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Performance Testing of Commercially Available Tools for Logo and Text Detection

Sydney Dorawa and Zoe Gastelum
Sandia National Laboratories

Yana Feldman and Teagan Zuniga
Lawrence Livermore National Laboratory

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Introduction and Research Question

- Open-source safeguards analysis involves large quantities of multimedia information (text, visual, audio, video)
- Possible to use commercial platforms for logo detection?
 - This project: testing Google's Vision AI platform performance on logo/text detection and identification capabilities
 - Usability for detecting nuclear-related logos?



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Data

- 283 images used for logo and text detection tests, collected from various sources
- Team labeled each image to create a “ground truth” against which to compare Vision AI’s performance

Description & Image Count	Nuclear Example	General Example
Logo without text Nuclear: 50 General: 5		



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Logo without text Nuclear: 50 General: 5		
Logo with text Nuclear: 100 General: 13		
Environmental logo with text Nuclear: 51 General: 30		



Data

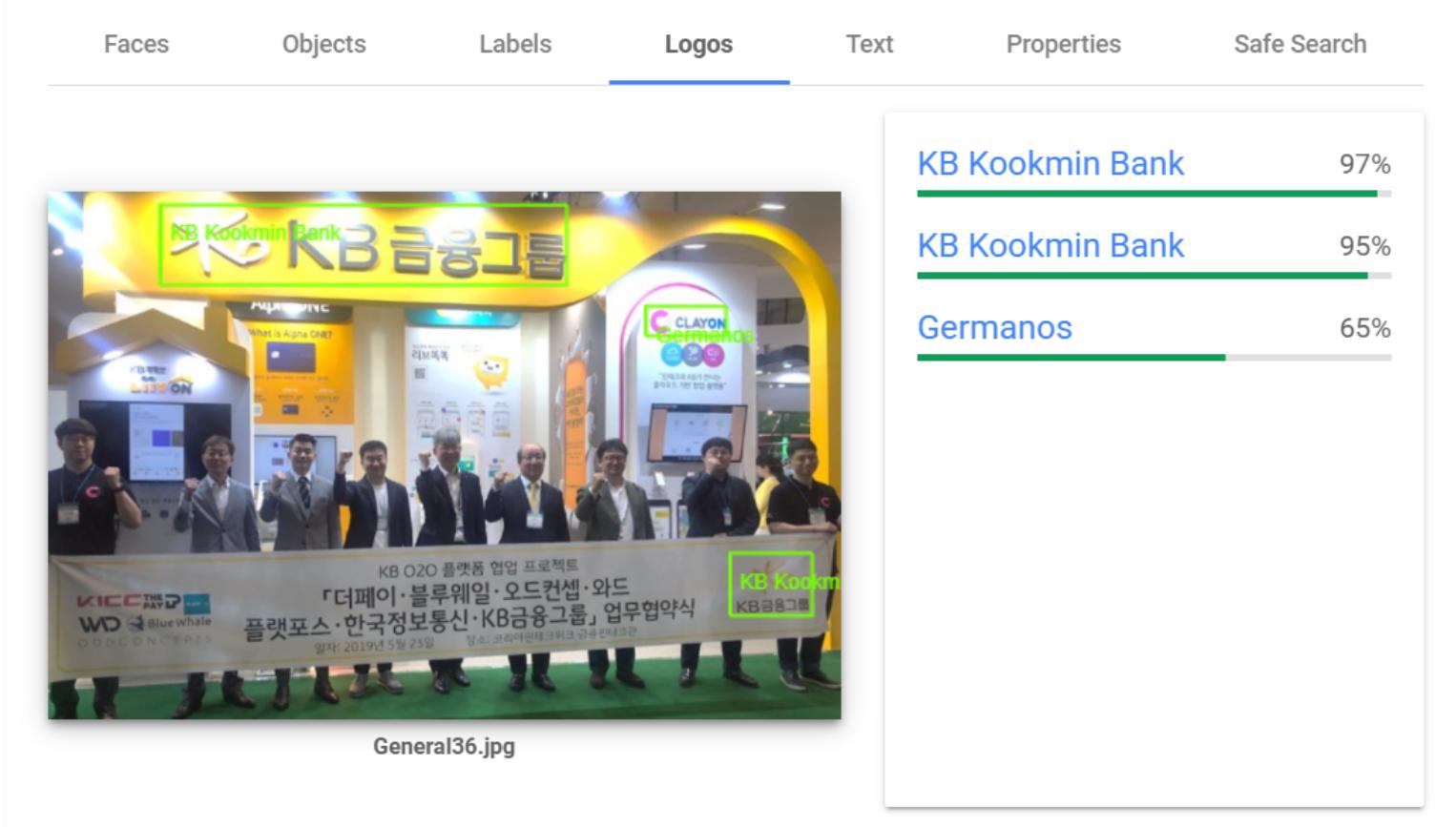
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Environmental logo with text Nuclear: 51 General: 30		
Environmental logo without text Nuclear: 23 General: 11		

Vision AI Evaluation Metrics

Team measured Vision AI's performance on four key metrics:

1. Logo Detection
2. Logo Identification



Example of logo detection and identification



Vision AI Evaluation Metrics

Team measured Vision AI's performance on four key metrics:

1. Logo Detection
2. Logo Identification
3. Text Detection
4. Text Identification

Objects Labels Logos **Text** Properties Safe Search

+Block 5
中国 生物 Ba E CNBG

+Block 6
+Paragraph 1
SINOPHARM

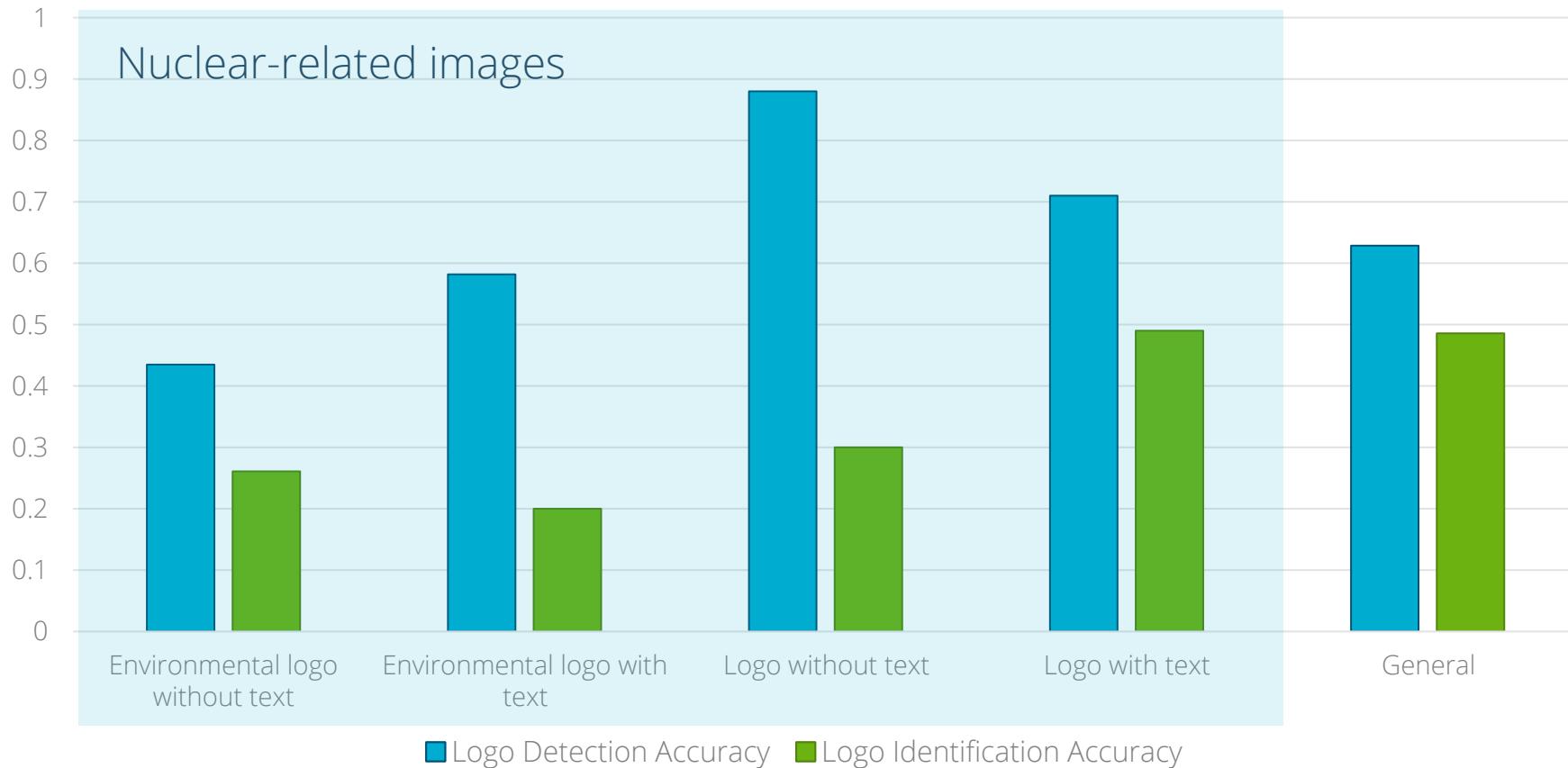
+Block 7
青花

+Block 8
+Paragraph 1
SONYXKK

Example of text detection and identification

Results

Logo Detection & Identification Accuracy

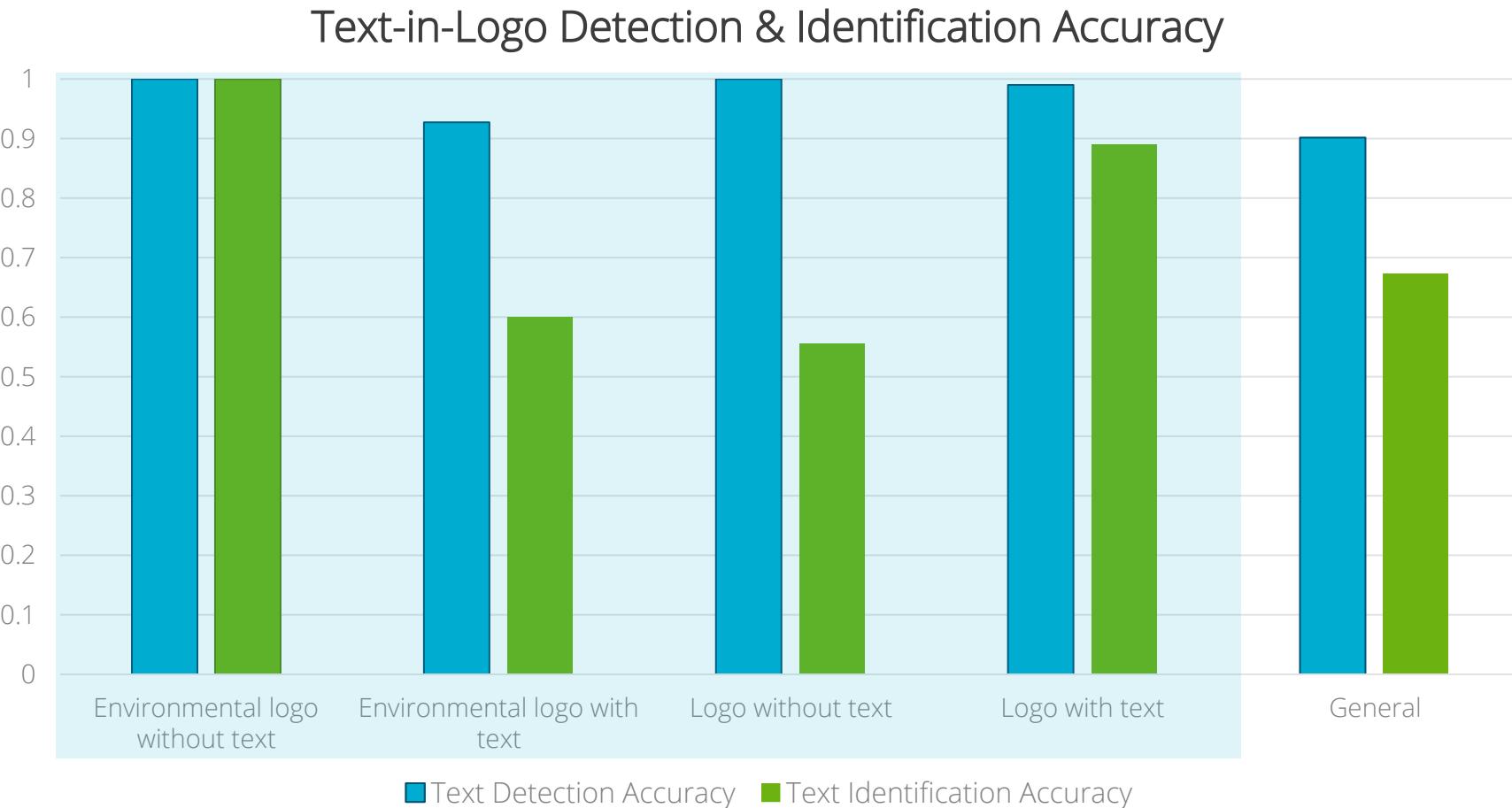


Average logo detection accuracy for nuclear-related images: 68.9%

Average logo identification accuracy for nuclear-related images: 35.6%

- Detection accuracy is higher than identification accuracy across the board
- Comparable performance on nuclear-related and general logos
- Better performance when logos are isolated

Results (cont.)



Average in-logo text detection accuracy for nuclear-related images: 95.2%

Average in-logo text identification accuracy for nuclear-related images: 74.9%

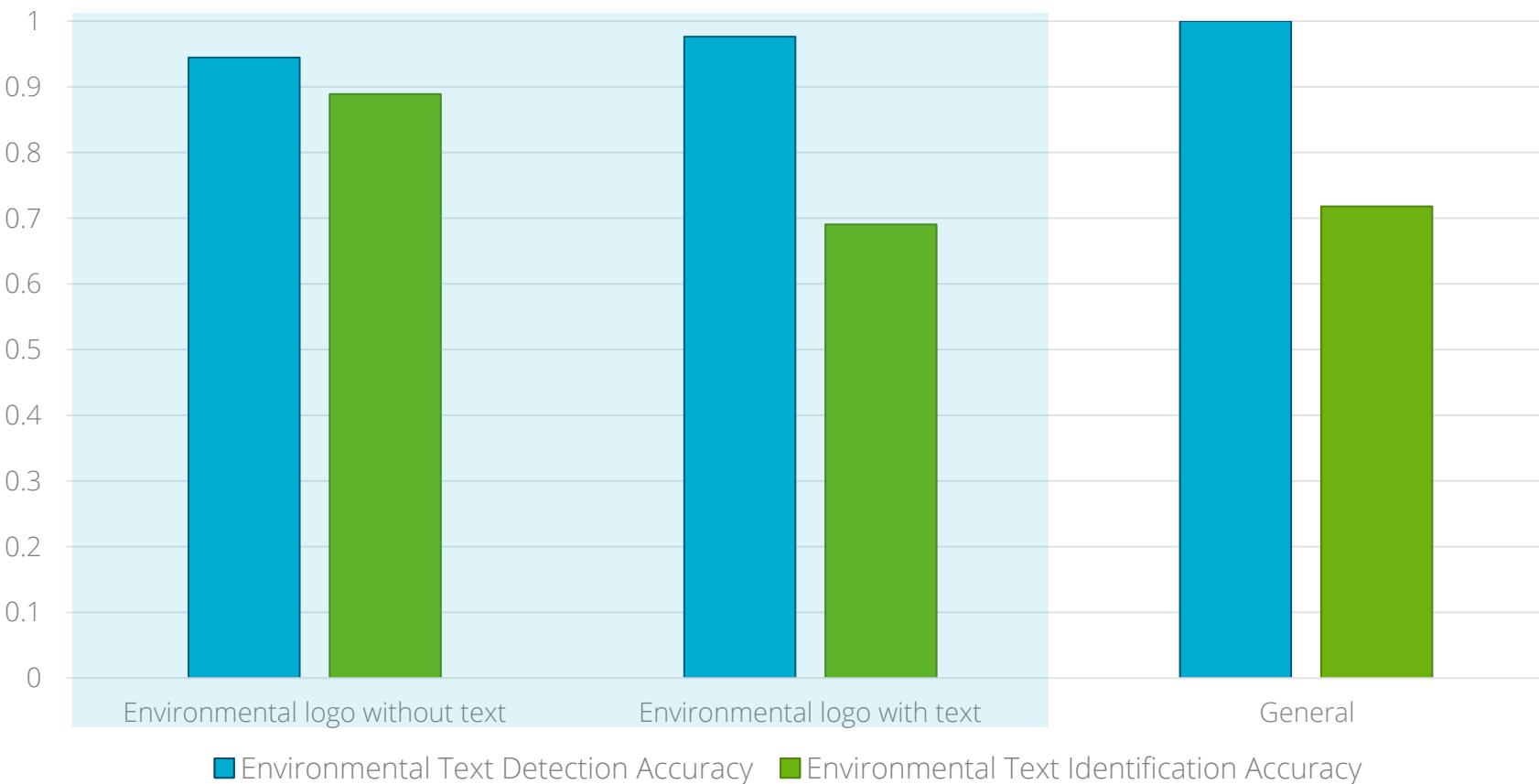
- Note: "Logo without text" images were tested in this category as a baseline. Text detection was coded as correct in cases where the logo resembled text (i.e., Westinghouse's logo, which is a stylized "W")
- Text identification accuracy much higher than logo identification
- Comparable performance on nuclear-related and general images



Westinghouse logo, which resembles the letter "W"

Results (cont.)

Environmental Text Detection & Identification



- Excluded images of isolated logos with no environmental text
- Detection accuracy > identification accuracy
- Comparable performance on nuclear-related and general images

Average environmental text detection accuracy for nuclear-related images: 96.7%

Average environmental text identification accuracy for nuclear-related images: 75%



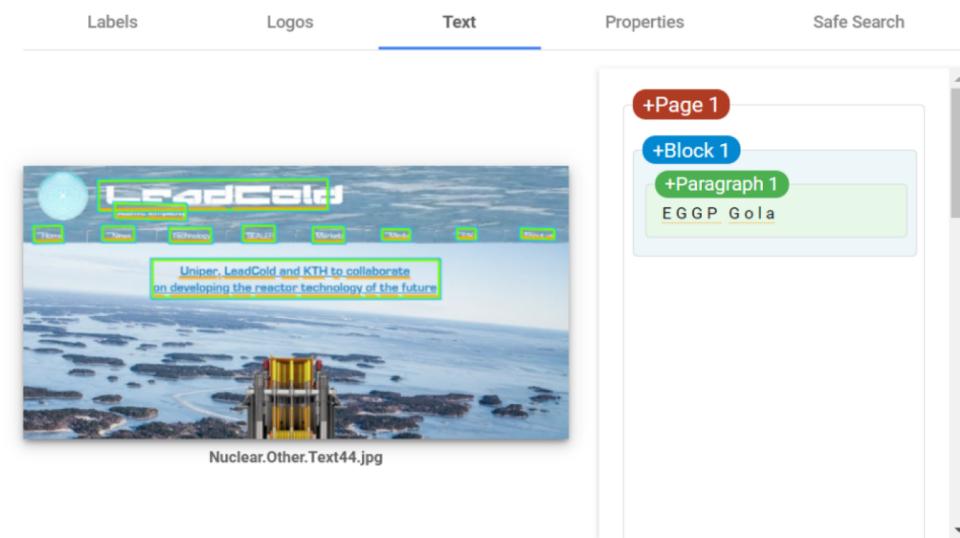
Discussion

- Trends across all tests:
 - Detection accuracy > identification accuracy
 - Similar performance on nuclear-related and general images
- Observations:
 - Logo misidentifications
 - Text transcription errors



Example: Vision AI misidentified the Altius Materials logo (left) as American Eagle Outfitters (right)

Labels Logos **Text** Properties Safe Search



+Page 1
+Block 1
+Paragraph 1
EGGP Gola

LeadCold

Uniper, LeadCold and KTH to collaborate on developing the reactor technology of the future

Nuclear.Other.Text44.jpg

Example: The stylized text of the LeadCold logo may have contributed to Vision AI's poor transcription of the text as "EGGP Gola."



Safeguards Implications

- Low performance in the most realistic safeguards use case for logos
 - 35.6% logo identification accuracy in images with environmental logos
- Performance on text detection and identification was relatively high across all tests
- Future work
 - Test other computer vision platforms like Amazon's Rekognition or Hive AI
 - Re-test Vision AI given rapid pace of development/training of commercial AI platforms
 - Develop library of nuclear-related logos to train models



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