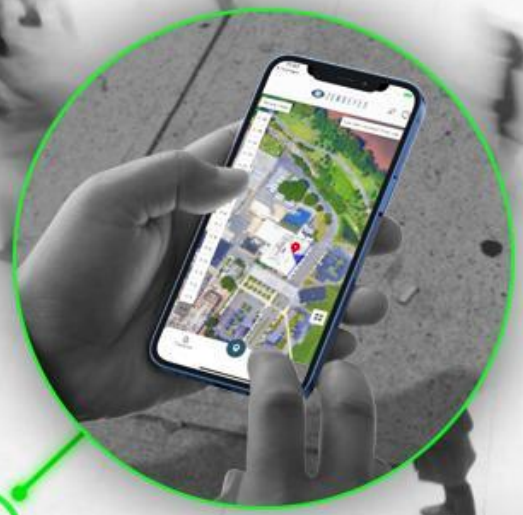
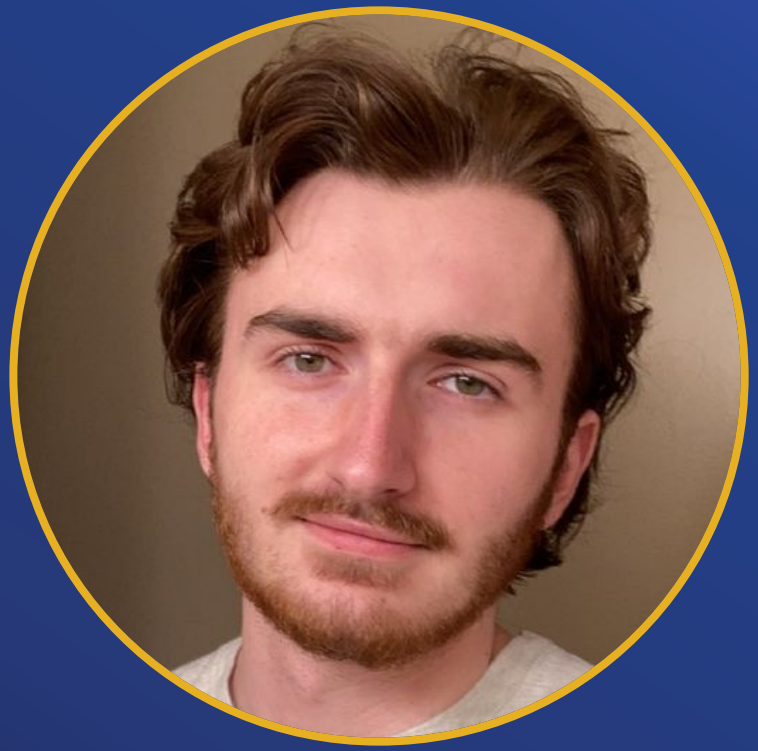


Identifying Rolling Shutter Distortion

by Nick Hall

ZEROEYES

Nick Hall



github.com/hall-nicholas

What is ZeroEyes?

- Uses AI to prevent & mitigate active shooter scenarios
- Robust, multilayered approach including a “human-in-the-loop” to negate false positives
- Active in thousands of cameras in schools, corporate campuses, government buildings, etc. nationwide

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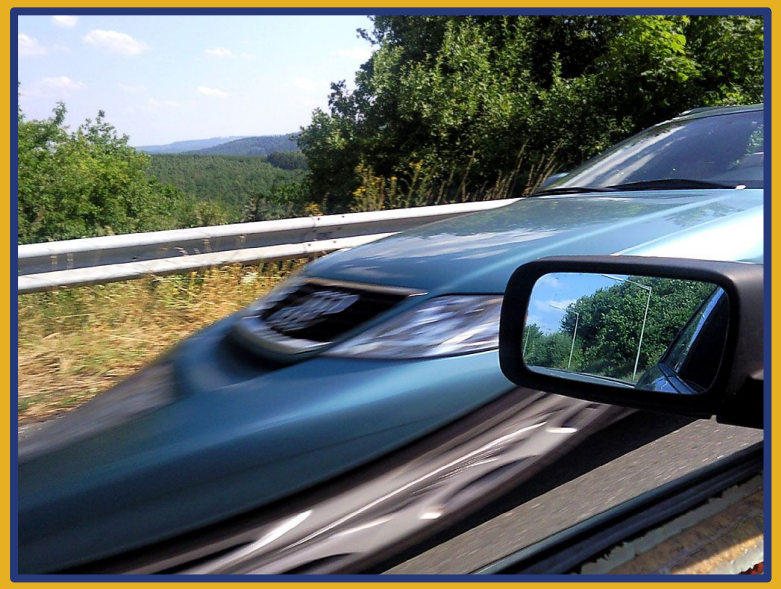

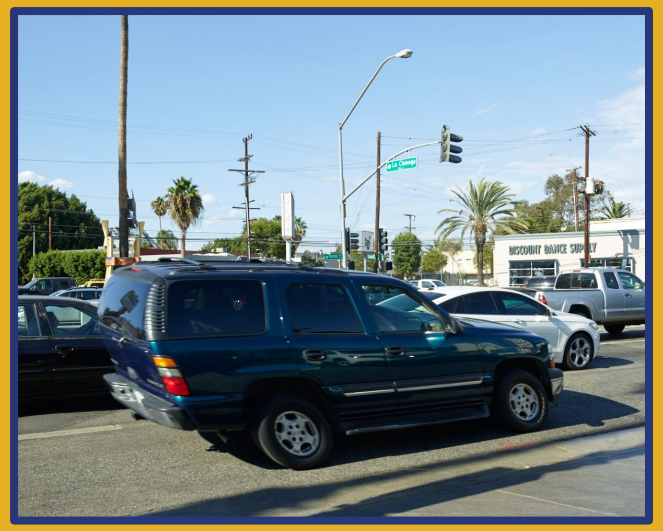

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What is rolling shutter?

Rolling shutter

- Captures pixels *sequentially*
- Typically offers higher frame rate for price point
- **Delay between first & last pixel**

Global shutter

- Captures pixels *simultaneously*
- Typically offers *lower* frame rate for price point
- No delay between first & last pixel

- Commonly found on consumer & commercial cameras

Why this matters:

- **ZeroEyes is camera agnostic, it already operates on many rolling shutter cameras**
- **Rolling shutter distortion can modify the appearance of objects and impact detection**
- **In the context of ZeroEyes, examples of how this could impair detection capabilities include:**
  - Shooter running quickly down a hallway
  - Shooter in fast-moving vehicle with gun exposed
  - Shooter turning his/her body quickly

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Create tool to detect rolling shutter distortion

Objective:

Potential uses:

- First step in a process to attempt to repair this distortion
- Identify cameras that often produce distorted images

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Data

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Data synthesis

Unfortunately, there is **no readily available data** on rolling shutter distortion

Solution:

➢ Synthesize data using **an existing dataset**

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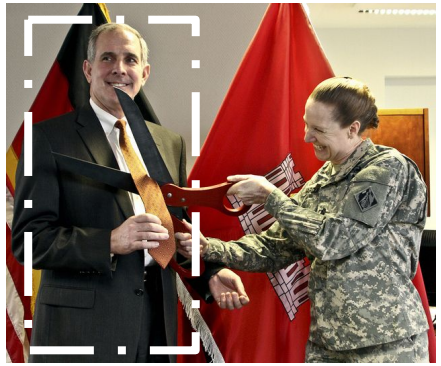
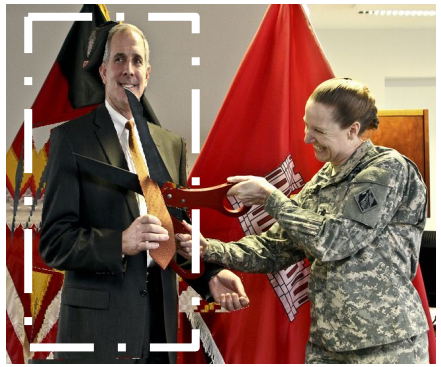
Data synthesis

Using the **COCO 2017 dataset**, synthesized new data with a custom rolling shutter effect:





- Used people as a target for model
- Extracted polygonal segmentation annotations provided by COCO
- Applied a custom rolling shutter effect to the area within the segmentation

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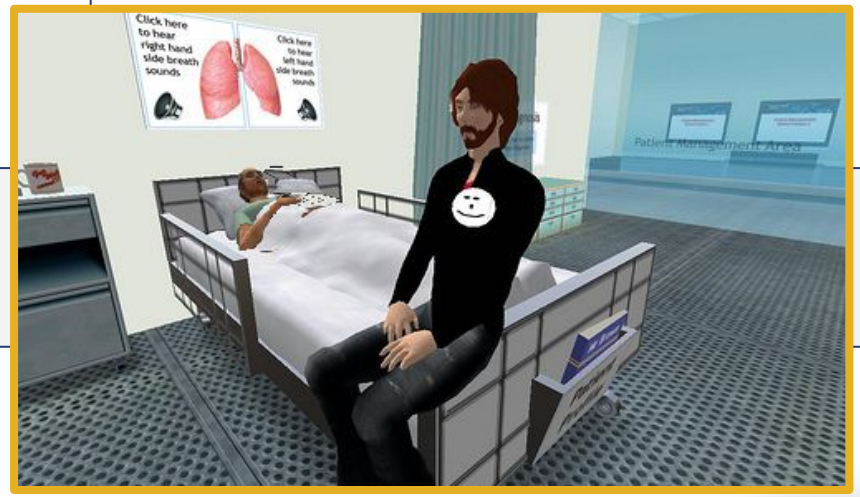
Common Objects in Context

Strengths	Limitations
Over 330,000 images in total	Imprecise annotation boundaries
Over 200,000 annotated images	Some inaccurate annotations
Multiple types of annotations	
Benchmark for ML algorithms	



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Model

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Model comparison

Model	Precision	**Accuracy**
Random forest	*.47*	**.48**
Logistic regression	*.51*	**.52**
MobileNetV3Large	*.50*	**.57**

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Conclusions & Recommendations

ZERO EYES

Conclusions & Limitations

- Suitable as a proof of concept, but needs to be improved upon with real-world data
- Inaccurate/imprecise COCO annotations hampered data synthesis process
- Pre-existing distortion within COCO datasets were unaccounted for

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Future Recommendations

- Implement different neural network architectures
- Obtain more accurately annotated data to synthesize with
- Experiment with creating different types of artificial rolling shutter distortion (ex. rotational)
- Explore locating & reversing rolling shutter distortion within an image

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Thank you!