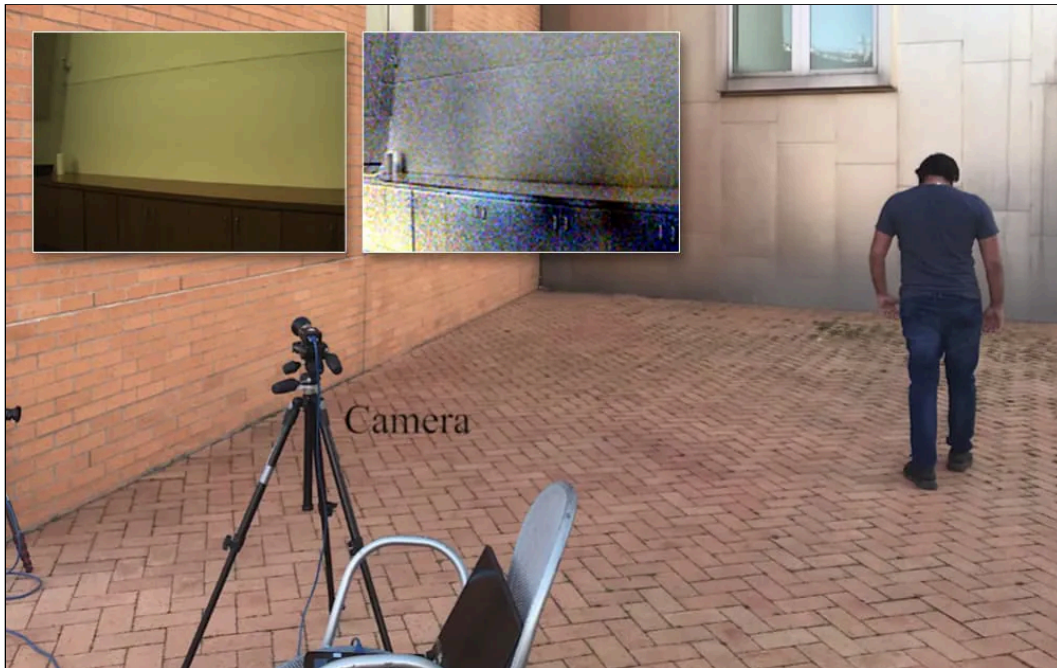
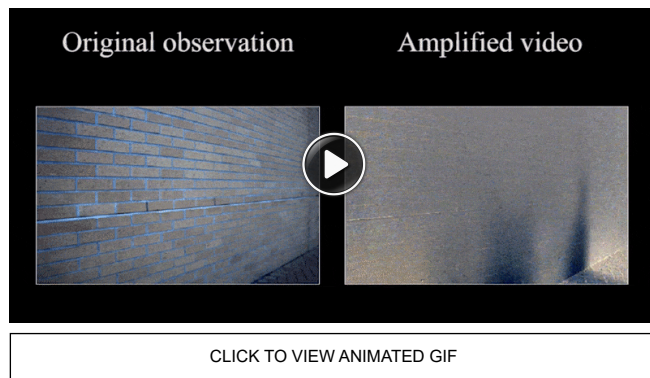


AI Uncovers the Secret Activity Revealed by Blank Walls

Originally published at <https://www.unite.ai/ai-uncovers-the-secret-activity-revealed-by-blank-walls/>



A research collaboration, including contributors from NVIDIA and MIT, has developed a machine learning method that can identify hidden people simply by observing indirect illumination on a nearby wall, even when the people are nowhere near the illuminating light sources. The method has an accuracy near to 94% when attempting to identify the number of hidden people, and can also identify the specific activity of a hidden person by massively amplifying light bounces that are invisible to human eyes and to standard methods of image amplification.



Imperceptible perturbations of light, amplified by the new method, which uses convolutional neural networks to identify areas of change. Source: <https://www.youtube.com/watch?v=K4PapXyX-bl>

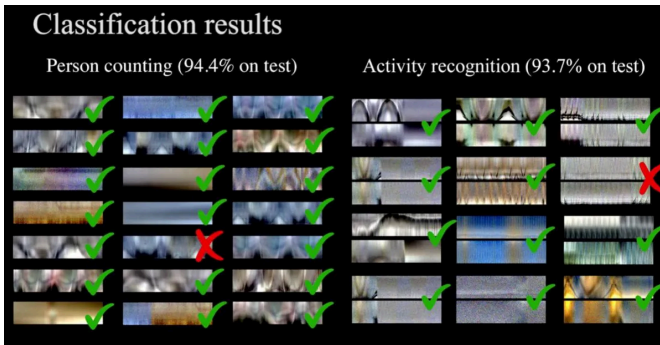
The new [paper](#) is titled *What You Can Learn by Staring at a Blank Wall*, with contributions from NVIDIA and MIT, as well as the Israel Institute of Technology.

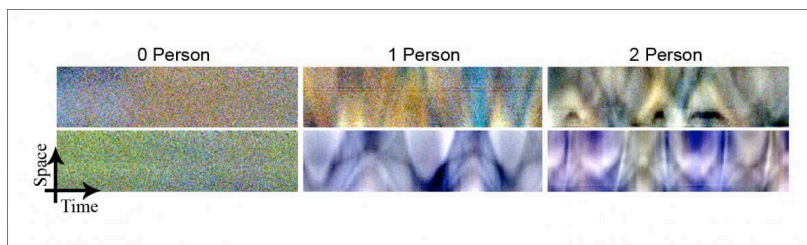
Prior approaches to 'seeing around walls' have relied on controllable light sources, or prior knowledge of known sources of occlusion, whereas the new technique can generalize to any new room, with no requirement for recalibration. The two convolutional neural networks that individuate hidden people used data obtained from only 20 scenes.

The project is aimed at high-risk, security-critical situations, for search and rescue operations, general law enforcement surveillance tasks, emergency response scenarios, for fall detection among elderly people, and as a means to detect hidden pedestrians for autonomous vehicles.

Passive Evaluation

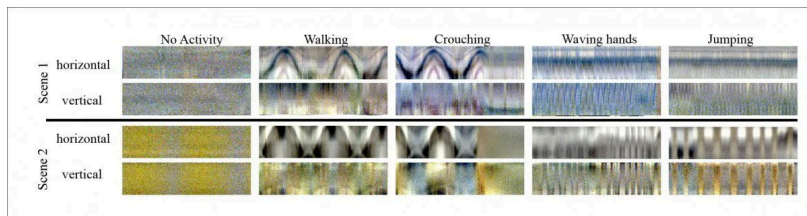
As is frequently the case with computer vision projects, the central task was to identify, classify and operationalize perceived state changes in an image stream. Concatenating the changes leads to signature patterns that can be used either to identify a number of individuals or to detect the activity of one or more individuals.





Signature space-time plots representing different numbers of hidden people in a room.

Different human activities will also result in signature perturbations which can be classified and later recognized:



The space-time plot signatures for inactivity, walking, crouching, waving hands, and jumping.

In order to produce an automated machine learning-based workflow for hidden person recognition, varied footage from 20 apposite scenarios was used to train two neural networks operating on broadly similar configurations – one to count the number of people in a scene, and the other to identify any movement occurring.

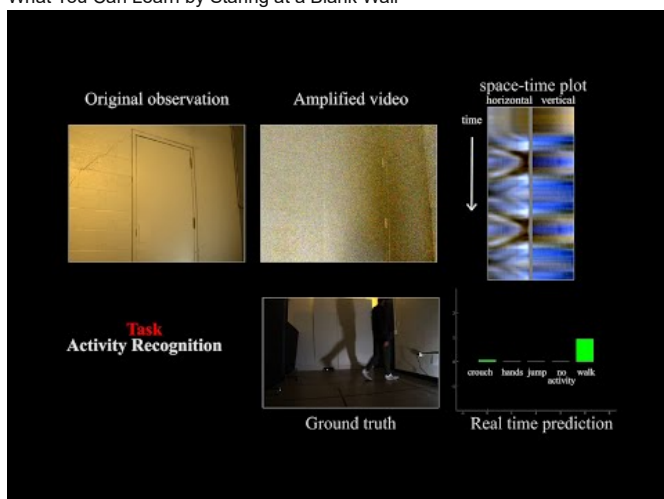
Testing

The researchers tested the trained system in ten unseen real-world environments designed to recreate the limitations anticipated for ultimate deployment. The system was able to achieve up to 94.4% accuracy (over 256 frames – typically just over 8 seconds of video) in classifying the number of hidden people, and up to 93.7% accuracy (under the same conditions) in classifying activities. Though accuracy drops with fewer source frames, it's not a linear drop, and even 64 frames will achieve a 79.4% accuracy rate for 'number-of-people' evaluation (against nearly 95% for four times the number of frames).

Though the method is robust to weather-based changes in lighting, it struggles in a scene illuminated by a television, or in circumstances where the people are wearing monotone clothing the same color as the reflecting wall.

More details of the research, including higher-quality footage of the extractions, can be seen in the official video below.

What You Can Learn by Staring at a Blank Wall



Writer on machine learning, domain specialist in human image synthesis. Former head of research content at Metaphysic.ai, until its dissolution into DNEG's Brahma.ai.

Portfolio site: martinanderson.ai

Contact: martin@martinanderson.ai



Discover More