement the negative polarity design and prioritize the visual hierarchy of information.

Modular Grid

Appearing in the late 19th Century, the Modular Grid was first employed for print-making and type-setting materials for print. This reliable system was then incorporated alongside modernist design principles to create the International Typographic Style, still finding application today in the design of digital interfaces, branding, education, and informational design.

The Modulor Grid is an extremely useful tool for maintaining the visual compatibility, integrity and creating effective layouts or composition easily. If the Modulor Grid is applied when determining layout of content, any layout will share visual consistency with any other utilizing that same grid.

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Two critical key factors to consider when designing an interface for any visual impairment is page navigation and clarity. By using the Modulor Grid as shown here, composition can be dynamic or varied while still maintaining dimensional constants, allowing for variable compositions within a single layout

Modular Grid (Example)

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Type Families:

Font Packages:

- Geologic
- Lato
- Lexend Deca
- Saira
- Space Mono
- Google Sans Code

Design Resource Use

Modular Grid:

The Modular Grid provides a consistent framework for developing variant compositions and layouts while simultaneously retaining the same basic dimensions. As long as proportions of spacing remains consistent between page elements, each of the layouts can function re-combinatorially with each other. Using this tool allows the developer to build a series of layouts or compositions that can be used across multiple projects or courses.

Contrast Ratio Range of 5.75:1 - 7:1

These ratios provide the ideal range suitable for designing Negative Polarity for the intersection between contrast-sensitive visual impairments and color-blindness.Additional contrast ratios can be used but not in place of the ideal contrast ratio range of 5.75:1 – 7:1 for any assets or page elements featuring critical information or material pertinent to the course objective. If contrast needs to be checked the tool below allows manipulation of hue and saturation without affecting the color value:

https://colorable.jxnblk.com/

Color Considerations:

For development of negative polarity color palettes, 5 color palettes have been designed for dark mode application. All color palettes offer a range of colors that can be mixed through combinatory processing and additive color-mixing, with the addition of the Okabe-Ito color palette for a supplementary range of color. Keep in mind that any combination of these colors should be checked for contrast and color-blindness sensitivity both in relation to the other colors being used, as well as for ideal contrast range when paired with off-black and greys for accessibility of visual impairments and color-blindness.