Generating Audio Descriptions for Videos Using Contrastive Language-Image Pre-Training (CLIP) Interrogation

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Introduction

Context

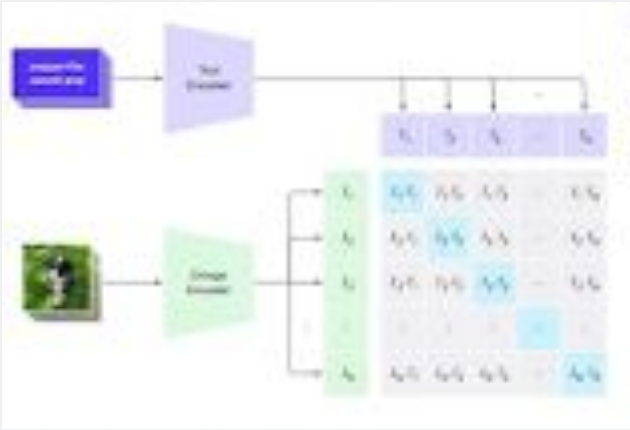
- Audio descriptions
  - Provide blind and low vision individuals information about key visual elements of a video
  - Typically manually transcribed

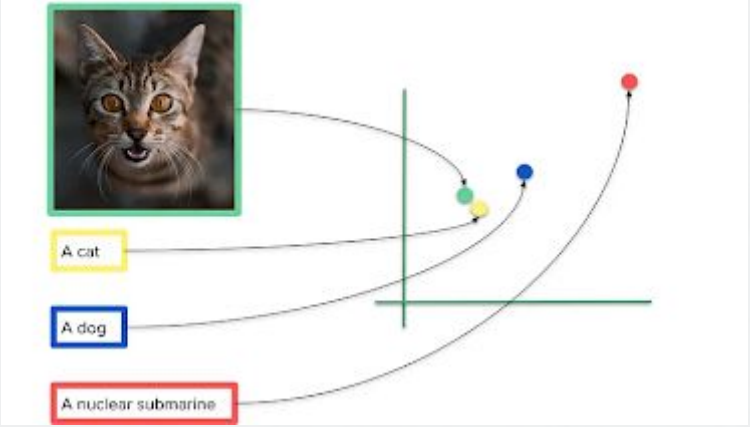
Objective

- Create an algorithm that generates audio descriptions of videos for blind and low vision individuals
- Audio descriptions should be
  - Concise
  - Accurate
  - Generated efficiently

Background

- Contrastive Language-Image Pre-training (CLIP)
  - Embeds images and text to a shared vector space
  - Embeddings are optimized during training





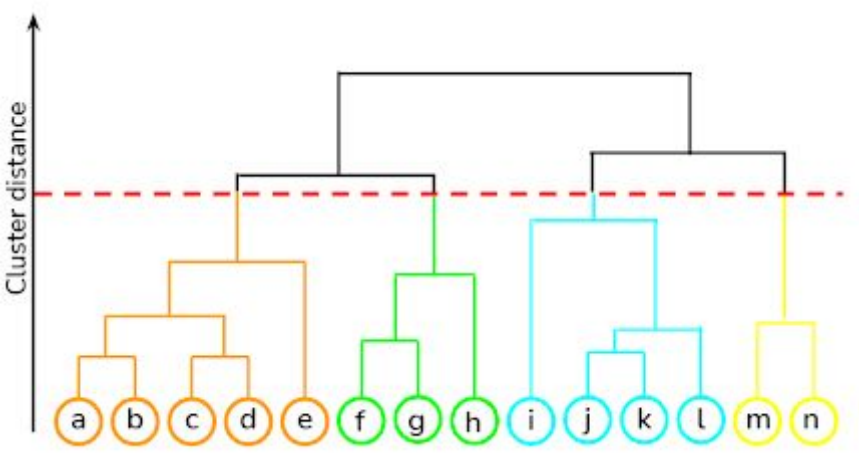
Background

- Image Interrogation
  - Generates prompt that would have produced the given image

a cliff with a waterfall in the middle, imax 7. 0 mm footage, imax photography 4 k, ocean cliff view, cinematic lens flare, beautiful cinematography, anamorphic lens flares, stunning cinematography, anamorphic lens flare, neil blomkamp film landscape, shot on anamorphic lenses, anamorphic cinematography, imax cinematography

Background

- Hierarchical clustering
  - Creates clusters of different granularities



Background

- JPEG file size
  - Quantify image complexity

185 KB

422 KB

02

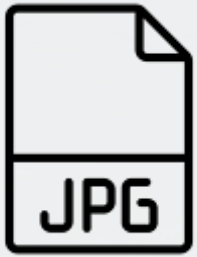
Methodology

Libraries

- OpenCV 2 (cv2)
- scipy
- gTTS
- pydub

Algorithm Design

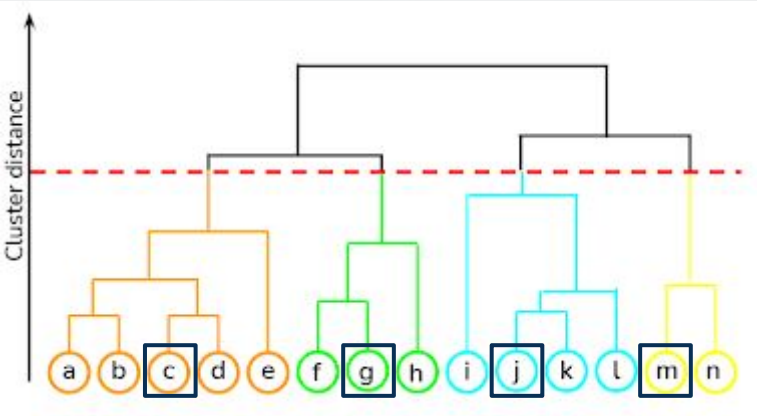
- Frame selection
  - Separate video into frames
  - Quantify using JPEG image size



→ 493 KB

Algorithm Design

- Frame selection
  - Perform hierarchical clustering
  - Select frame in center of each cluster



Algorithm Design

- Description generation
  - CLIP Interrogator analyzes selected frames
  - Description generated is associated with the cluster the frame represents

→ a cliff with a waterfall in the middle

Challenges

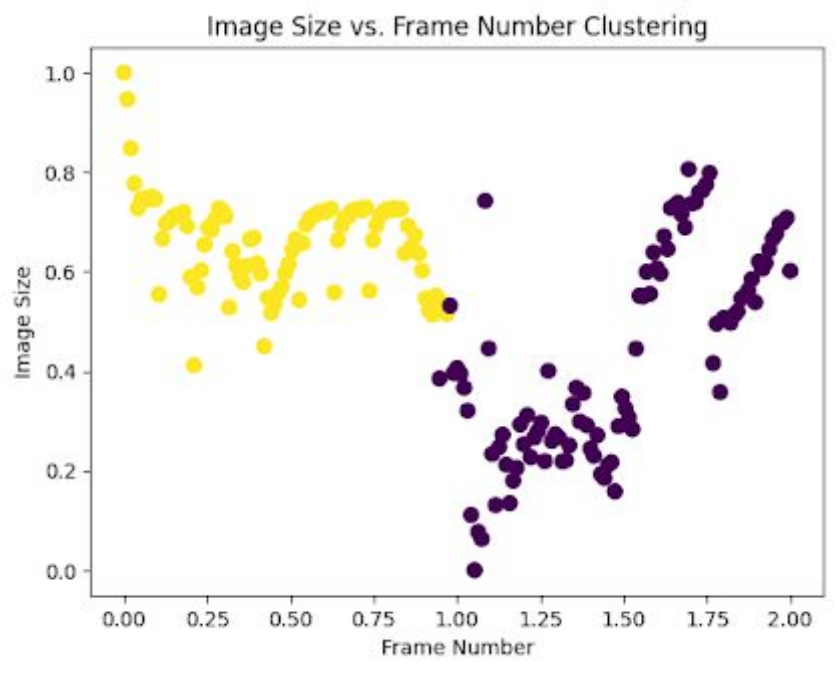
- You Only Look Once Version 11 (YOLOv11)
  - As frame selection metric

3 chairs, 2 tvs

4 chairs, 3 tvs

Challenges

- K-means clustering
  - As frame selection algorithm



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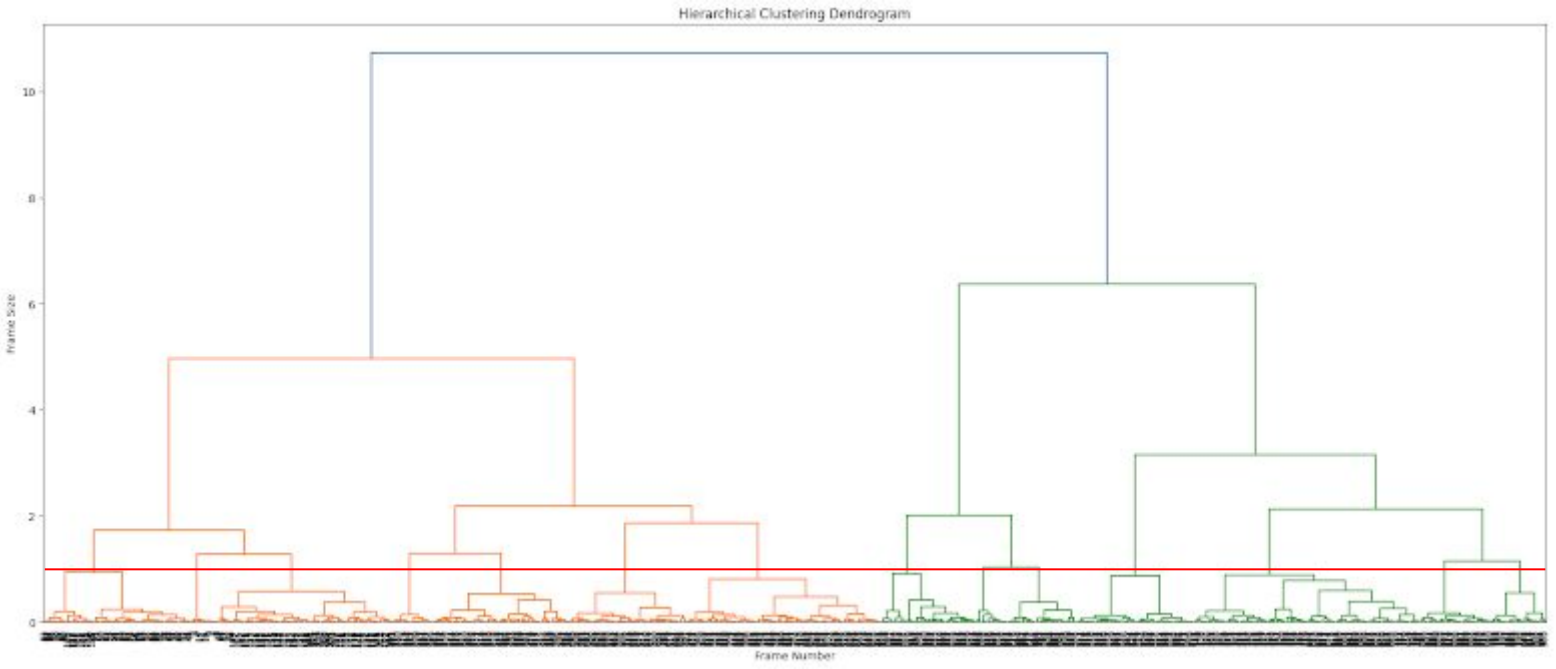
Results and Discussion

Input Video

- Clip from *Antarctica: Home at the End of the Earth*
  - Concrete subjects and landscapes
  - Camera pans, moving subjects, and jump cuts

Results


Hierarchical Clustering Dendrogram
Frame Size
Frame Number
0
2
4
6
8
10

Results















a close up of a penguin with a yellow beak

Successes

- Descriptions are concise
- Frequency of descriptions
- Some accurate descriptions
- Frame selection algorithm
  - Selects representative frames

Limitations

- Inaccurate descriptions
  - Unable to consider context
- Audio description alignment
- Expensive runtime
  - 12 seconds of processing per second of video

A seal swimming in the ocean

04

Conclusion

Significance

- Developed novel algorithm to generate audio descriptions
  - Frame selection
    - ↳ Hierarchical clustering on JPEG image sizes
  - Description generation
    - ↳ CLIP interrogation

Future Work

- Optimizing runtime
- Improving CLIP model
  - Description generation that considers previous context
- Improving clusters to align with video jump cuts

Acknowledgements

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Thank you!

Any questions?