Smart Display Accessibility Modes (S-DAM)

A Programmatic Approach to Improve Accessibility on Digital Displays for Light and Contrast Sensitivity

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Introduction

- What is Contrast and Light Sensitivity?
- Who does it affect?
- Why does it matter?

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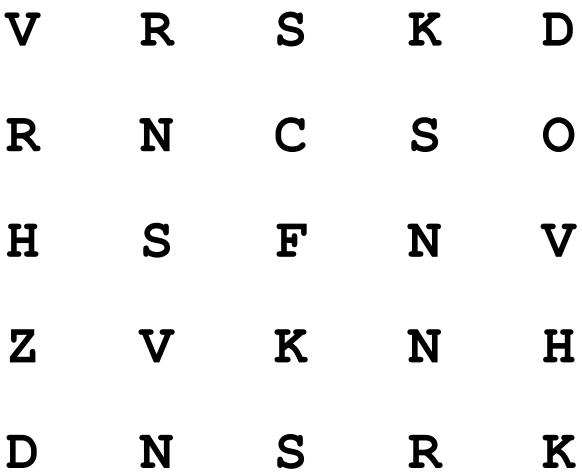

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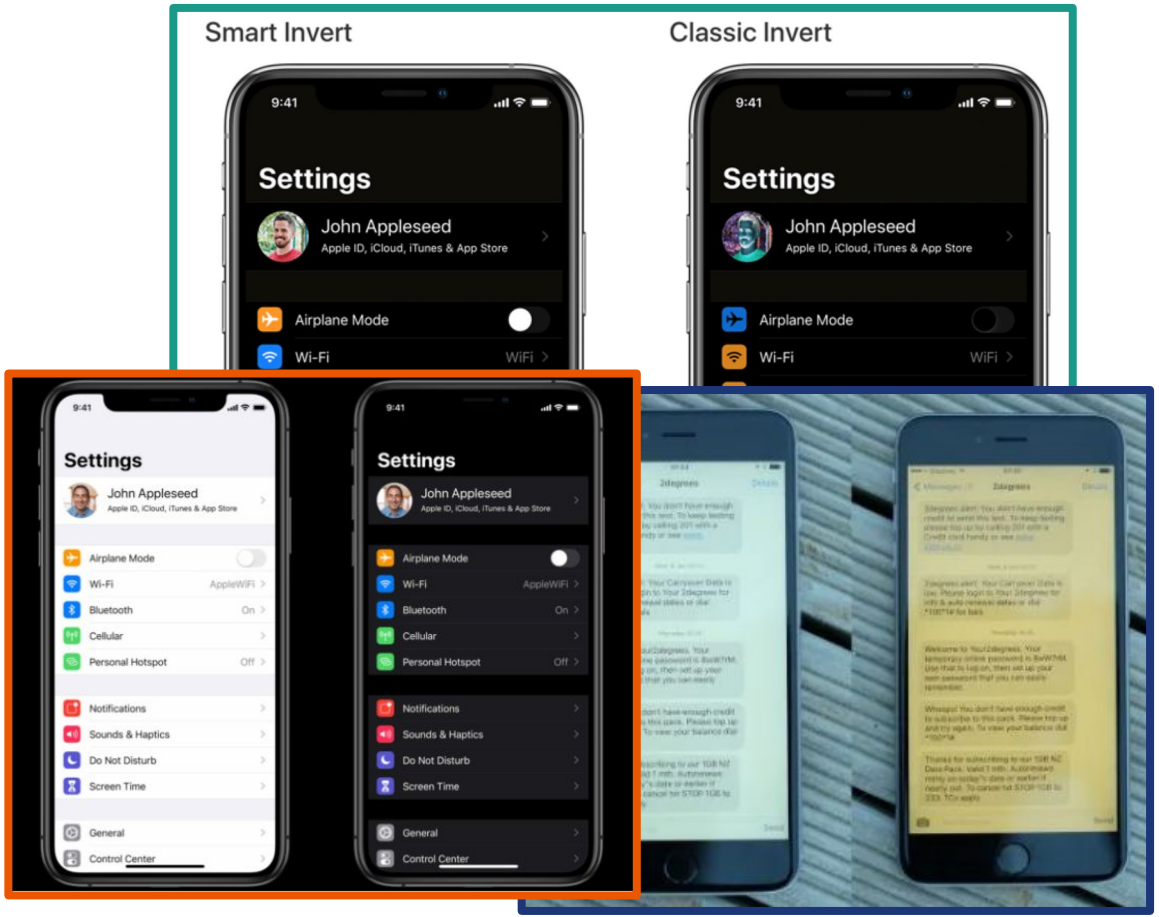
Existing Solutions

- Classic Invert
- Smart Invert
- Dark Mode
- Night Shift
- Color Correction
- etc.



Our Implementation

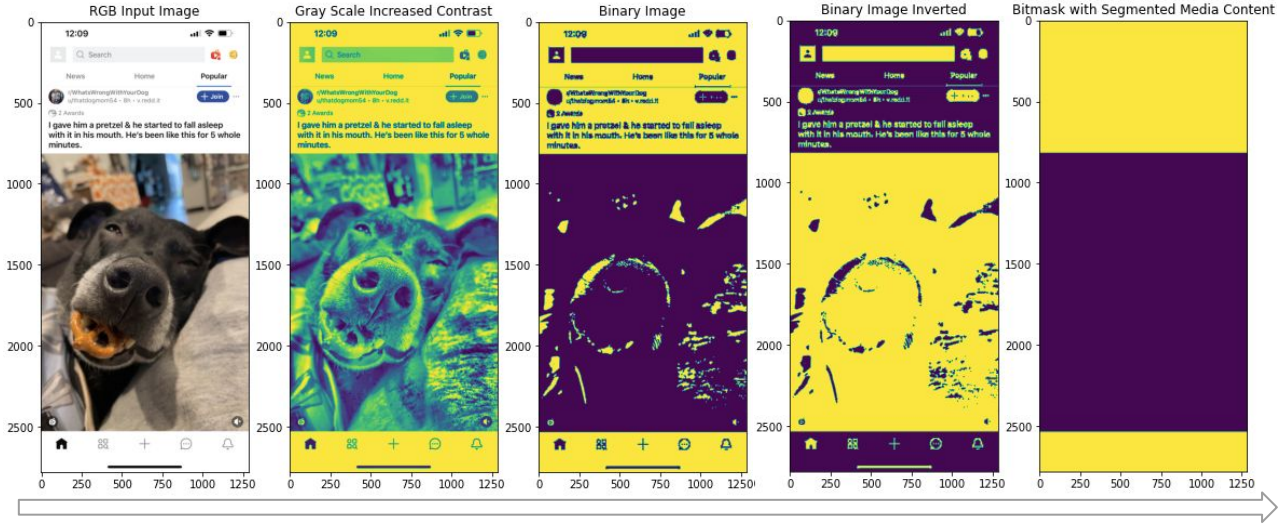
Smart Display Accessibility Modes (S-DAM)

- Display mode for contrast or light sensitive users
- Skip media like images and video
- Does not require extensive developer input
- Agnostic to platform

Our Implementation

Step 1 - Detect Media Content

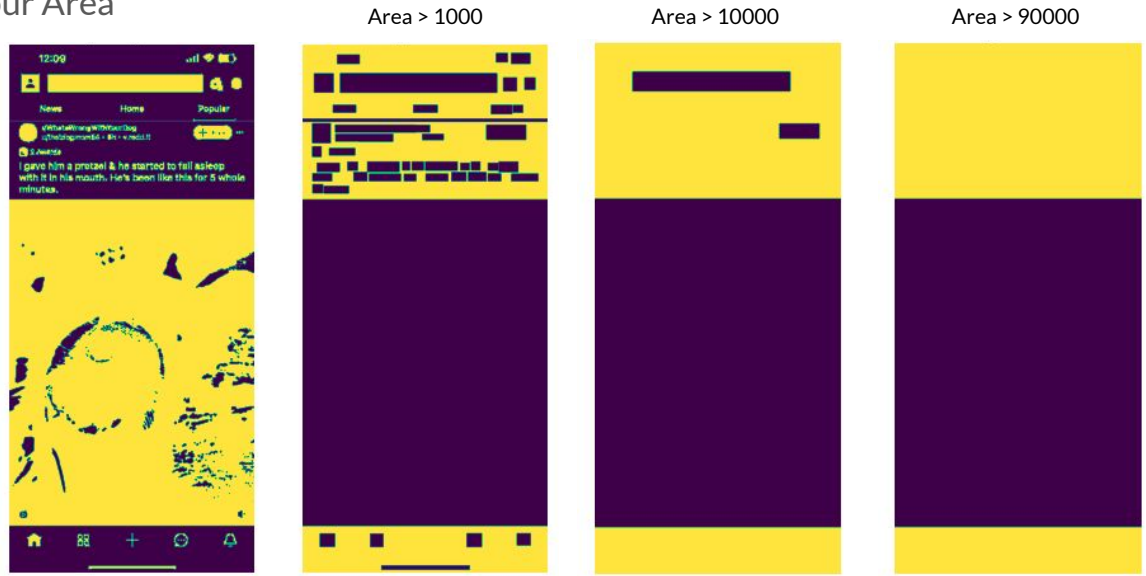
- Goal - segment media (images) from background, text, and UI
- OpenCV - C++, Python, Java



Our Implementation

Step 1 - Detect Media Content

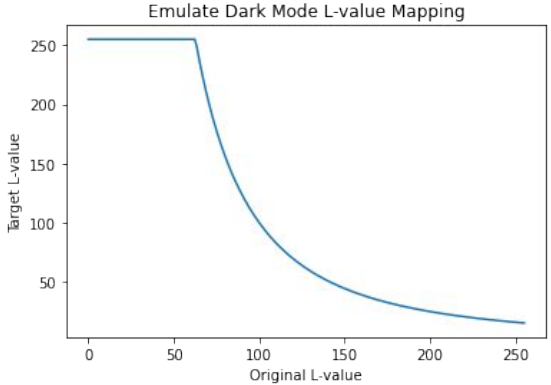
- Contour Shape - Rectangle
- Contour Area

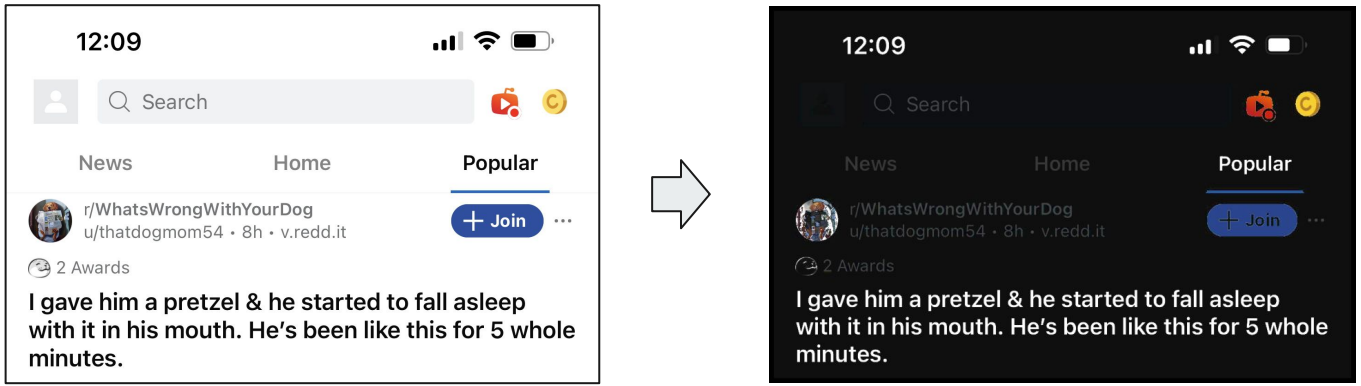


Our Implementation

Step 2 - Emulate Dark Mode

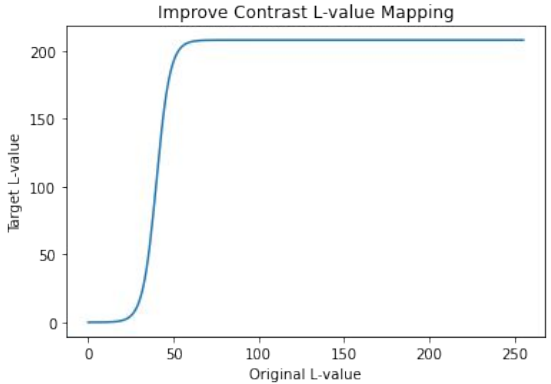
- Goal - Take background/UI content and turn it dark



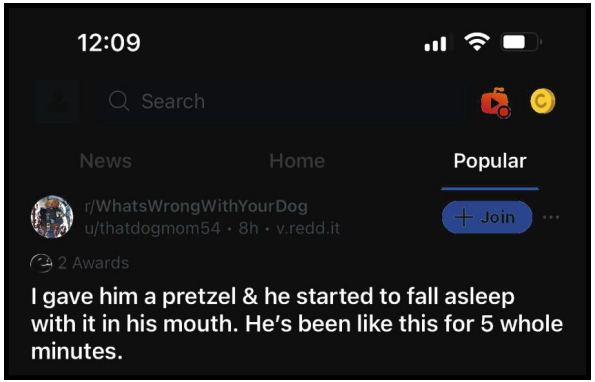


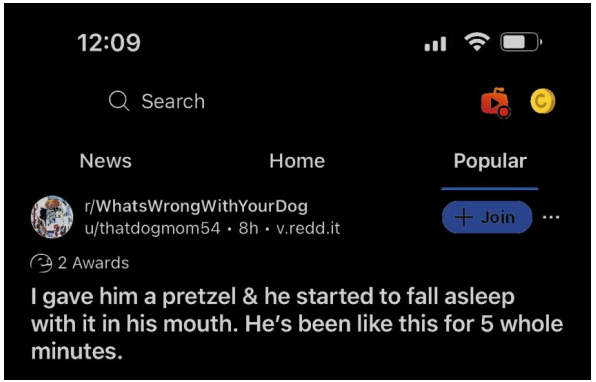
Our Implementation

Step 3 - Improve Contrast



- Goal - Improve the contrast of the generated dark mode



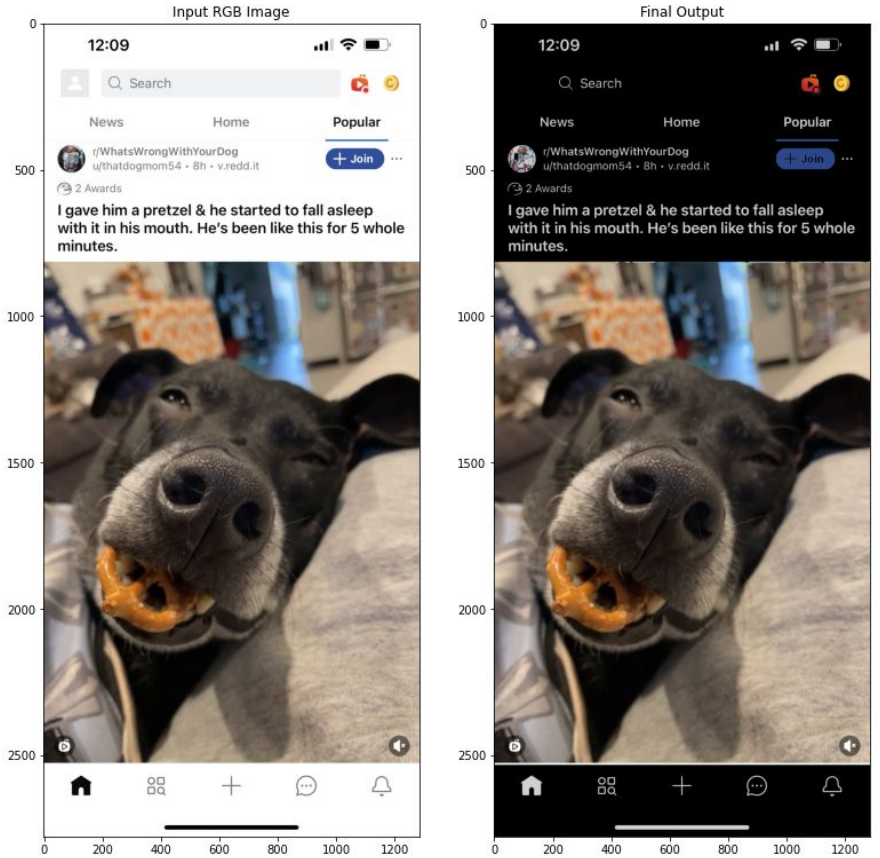


Our Implementation

Final Result

- Good
  - Images preserved
  - Icon colors preserved
  - All text and symbols legible

- Meh…
  - Join button text color
  - Subreddit icon slight distortion
  - Loss of search text box bounds



Evaluation

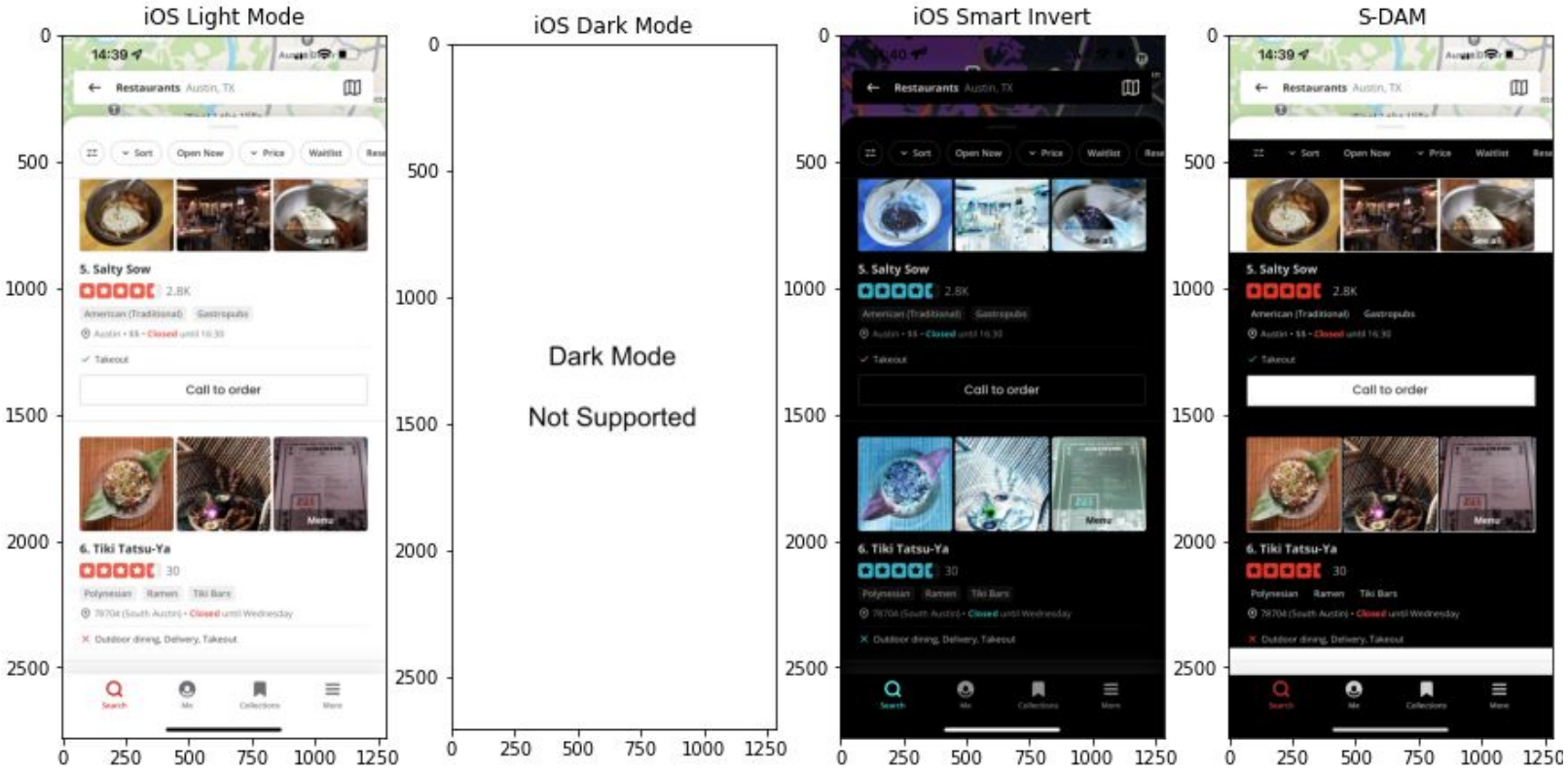
Effective Light Output

- Measures total ‘light’ emitted by a screen
  - In HSL color scheme, average L-value
- Lower score is better
- S-DAM always better than Original
- S-DAM worse than alternatives when it makes mistakes

App Category	App Name	Original	Dark Mode	Smart Invert	S-DAM
Life Style	Yelp	213.58	N/A	41.02	81.65
	Uber Eats	201.71	N/A	73.01	135.16
Social	Reddit	164.70	75.53	90.79	74.81
	Twitter	201.56	56.93	60.14	91.19
Financial	Paypal	219.66	N/A	35.33	114.30
WeView	Chrome Browser	184.93	152.04	69.49	61.11

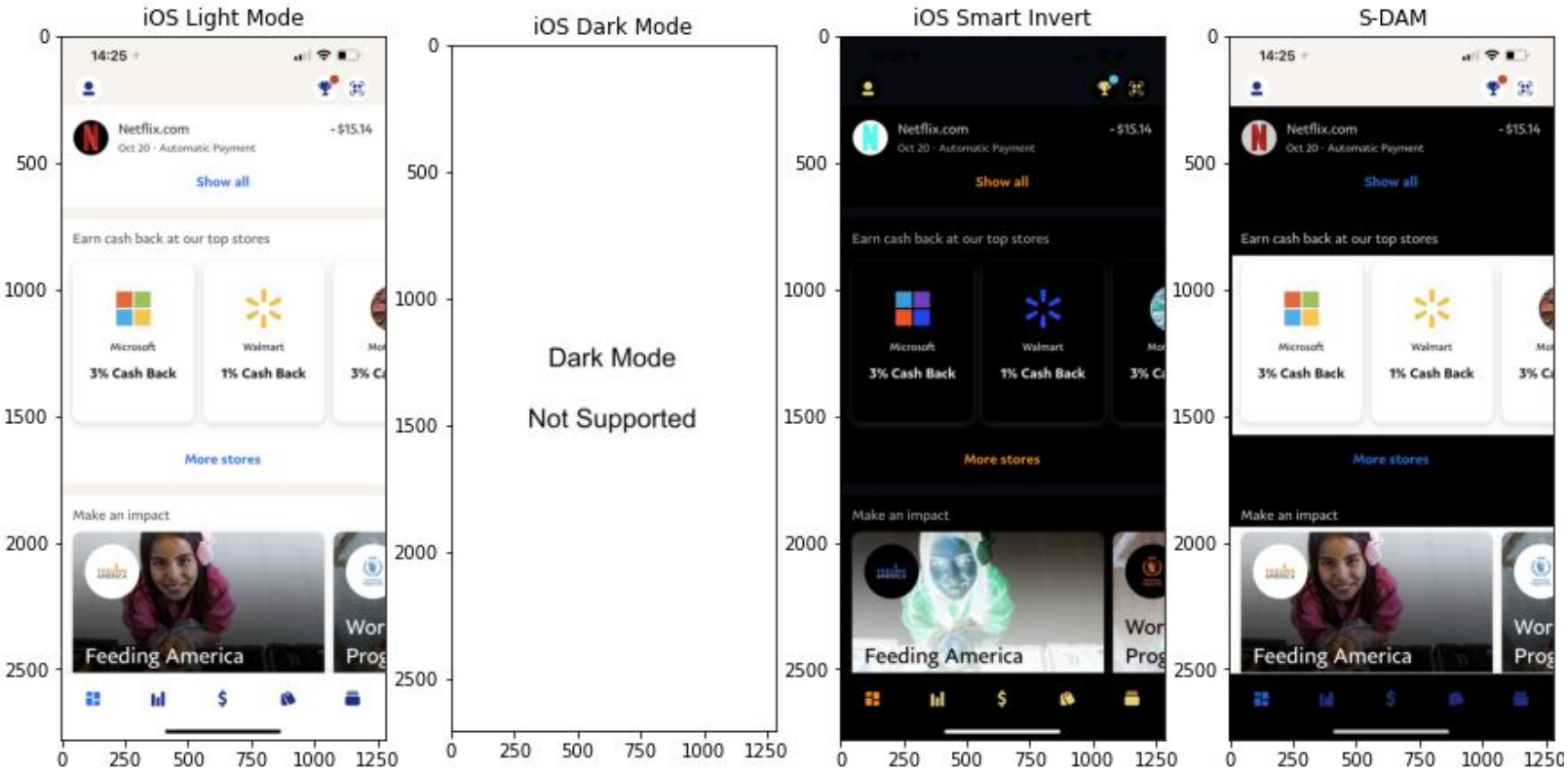
Evaluation

Accuracy - Yelp



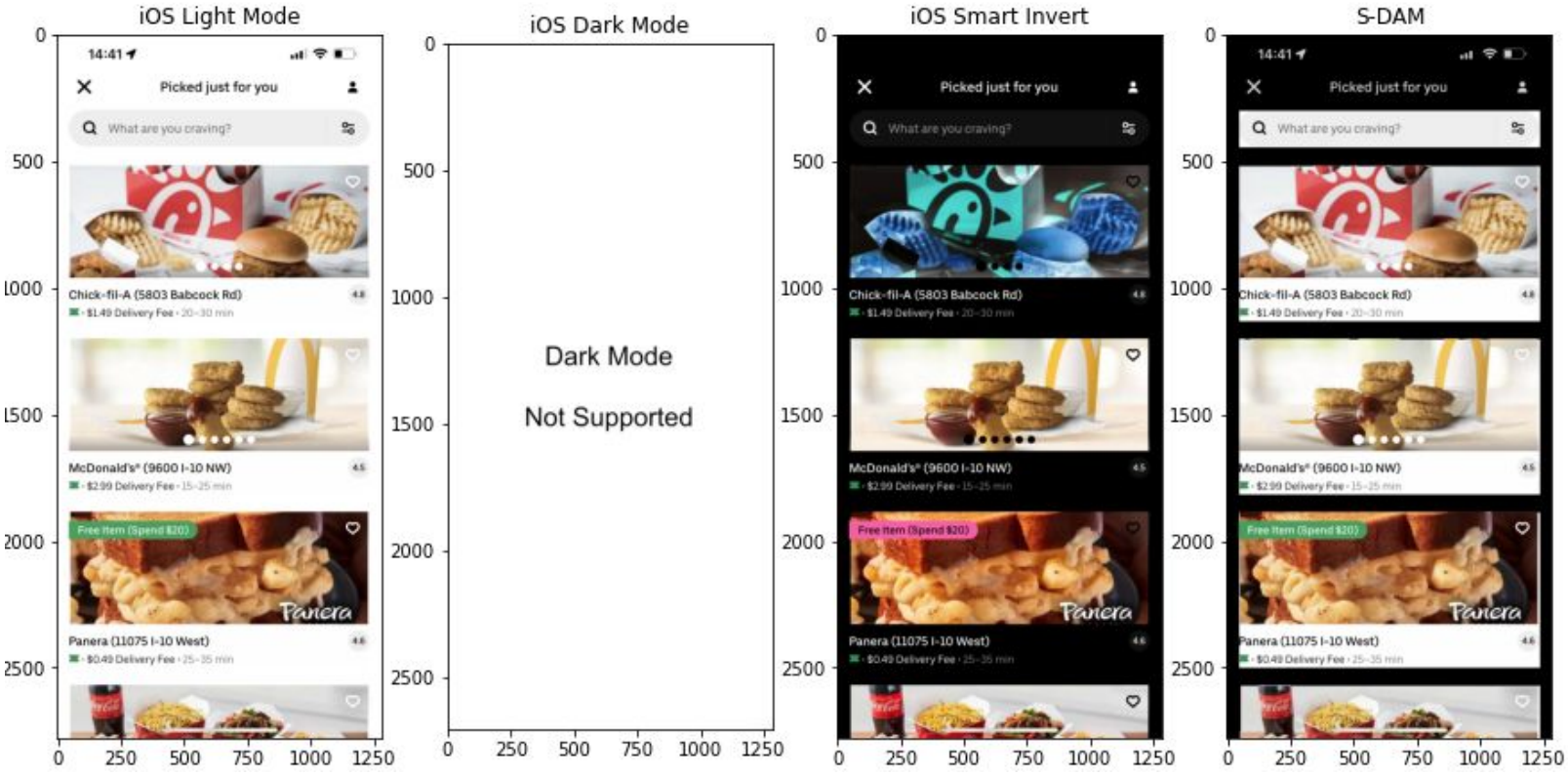
Evaluation

Accuracy - PayPal



Evaluation

Accuracy - UberEats

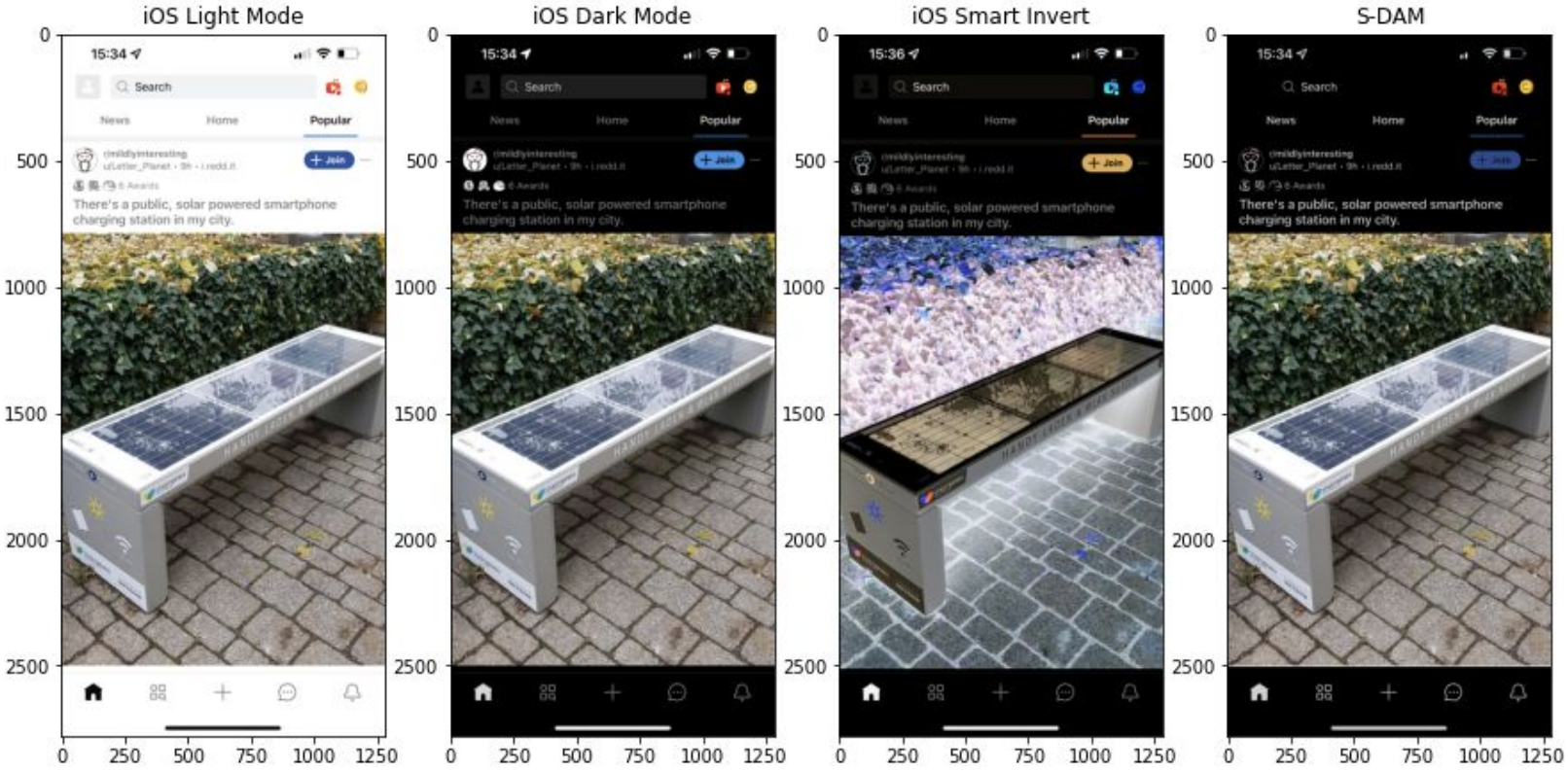


Evaluation

Accuracy - Twitter

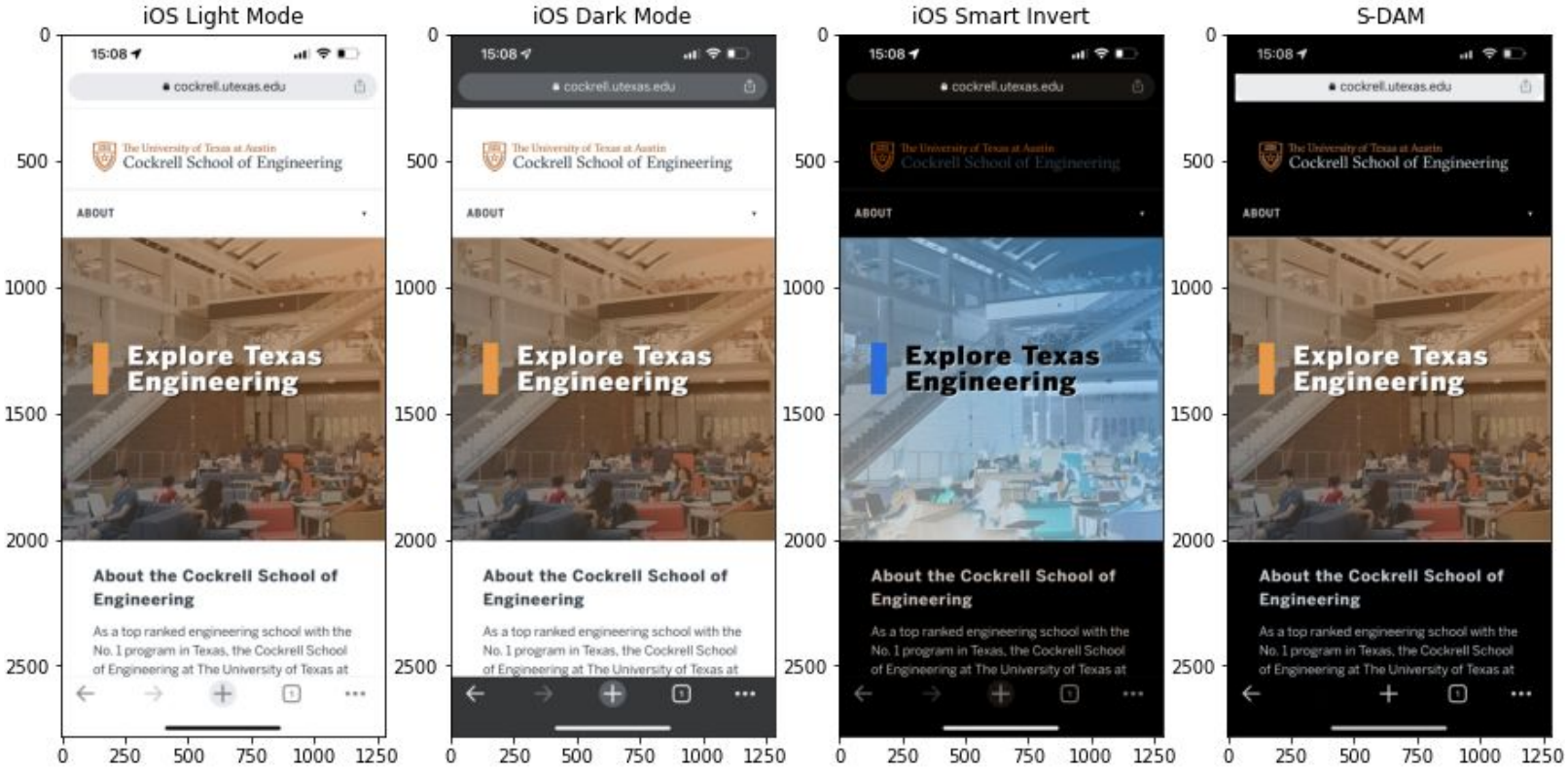
Evaluation

Accuracy - Reddit



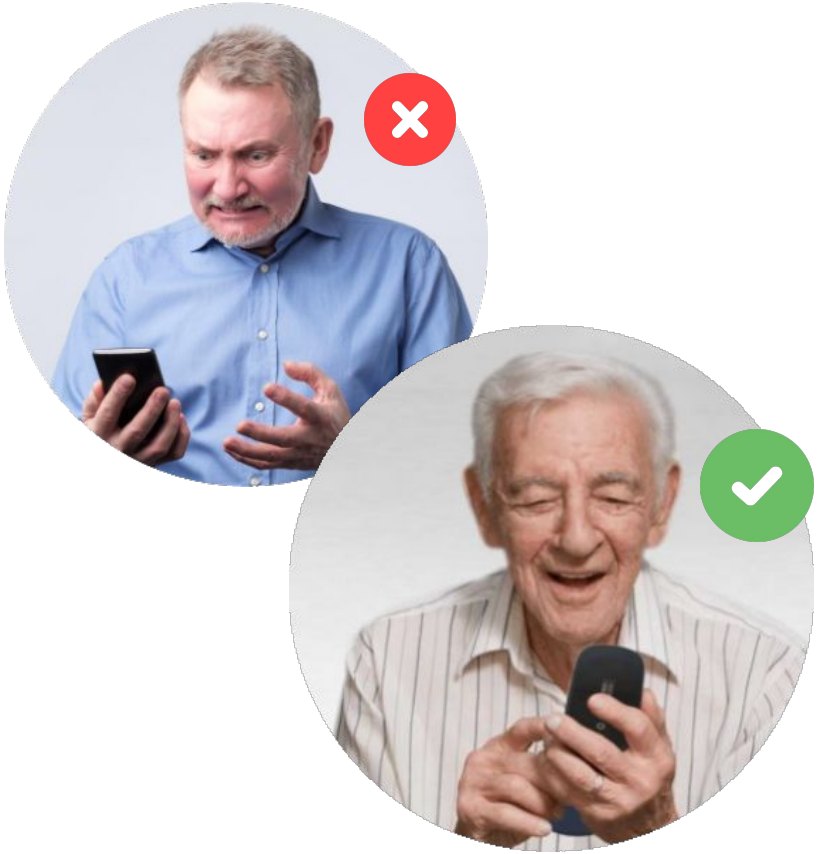
Evaluation

Accuracy - Chrome



Future Work

- Improve image segmentation step
  - ML?
  - Multiple stages?
- Evaluate real-time performance
- Implement as a Browser Extension
- Implement for Desktop
- Tune parameters and thresholds
  - Optimize for different application types



Questions?

https://github.com/friedliver/smart-accessibility-modes-for-mobile-display