

FROM SPATIAL PERCEPTION TO MACHINE VISION

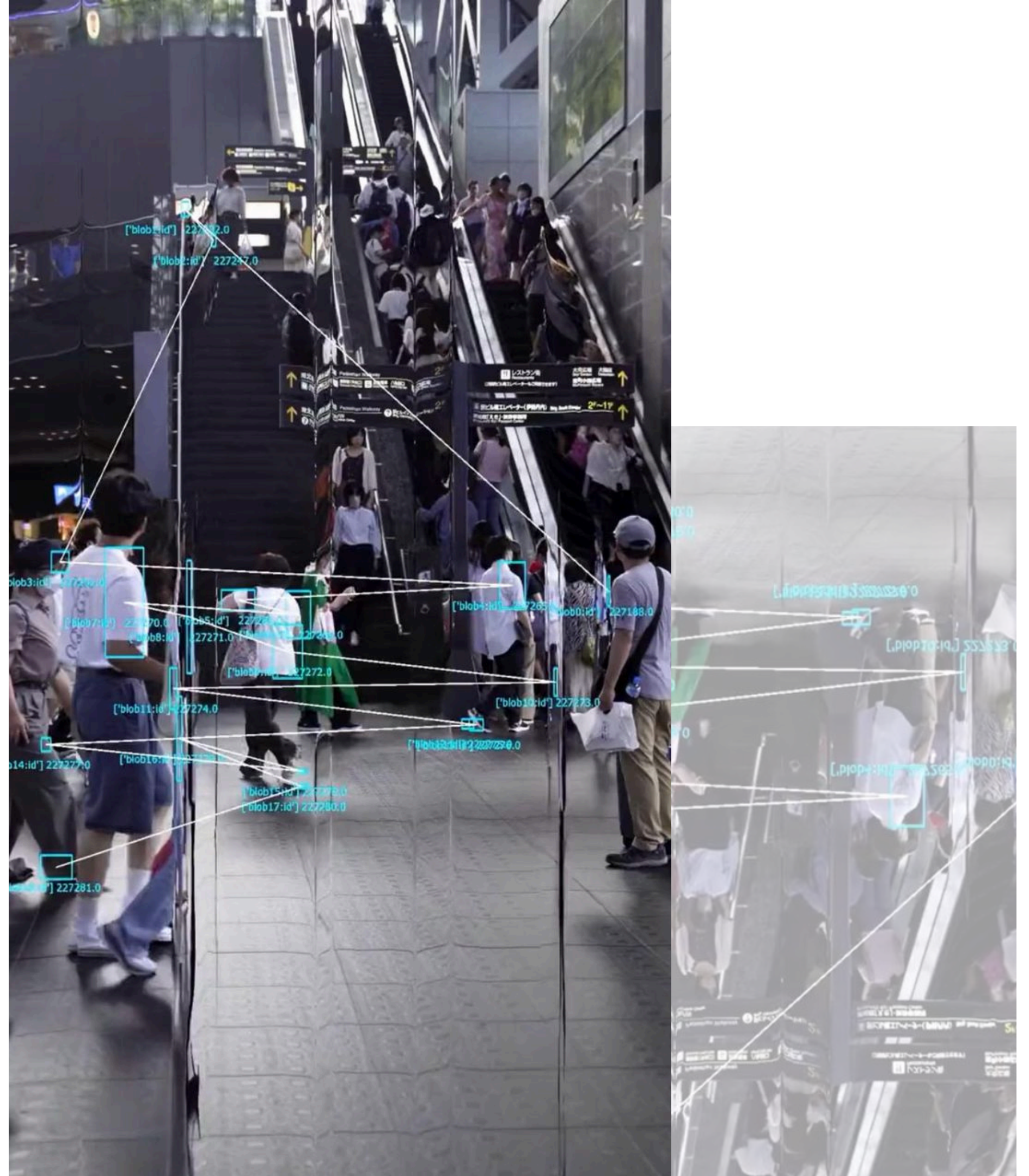
HOW MACHINES
UNDERSTAND SPACE

Z I X U A N Z H A N G



WHY MACHINE VISION?

- Human vs machine perception opens a new way to understand space.
- Machine vision is not “seeing” but computing.
- This talk examines machine perception, media art, and my robotics project.
- Based on four books on AI, technology, cybernetics & sensory environments.



HOW HUMANS PERCEIVE SPACE

- We perceive space through embodied experience: emotion, memory, spatial intuition.
- Space is qualitative, atmospheric, experiential.



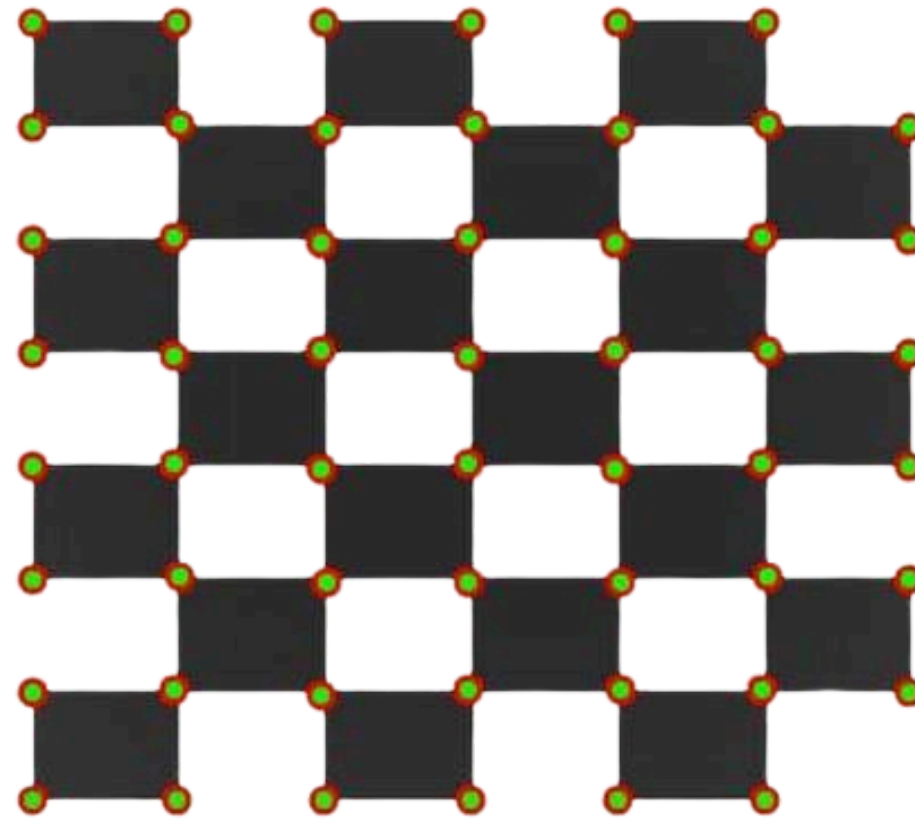
Pepsi Pavilion (1970): fog environment + sound floors + reflective dome transforming perception.



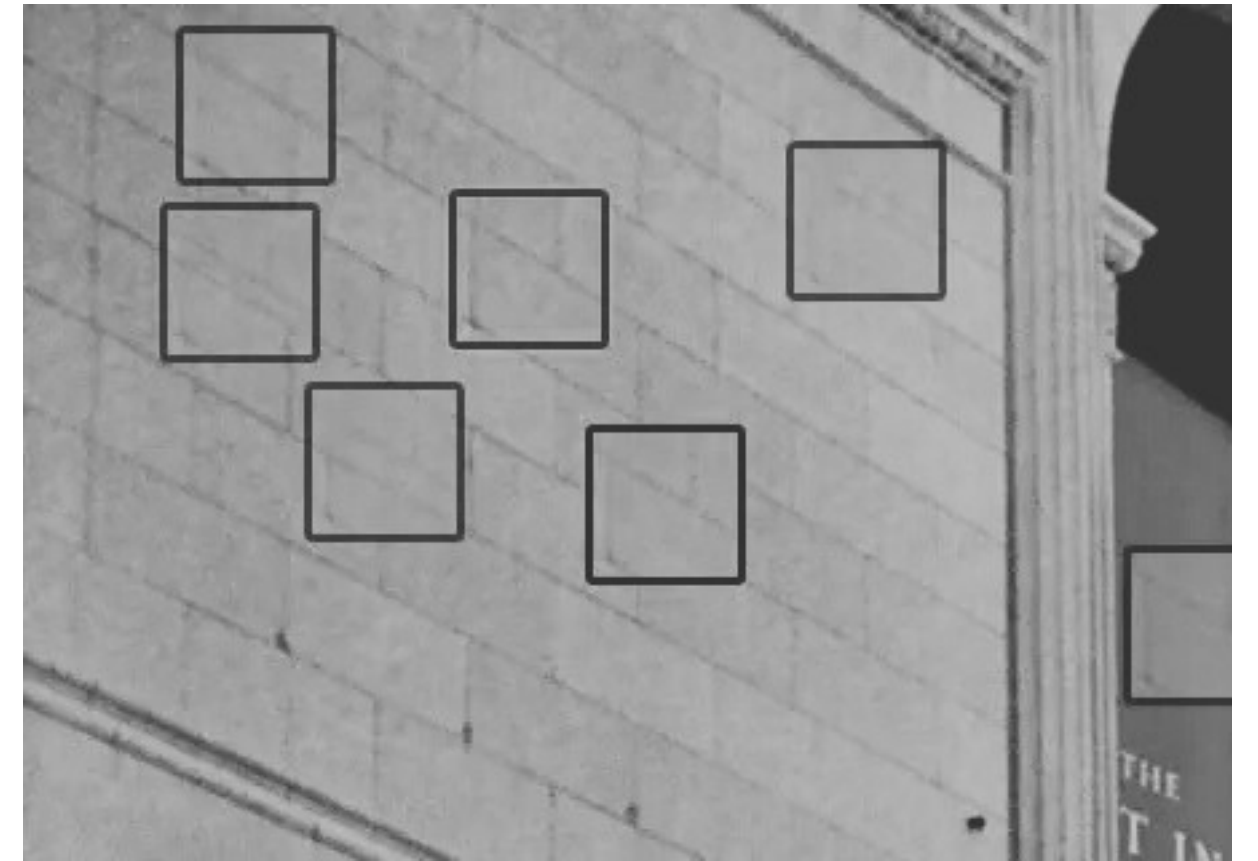
Demonstrates how humans rely on multi-sensory integration.

HOW MACHINES "PERCEIVE" SPACE

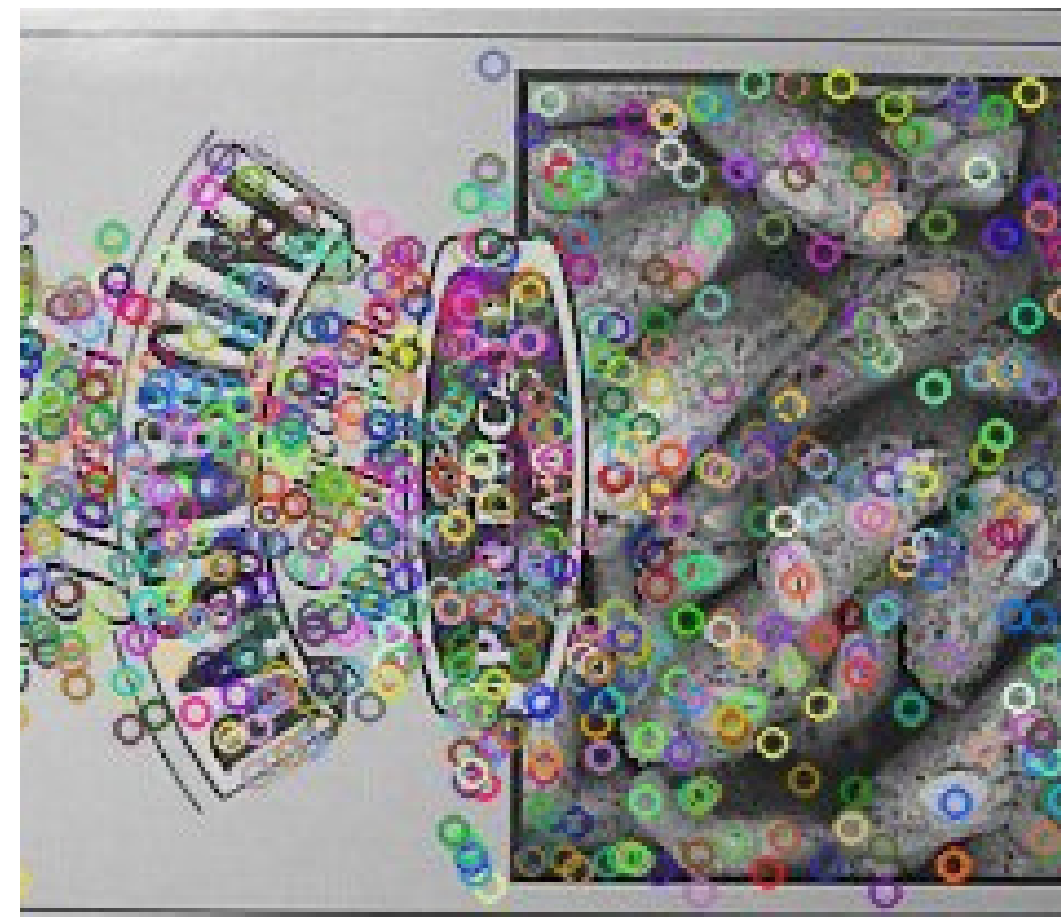
- Machines convert sensory input → pixels → features → coordinates.
- Machine perception is quantitative and geometric.
- No emotion, memory, or abstraction—only computation.



Harris Corner Detector



Corner Detection



Result of the Feature Detection Applied



The Result for the box.in-scene.png image

HARUN FAROCKI: EYE/MACHINE (2001)

- Farocki analyzes “operational images”—images produced for machines rather than for human viewing.
- The work includes footage from industrial robots and military targeting systems.
- Machine vision is shown guiding automated actions such as tracking and welding.

MACHINE VISION



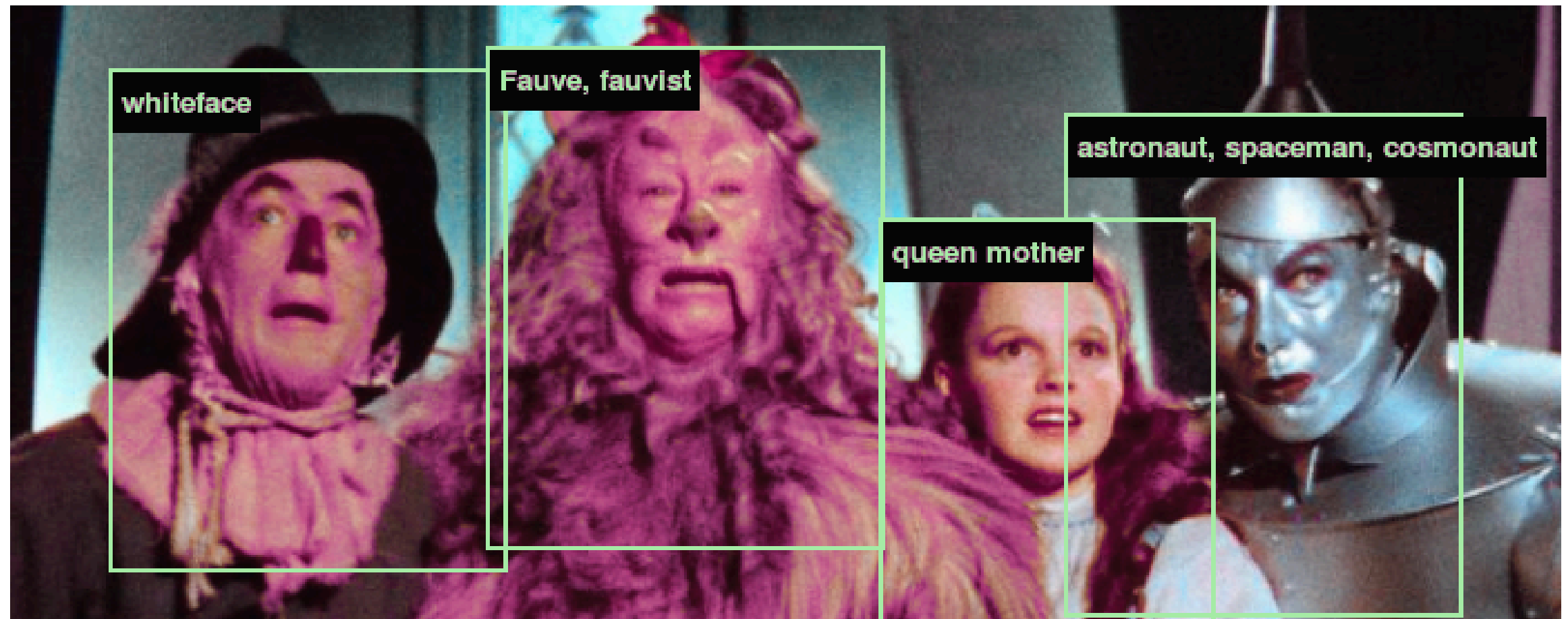
Farocki opens War at a Distance, 2003, with missile footage from the Iraqi war.

TREVOR PAGLEN: IMAGENET ROULETTE (2019)

- Trained using the ImageNet dataset—a foundational dataset in computer vision.
- The model assigned users biased or offensive labels such as “cheerleader,” “failure,” or “rapist.”
- Demonstrates ethical issues in dataset labeling and classification.



Trevor Paglen's "ImageNet Roulette"



ImageNet Roulette Happened



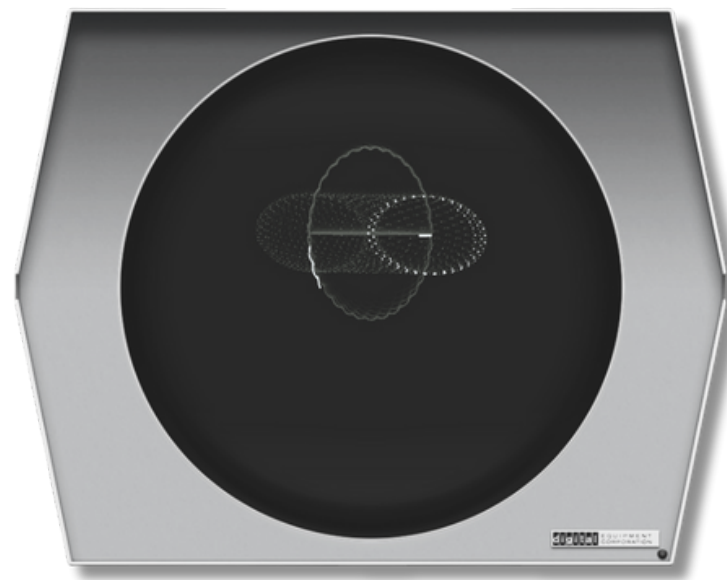
HITO STEYERL: HOW NOT TO BE SEEN (2023)

- Uses military resolution targets and pixel grids to demonstrate how machine vision detects bodies.
- Performance-style instructions parody "training programs" for avoiding automated surveillance.
- Exposes how digital systems define what becomes visible or invisible.

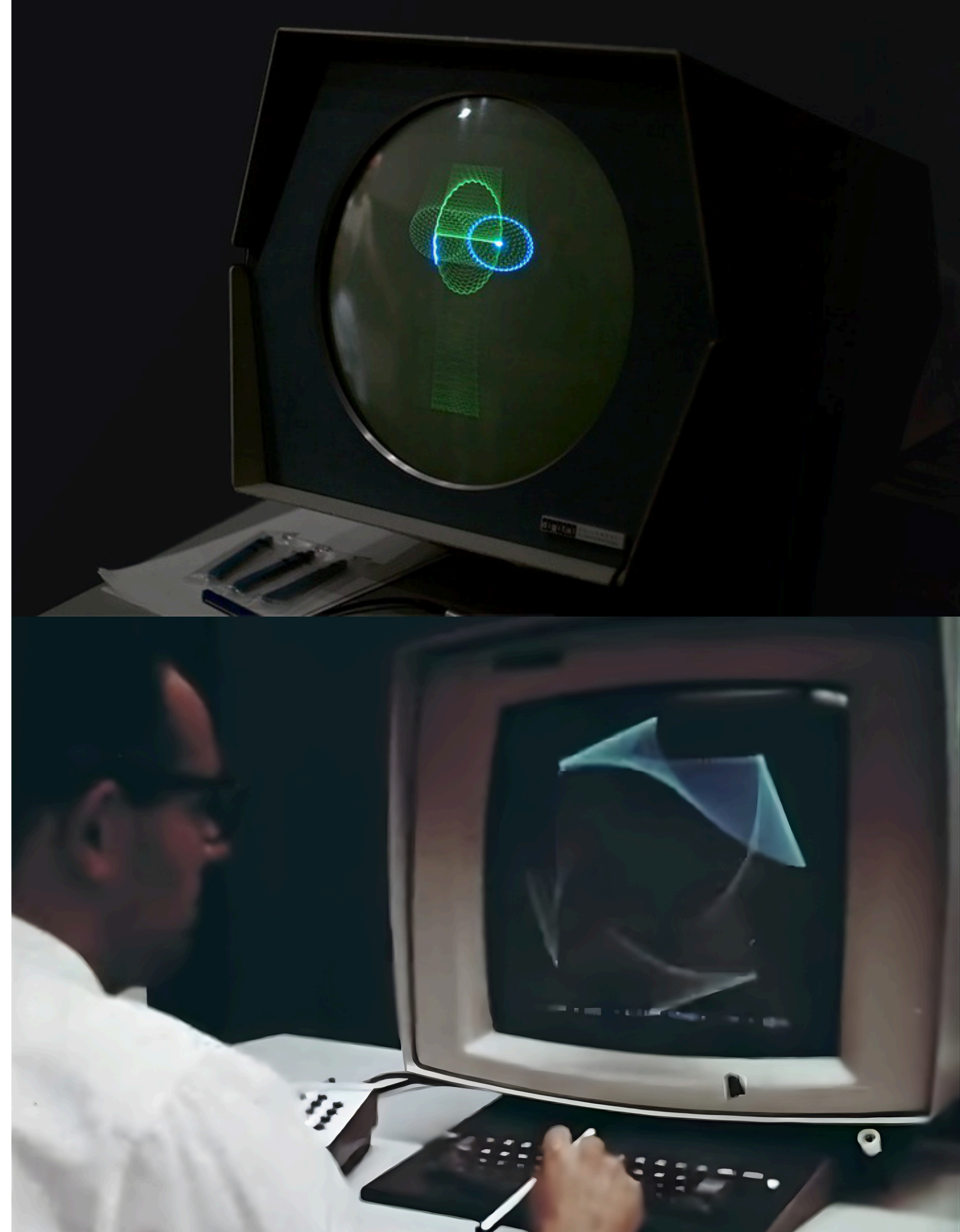
How Not To Be Seen

EARLY COMPUTER VISION EXPERIMENT: THE MINSKYTRON (1960S)

- A computer program simulating particle motion in force fields.
- Produced images algorithmically using time-lapse photography of oscilloscopic output.
- Displayed in the 1968 exhibition Cybernetic Serendipity.



<https://www.masswerk.at/minskytron/>

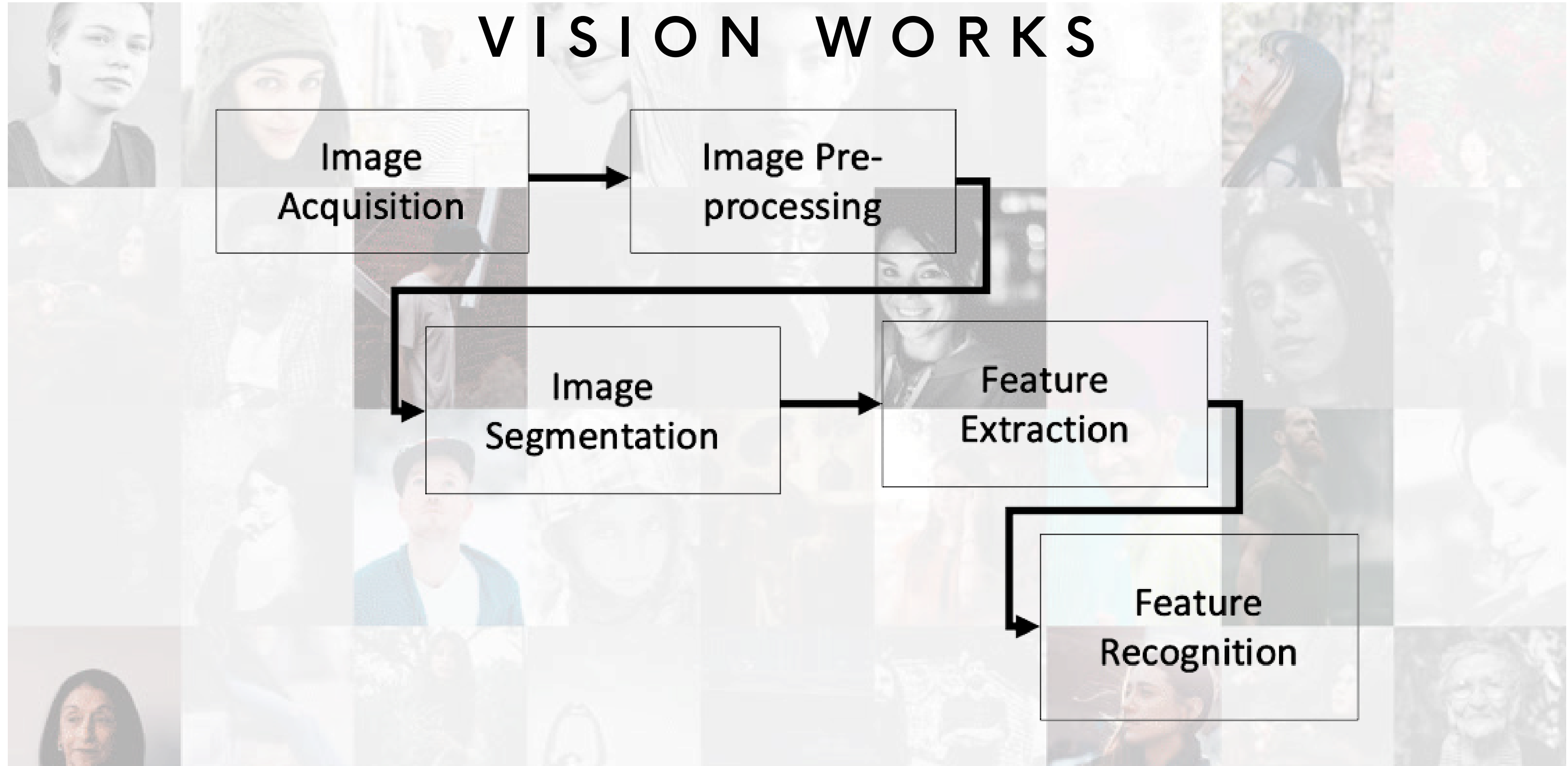


AMAZON ROBOTICS & VISION-BASED WAREHOUSES

- Robots use QR codes for navigation.
- Machine vision verifies item placement and shelf inventory.
- Human robot collaboration depends on real-time detection.
- Space becomes highly structured for machine readability.

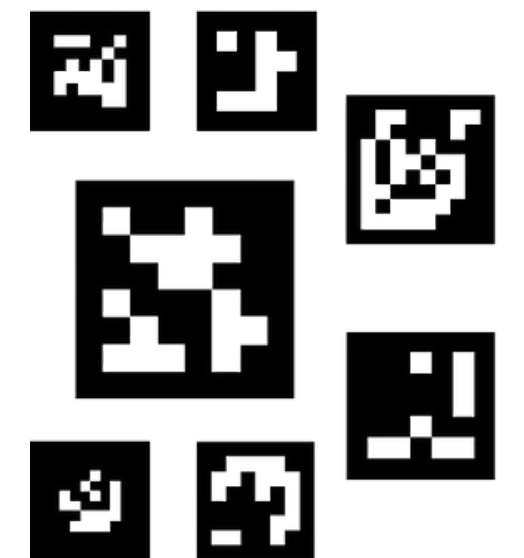


HOW MACHINE VISION WORKS



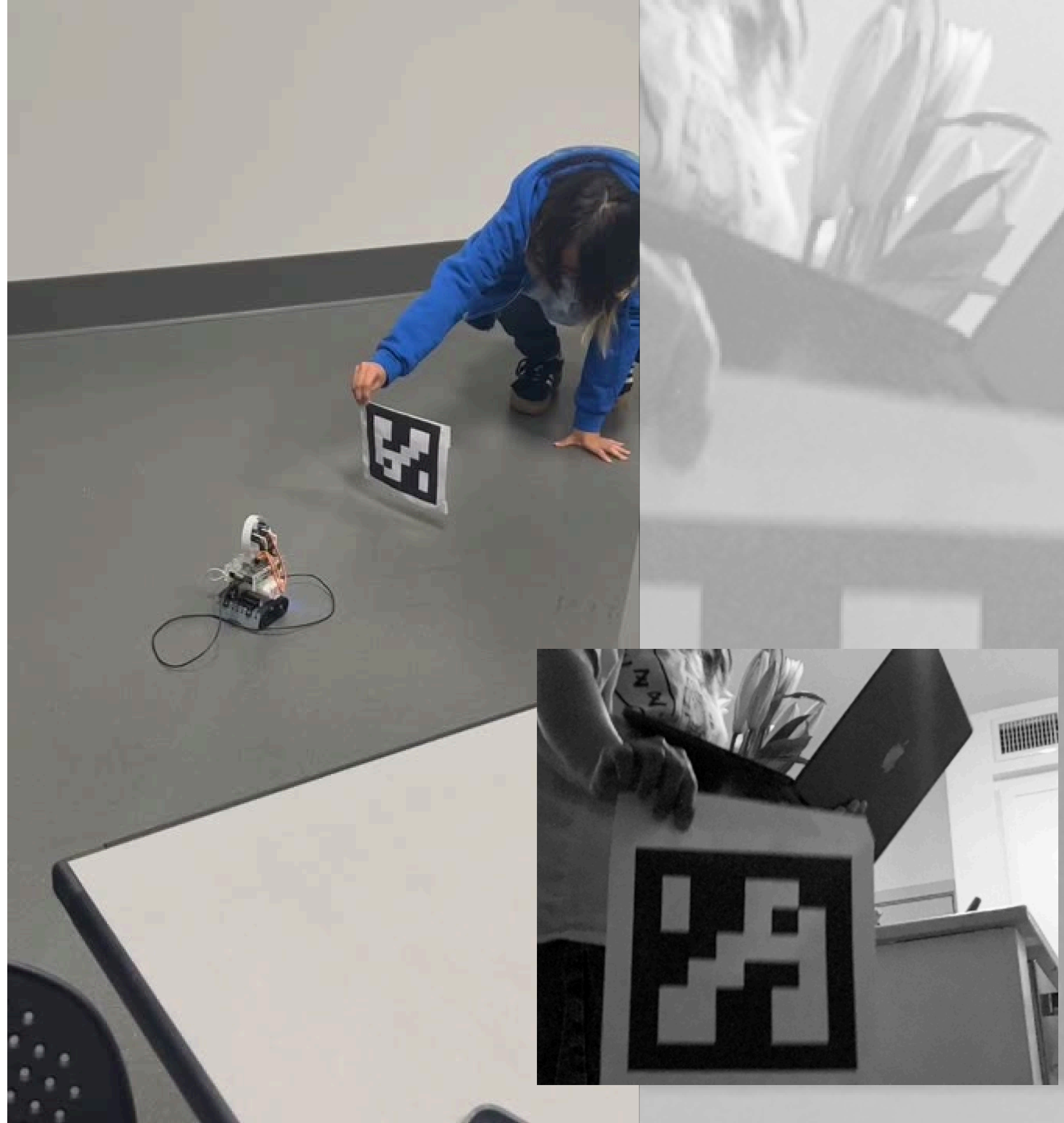
ARUCO MARKERS: A MACHINE- READABLE LANGUAGE

- Used in drone landing systems for precise autonomous navigation.
- Applied in warehouse automation for robot localization and coordination.
- Can Detect
 - ID number
 - Rotation
 - Orientation
 - Distance
 - 3D pose estimation
- Ideal for robot navigation and tracking



ROBOTICS CASE STUDY (XUE GAO & ZIXUAN ZHANG)

- Raspberry Pi camera detects ArUco marker
- Calculates distance + angle
- Sends commands via serial to Zumo 32u4
- Zumo adjusts motion to follow or maintain a constant distance
- Machine vision = spatial relationship control



WHY MACHINE VISION MATTERS FOR FUTURE SPATIAL DESIGN

Machine vision will influence:

- Autonomous navigation in architecture
- Smart environments that respond to users
- Adaptive lighting, HVAC, accessibility
- Human-robot coexistence in shared spaces
- Data-driven spatial planning



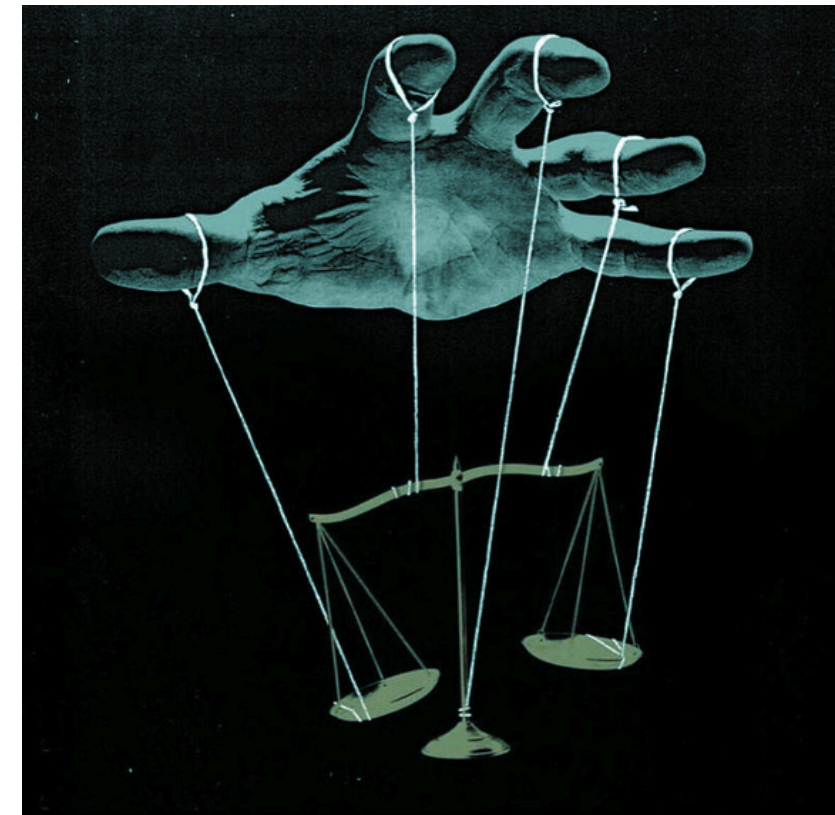
ETHICAL & CULTURAL IMPLICATIONS



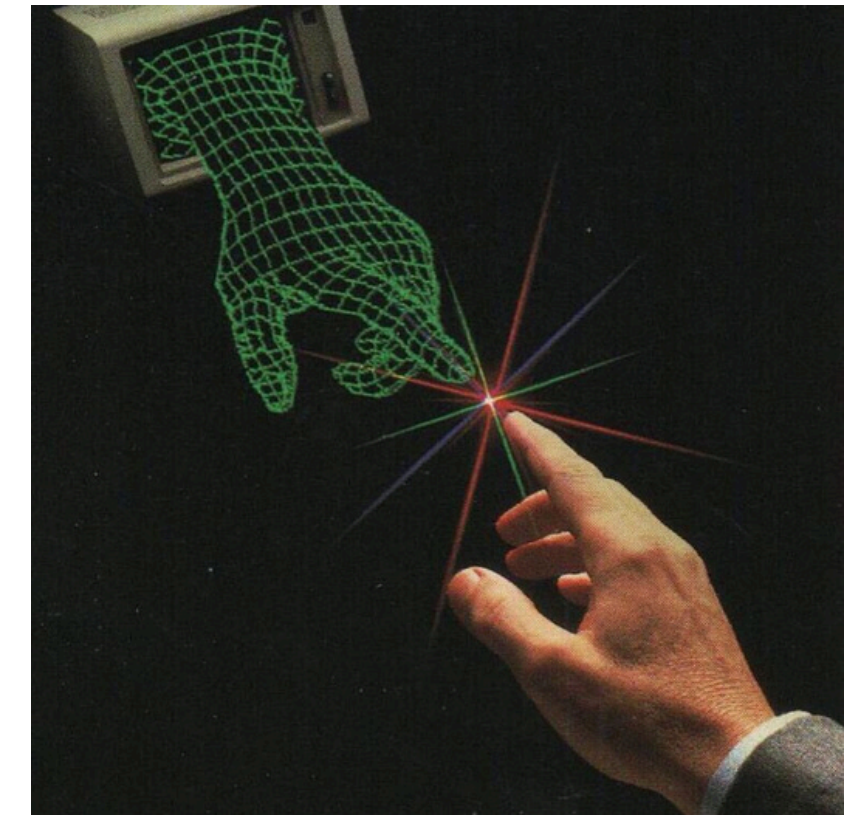
- Surveillance & Data Extraction



- Classification Bias



- Political Consequences of Automated Spatial Control



- Who Has The Right to "See" a Space?

WHAT DOES IT MEAN FOR MACHINES TO "SEE" ?

Do machines truly "see," or do they only calculate?

How does machine perception reshape the meaning of space?

What happens when human perception and algorithmic perception conflict?

How should designers respond to the rise of machine-readable environments?



CONCLUSION

Machine vision = computation, not human sight

Art exposes invisible machine perception systems

Robotics show how machine perception controls movement

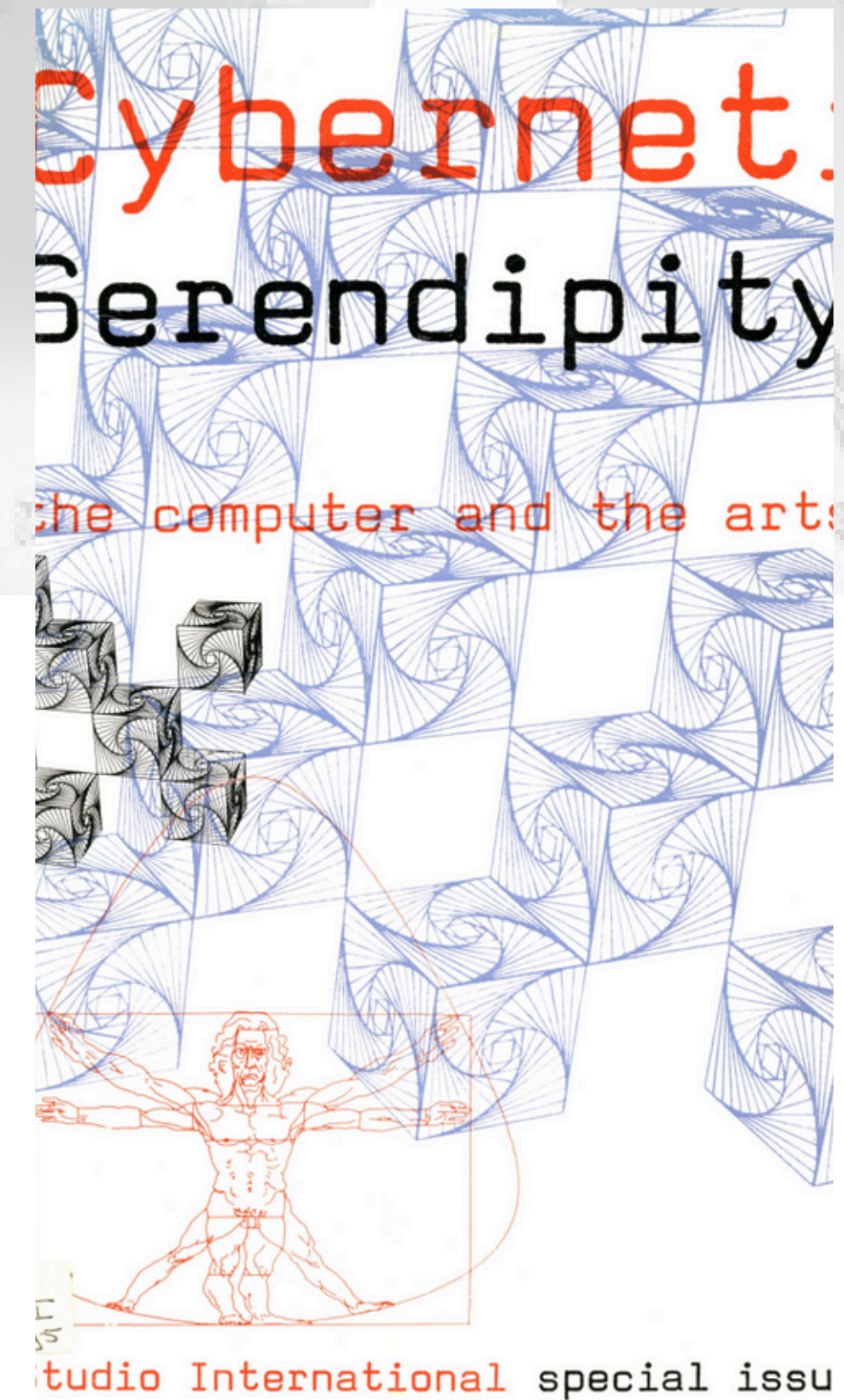
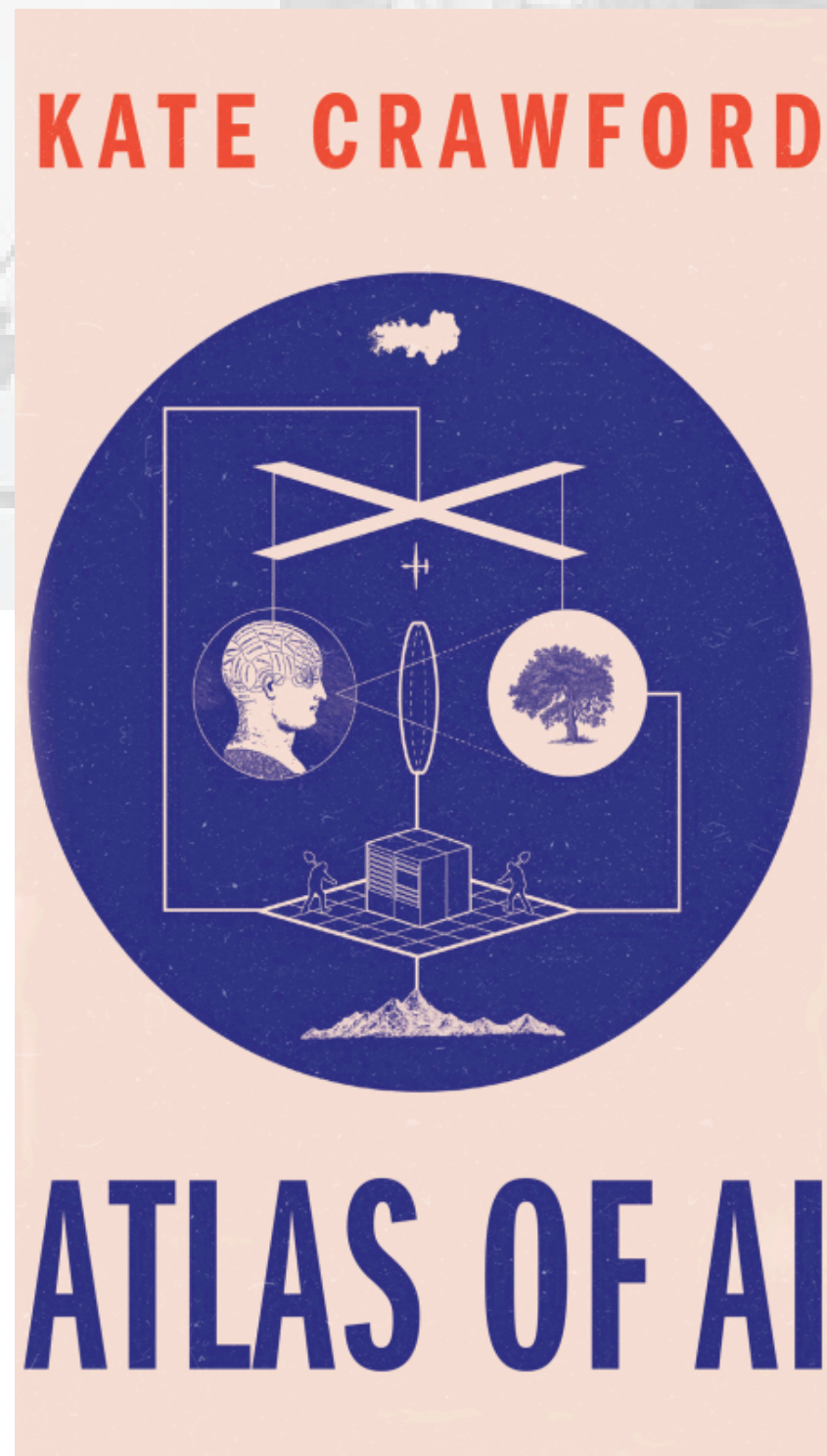
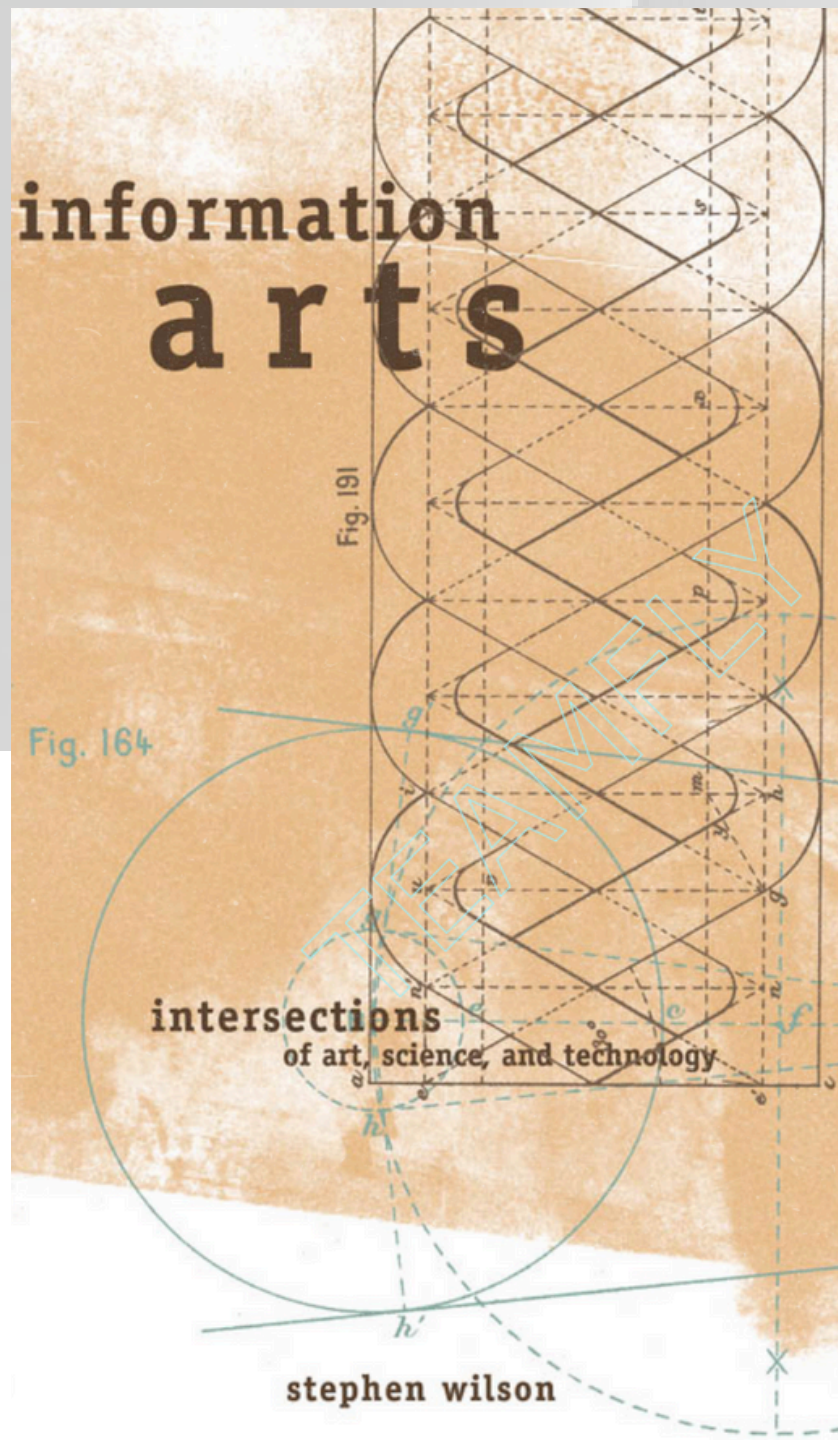
Future design involves both human & machine perception

Understanding machine vision reshapes how we build environments

MACHINE VISION



BOOKS REFERENCES





and let thy feet
millenniums hence
be set in midst of knowledge

THANK YOU