2018 Predictive Analytics Symposium

Session 32: ALL - Introduction to Computer Vision and Its Applications in Insurance

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Swiss Re

Introduction to Computer Vision and its Applications in Insurance

SOA Predictive Analytics Symposium 2019

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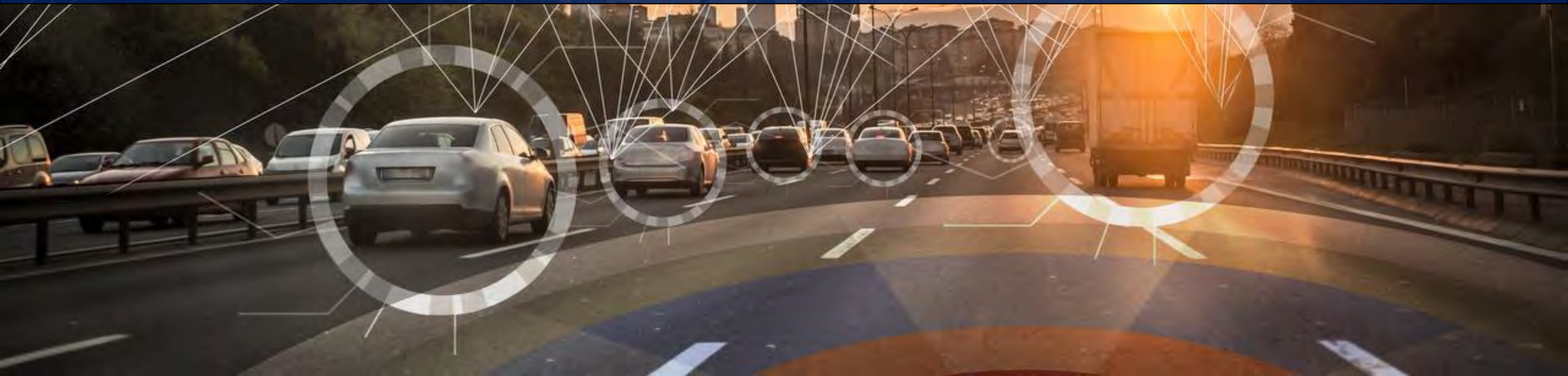


Branches of Artificial Intelligence

Machine Learning

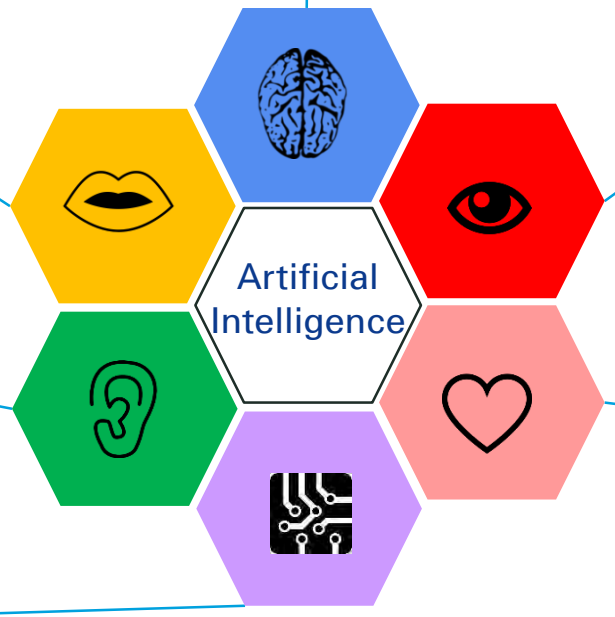
Research on fundamental methods in statistical analysis on how to reason, learn and make inference.

Natural Language Processing

Analyze textual data written in human language, from words, syntactic structure, to semantic meaning.

Computer Vision

Process images and videos. Recognize objects, identifying depth of objects, direction of light, and the interpretation of images.



Speech Recognition

Process signals and transform waveforms into words and sentences.

Affective Computing

Studies the computing that relates to, arises from, or deliberately influences emotion or other affective phenomena.

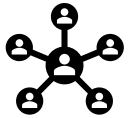
Robotics

Design and build machineries by using computer systems for their control, sensory feedback, and information processing.

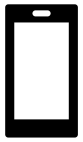
The Value Computer Vision Brings to Insurers

More accurate risk assessment

Better decision on portfolio management



Enhanced customer satisfaction



Easy adoption of insurance smart devices

Less fraudulent claims

Sales & Marketing → Application / Submission → Costing & Pricing → Underwriting → Inforce Management → Claim Management → Risk Management

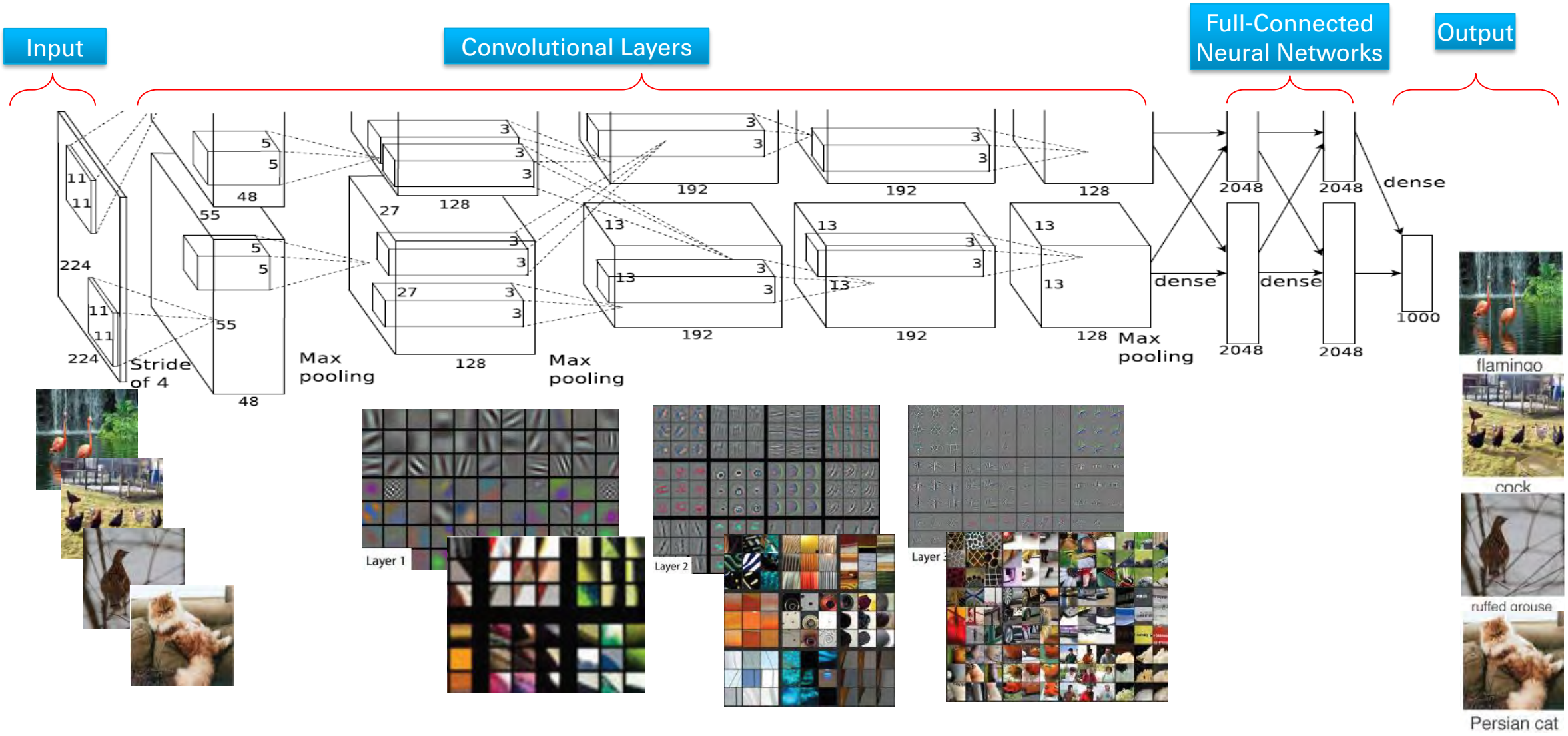
More efficient processing of application submission

Reduced claim settlement time

Increased underwriting capacity

Improved claim adjusters' efficiency

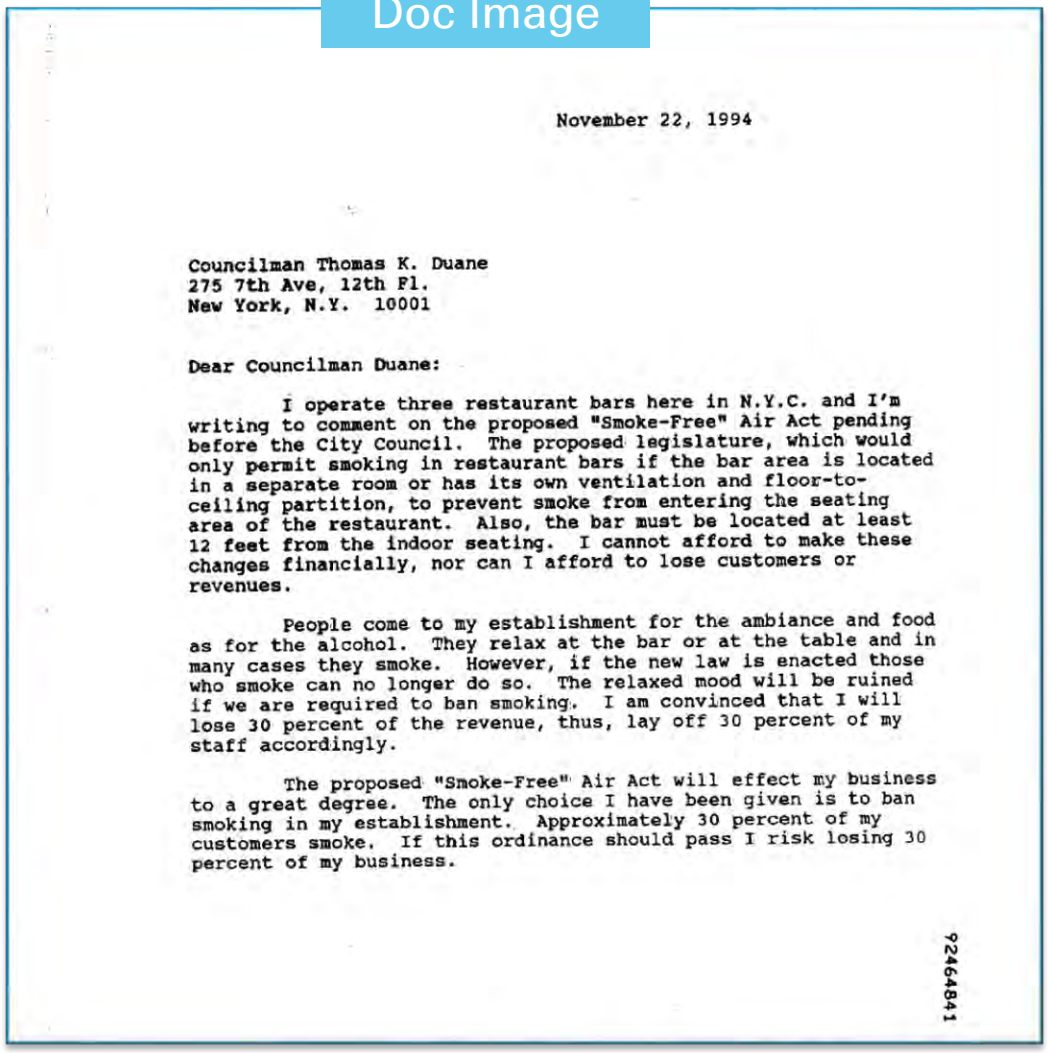
Computer Vision with Deep Learning



ImageNet Classification with Deep Convolutional Neural Networks, Krizhevsky, Sutskever, and Hinton, 2012

Applications: OCR & Text Intelligence

Doc Image



November 22, 1994

Councilman Thomas K. Duane
275 7th Ave, 12th Fl.
New York, N.Y. 10001

Dear Councilman Duane:

I operate three restaurant bars here in N.Y.C. and I'm writing to comment on the proposed "Smoke-Free" Air Act pending before the City Council. The proposed legislature, which would only permit smoking in restaurant bars if the bar area is located in a separate room or has its own ventilation and floor-to-ceiling partition, to prevent smoke from entering the seating area of the restaurant. Also, the bar must be located at least 12 feet from the indoor seating. I cannot afford to make these changes financially, nor can I afford to lose customers or revenues.

People come to my establishment for the ambiance and food as for the alcohol. They relax at the bar or at the table and in many cases they smoke. However, if the new law is enacted those who smoke can no longer do so. The relaxed mood will be ruined if we are required to ban smoking. I am convinced that I will lose 30 percent of the revenue, thus, lay off 30 percent of my staff accordingly.

The proposed "Smoke-Free" Air Act will effect my business to a great degree. The only choice I have been given is to ban smoking in my establishment. Approximately 30 percent of my customers smoke. If this ordinance should pass I risk losing 30 percent of my business.

92464841

Machine Readable Text

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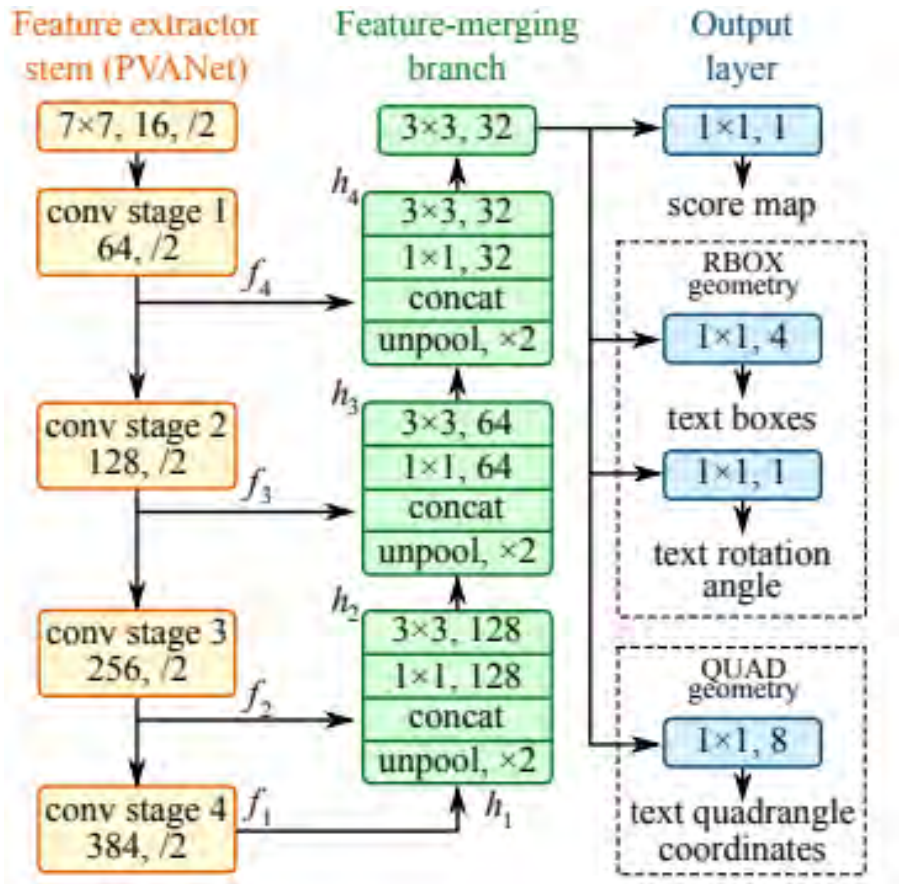
OCR in the Wild

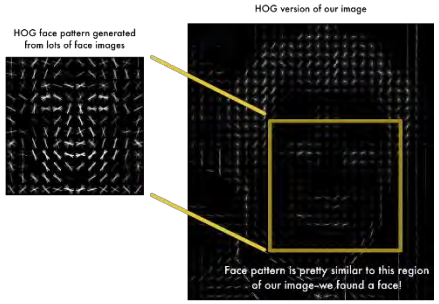
EAST: An Efficient and Accurate Scene Text Detector

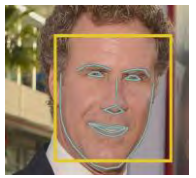


Zhou 2017, https://arxiv.org/abs/1704.03155

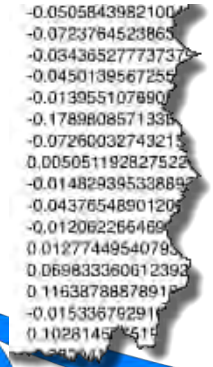
http://www.pyimageresearch.com

Facial Recognition





128x1 vector

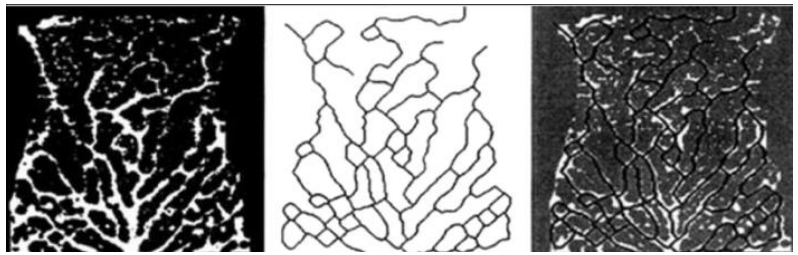


Will Ferrell

Cattle Images

Limited research on cattle face recognition

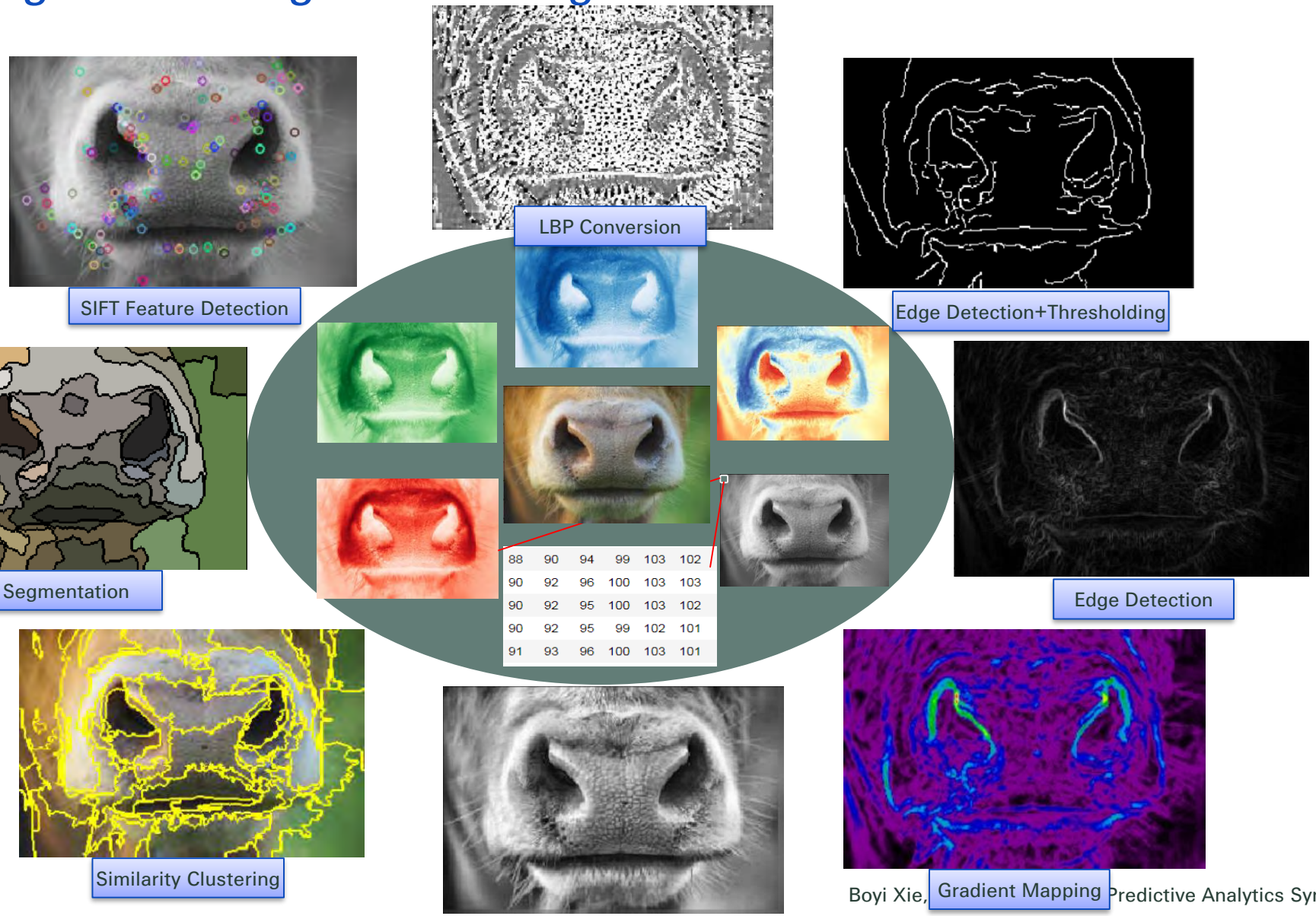
Potential Uniqueness: Texture and Features



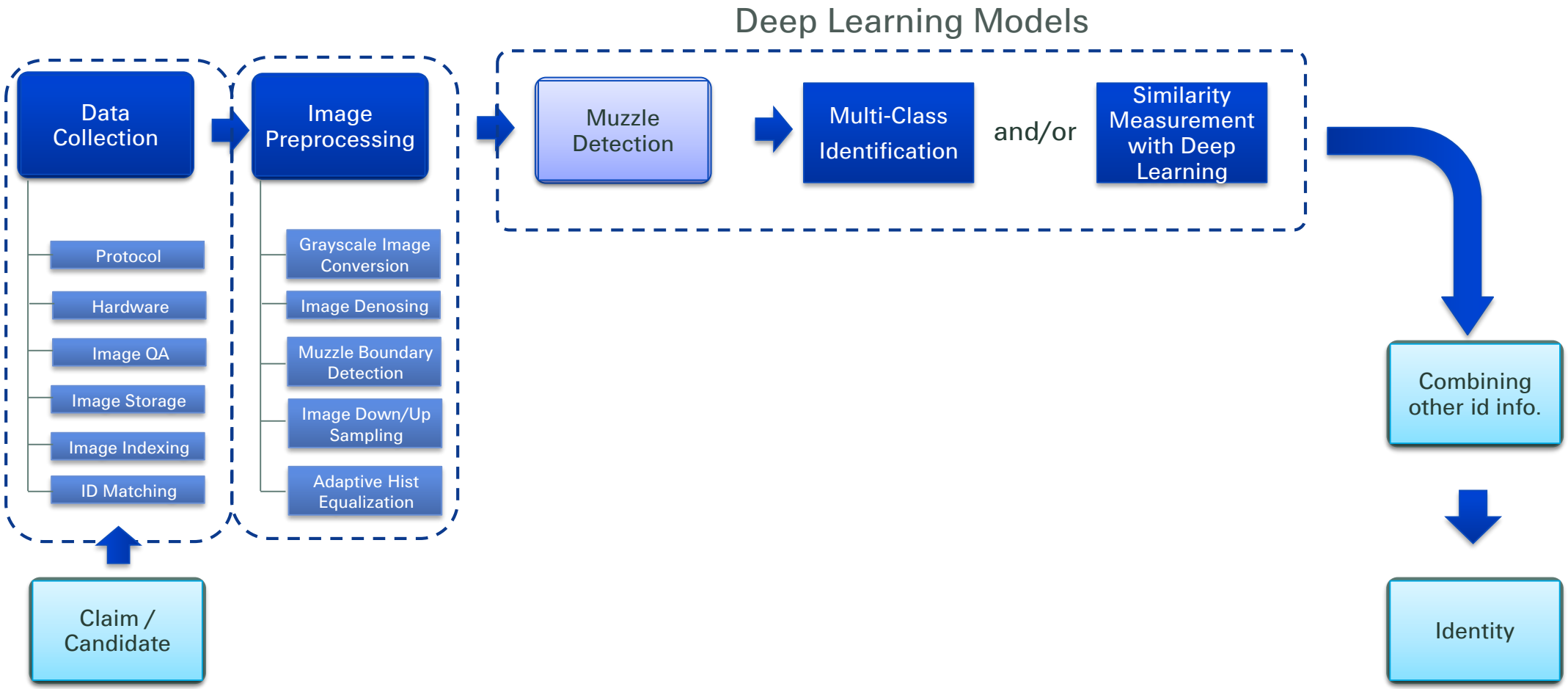
Feature Mapping and/or Deep Learning

S. Kumar, S. Kumar Singh, and A. Kumar Singh, Muzzle point pattern based techniques for individual cattle identification, IET Image Processing 2017

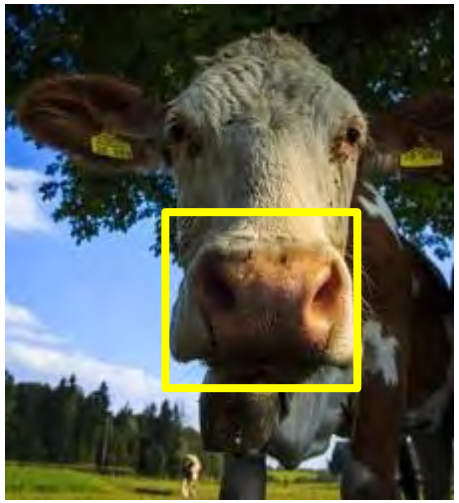
Digital Images and Image Processing



Cattle Identification Workflow

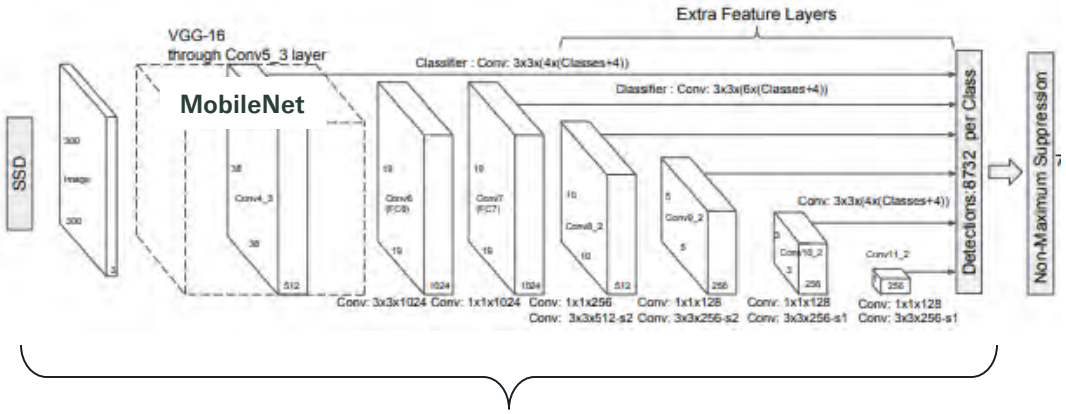


Muzzle Detection
- Transfer Learning Based on Google's Object Detection API



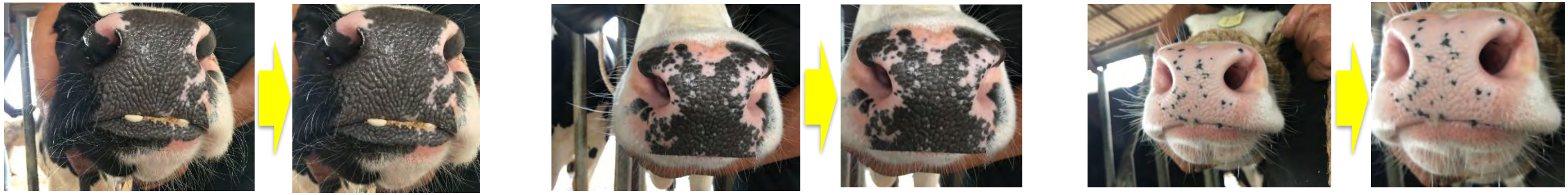
Data: Images of ~ 450 cows (Pixabay) with their muzzles labelled

Single Shot Multibox Detector (SSD) with MobileNet



Pre-trained with Oxford IIIT Pets data

- Trained network using Google's Object Detection API
- Used trained network to perform muzzle detection for images of 90 cows collected by a client in Thailand
- Each cow was photographed from 5 different angles of 4 different smart phones

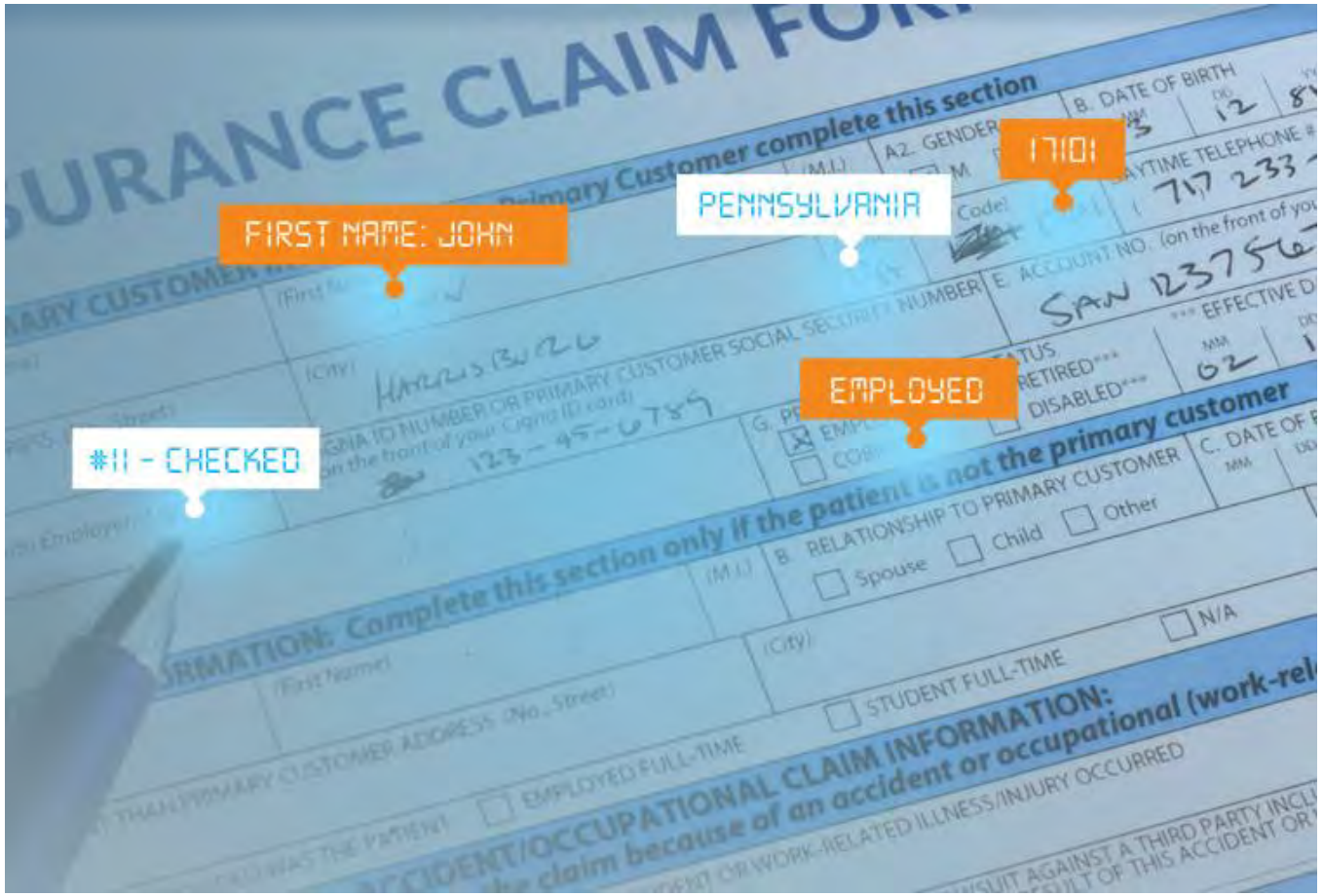


Cow Recognition in Action

cainthus

MOOO FARM

OCR & Content Intelligence



- Process legacy application forms
- Digitalize documents to enable data analysis
- Speed up the processing of insurance application
- Faster claims assessment

http://captricity.com/technology/

Video Surveillance to Mitigate Risk

- Robots with Computer Vision technologies are deployed to mitigate commercial and habitational risk

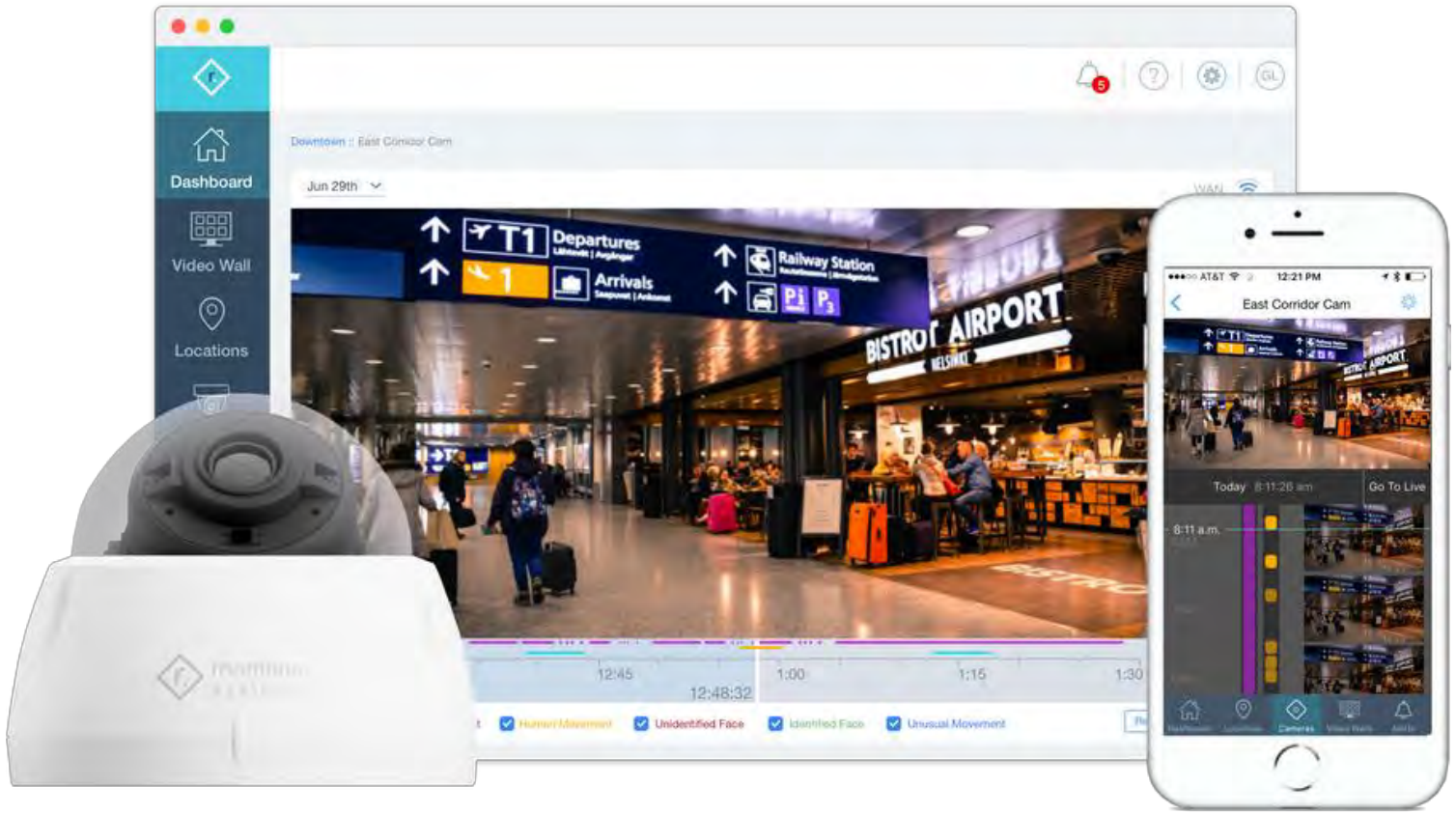
"RoboCop" at Huntington Park

Security robot at North Central Texas College

Security robot at Westfield shopping mall

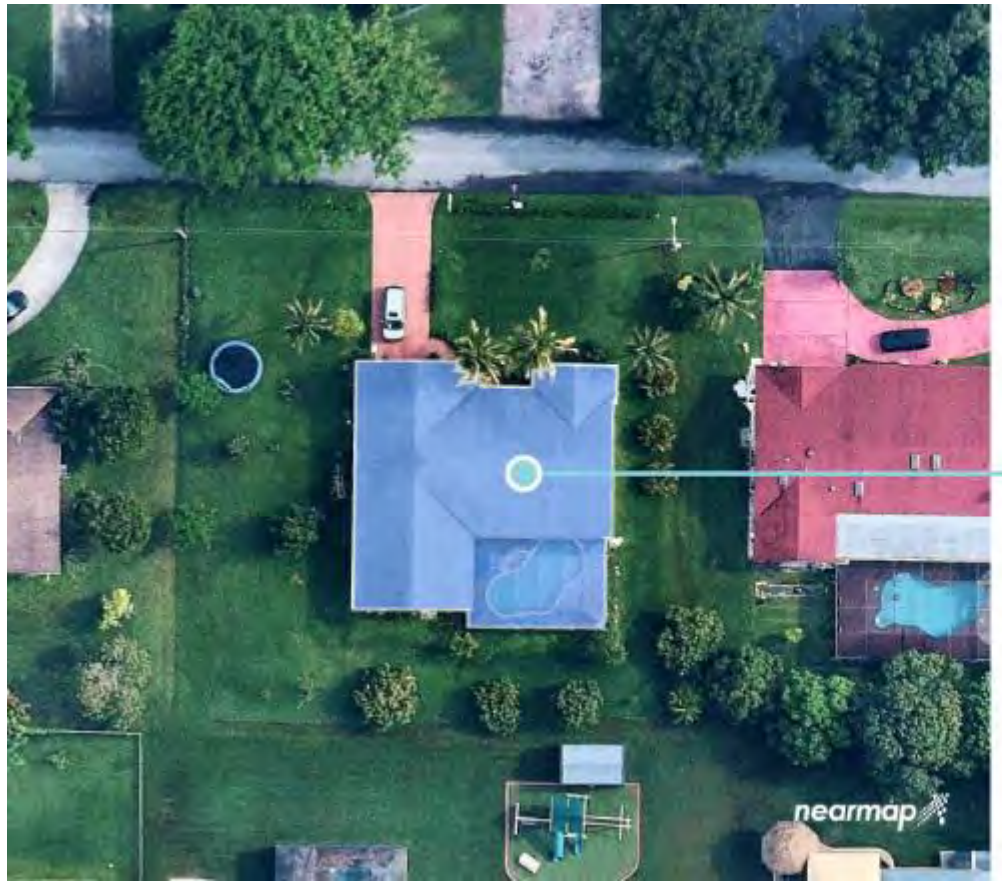
Video Surveillance to Mitigate Risk

rhombus systems



- Gain better visibility throughout your organization and know when things aren't right.
  - Motion, object, and vehicle detection
  - Facial recognition with unidentified people alerts
  - Foot traffic measurements and unique people counting
  - Unusual Behavior and Fall Detection
  - Customizable smart alerts

Image Analysis to Detect Property Profiles



TURNING IMAGERY INTO PROPERTY SPECIFIC INTELLIGENCE

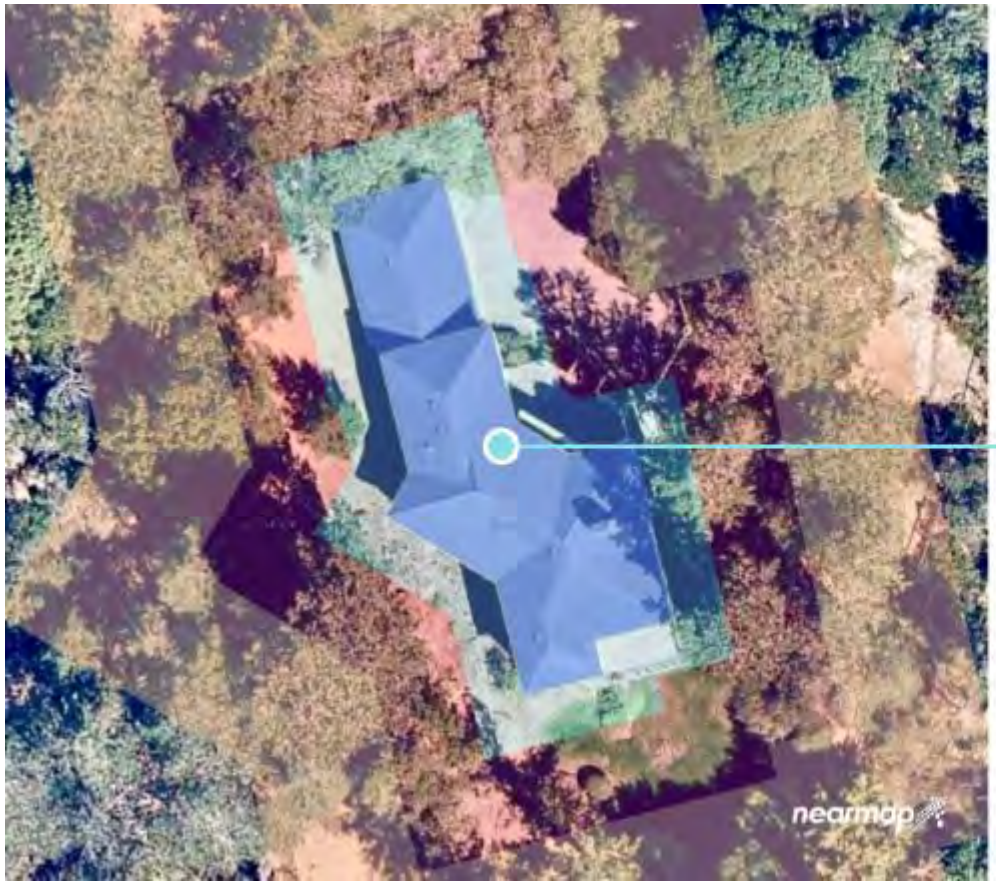
Property Profile

123 MAIN STREET, USA

BY PERIL ATTRIBUTES: Wind	Roof Geometry	Gable
	Pool Enclosure	Yes
	Roof Condition	Fair
LIABILITY EXPOSURES	Trampoline	Yes
	Pool	Yes

CHANGE DETECTED: TRAMPOLINE

Image Analysis to Detect Property Profiles



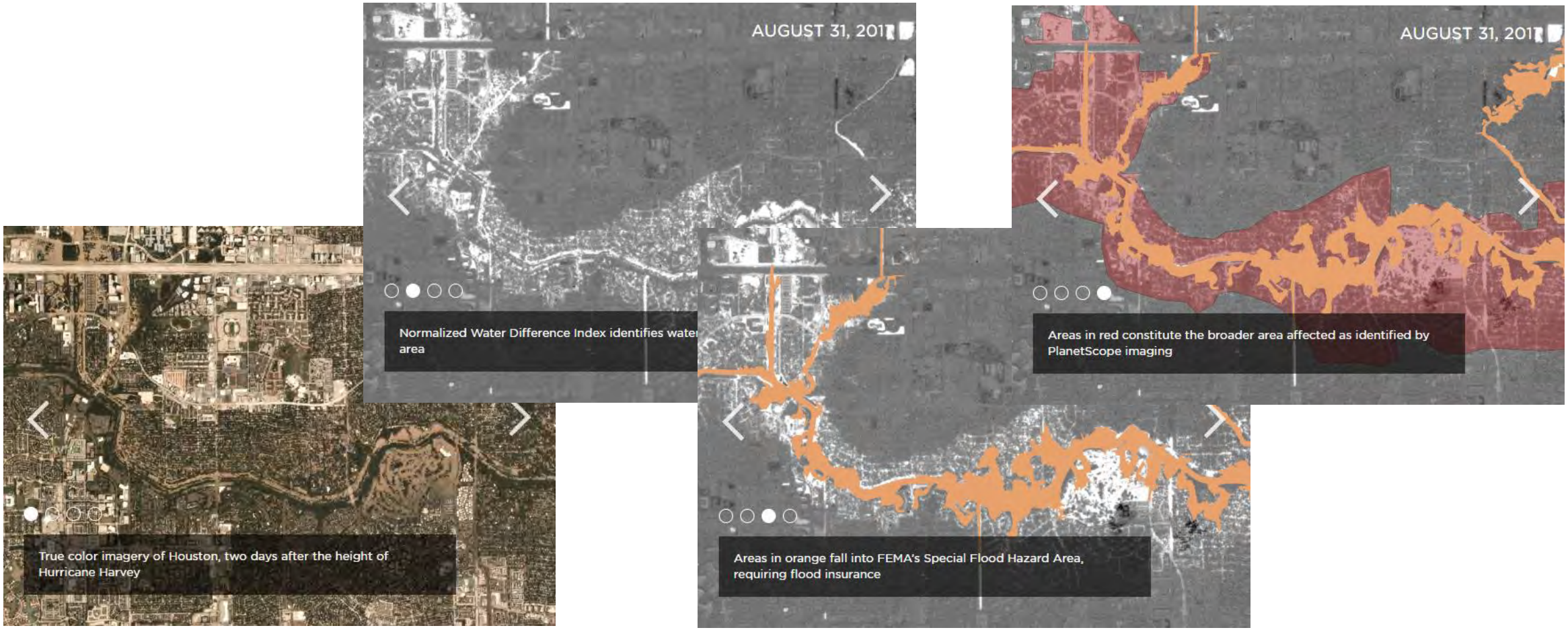
Property Profile

223 AUBURN AVENUE, USA

BY PERIL ATTRIBUTES: Wildfire	Distance to Vegetation	0 ft.
	Roof Covering	Shingle
	Roof Tree Coverage	Yes
PROPERTY CHARACTERISTICS	Roof Condition	Good
VEGETATION COVER	Zone 1 - 10 ft: 15%	
	Zone 2 - 30 ft: 70%	
	Zone 3 - 100ft: 80%	

U.S. FOREST SERVICE WILDFIRE HAZARD POTENTIAL: MODERATE

Aerial Imaging Technology to Help Loss Assessment



Aerial Imaging Technology to Help Loss Assessment

GEOSPATIAL INSIGHT

- Leverages technologies in drone, satellite, aerial, and street-view imagery with proprietary software platforms to deliver rapid visual assessment of natural catastrophe events.

Risk Analysis | Catastrophe Response | Loss Evaluation | Dynamic Monitoring

Aerial Imaging to Inspect Property Claims

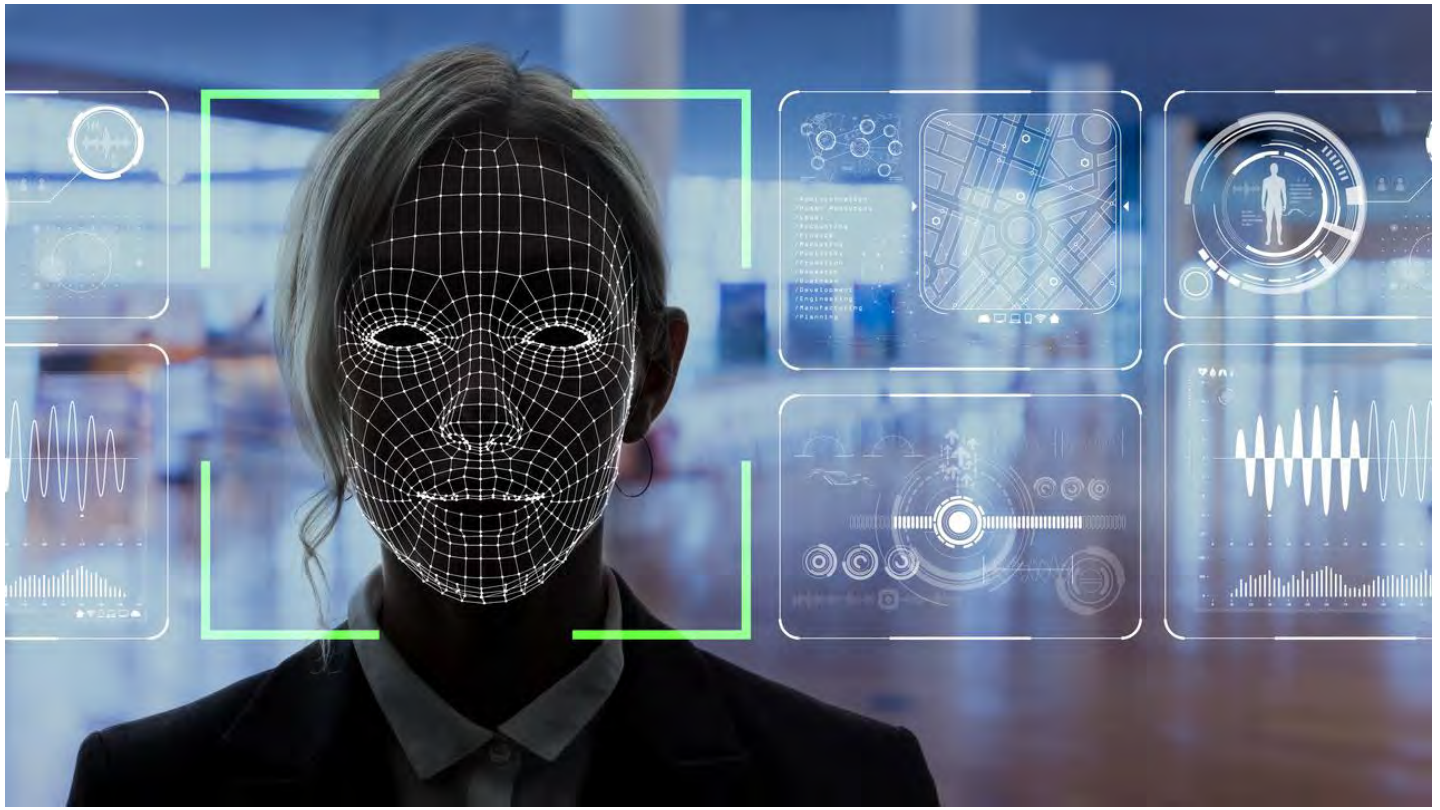
https://www.eagleview.com/2019/04/trending-insurance-claims-topics-plrb/

Facial Recognition to Evaluate a Person's Health Condition

- Can image or voice recognition improve Life and Health insurance underwriting?

NeuroLex

LAPETUS
LIFE EVENT SOLUTIONS



Cyber Risk and Cyber Insurance

- Technology has become so ubiquitous, it is hard to live without it. It comes with huge advantages, but also risks – and there is an increasing role for insurers to play in protecting customers in the face of cyber threats.
- From identity theft, to hacking of subscription services and IoT home devices, the list of cyber risks people, and not just organizations, are facing is growing all the time as the cyber threat landscape metastasizes rapidly.
- Although not yet widely available, personal cyber insurance is expected to become a fast-growing market segment in the near future due to the rapidly increasing exposures consumers face today.

Ubiquitous Computing

Digital Currency

Cyber-Physical Systems

Data Center

Swiss Re

Source: Swiss Re Institute

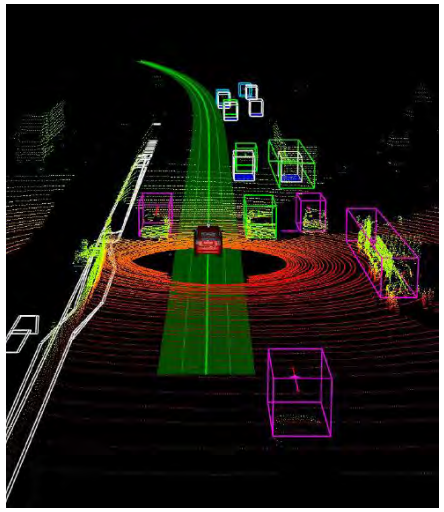
Technologies in Self-Driving Vehicles

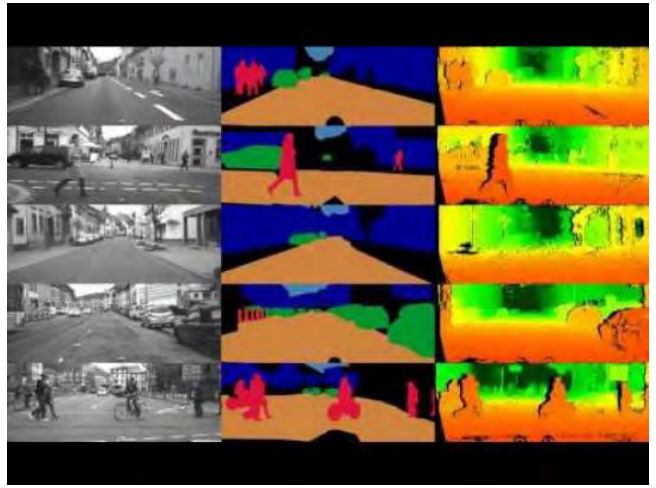
Localization and Mapping
- Where am I?

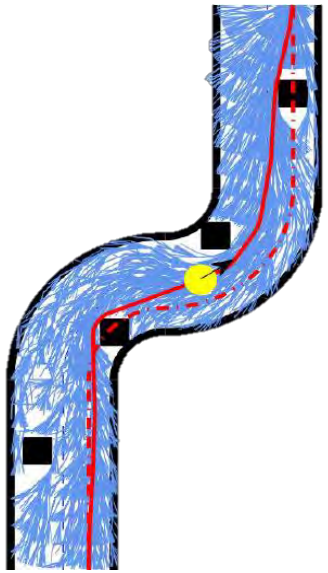
Scene Understanding
- Where is everyone else?

Movement Planning
- How do I get from A to B?

Driver State
- What's the driver up to?







Source: MIT Self-Driving Cars course

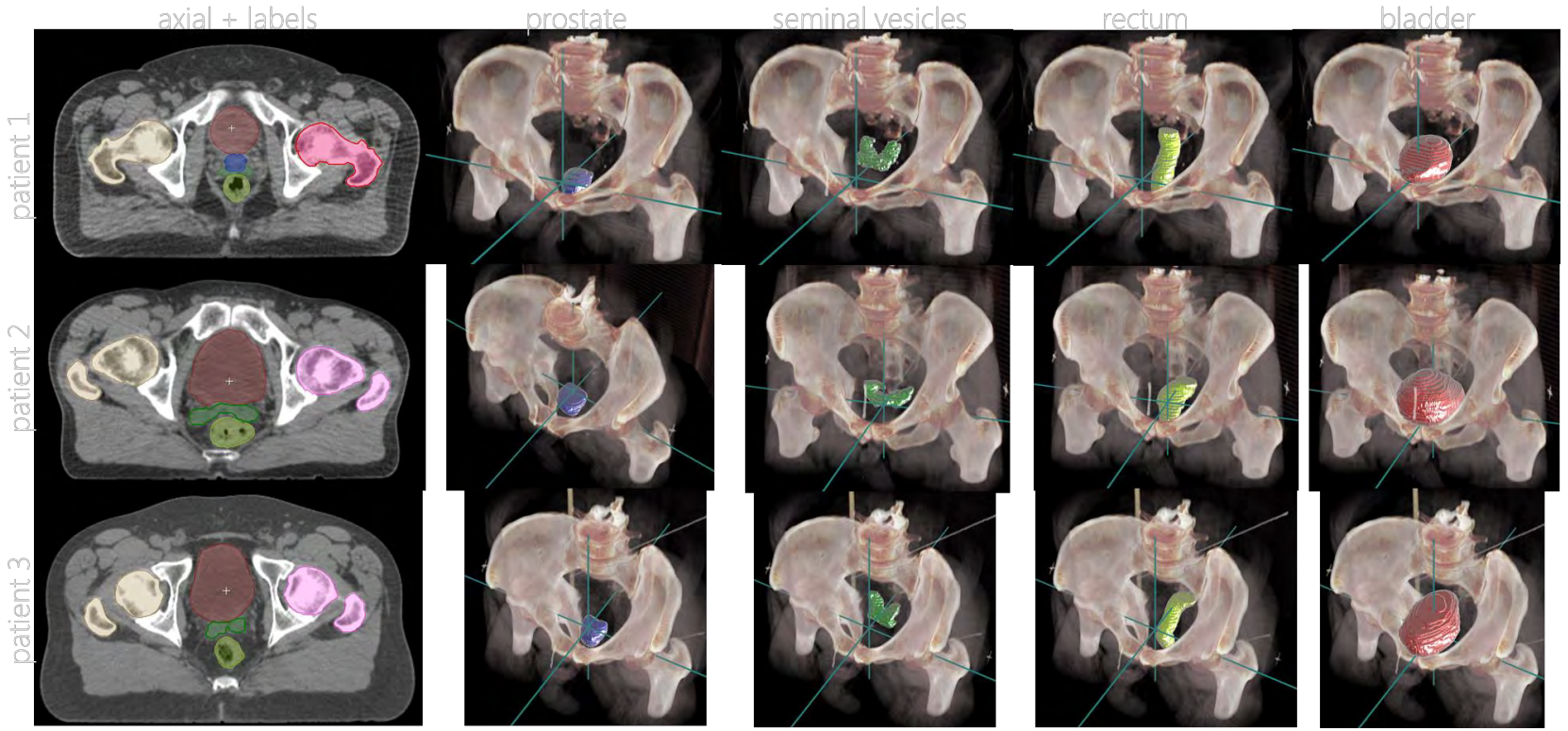
Usage-based Insurance and Vehicle Telematics

Consumers	Insurers	Regulator
• Lower premiums • Enhanced safety • Improved claims experience	• Reducing claim costs • Better risk pricing • Mitigating adverse selection • Modifying risky behavior	• Data privacy • Rate adequacy and transparency • Keep up with technology innovation • Safeguarding consumers' rights

Source: NAIC
Url: https://www.naic.org/documents/cipr_study_150324_usage_based_insurance_and_vehicle_telematics_study_series.pdf

Imaging Technologies in Healthcare

- Medical imaging AI to empower clinicians
- Quantitative tracking of disease progression



Microsoft

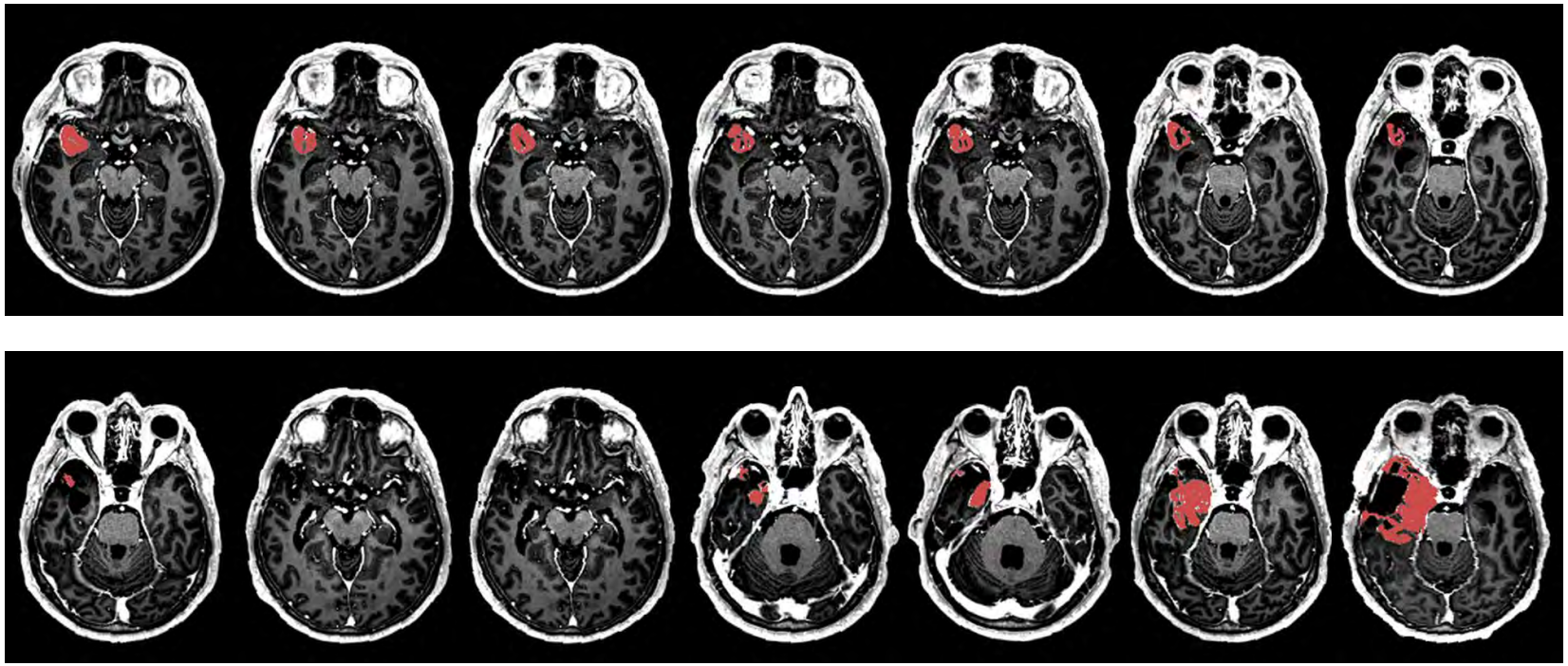
InnerEye is a research project that develops machine learning cloud services to assist medical experts in tasks of measurement, delineation and quantitative temporal assessment

Database of "ground-truth" labelled image dataset – hundreds of patients

https://www.microsoft.com/en-us/research/project/medical-image-analysis/

Imaging Technologies in Healthcare

- Medical imaging AI to empower clinicians
- Quantitative tracking of disease progression



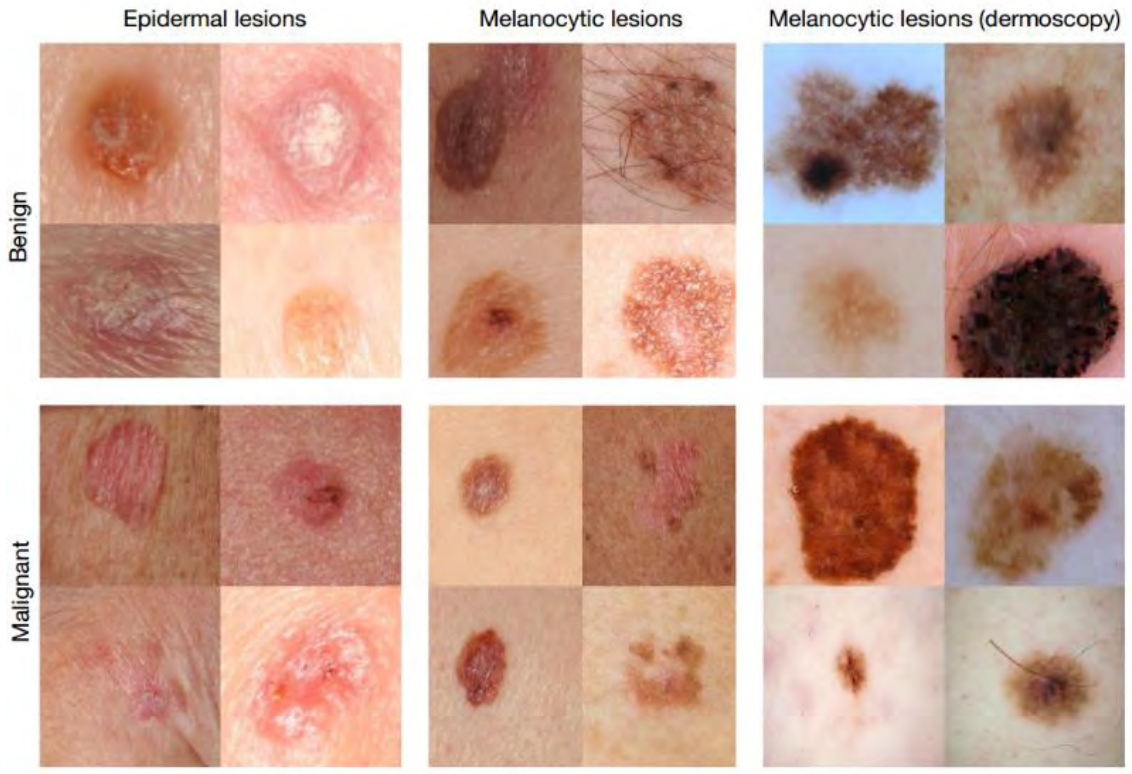
InnerEye is a research project that develops machine learning cloud services to **assist medical experts** in tasks of **measurement, delineation** and **quantitative temporal assessment**

Database of “ground-truth” labelled image dataset – hundreds of patients

https://www.microsoft.com/en-us/research/project/medical-image-analysis/

Imaging Technologies in Healthcare

Skin cancer is primarily diagnosed visually, beginning with an initial clinical screening and followed potentially by dermoscopic analysis.

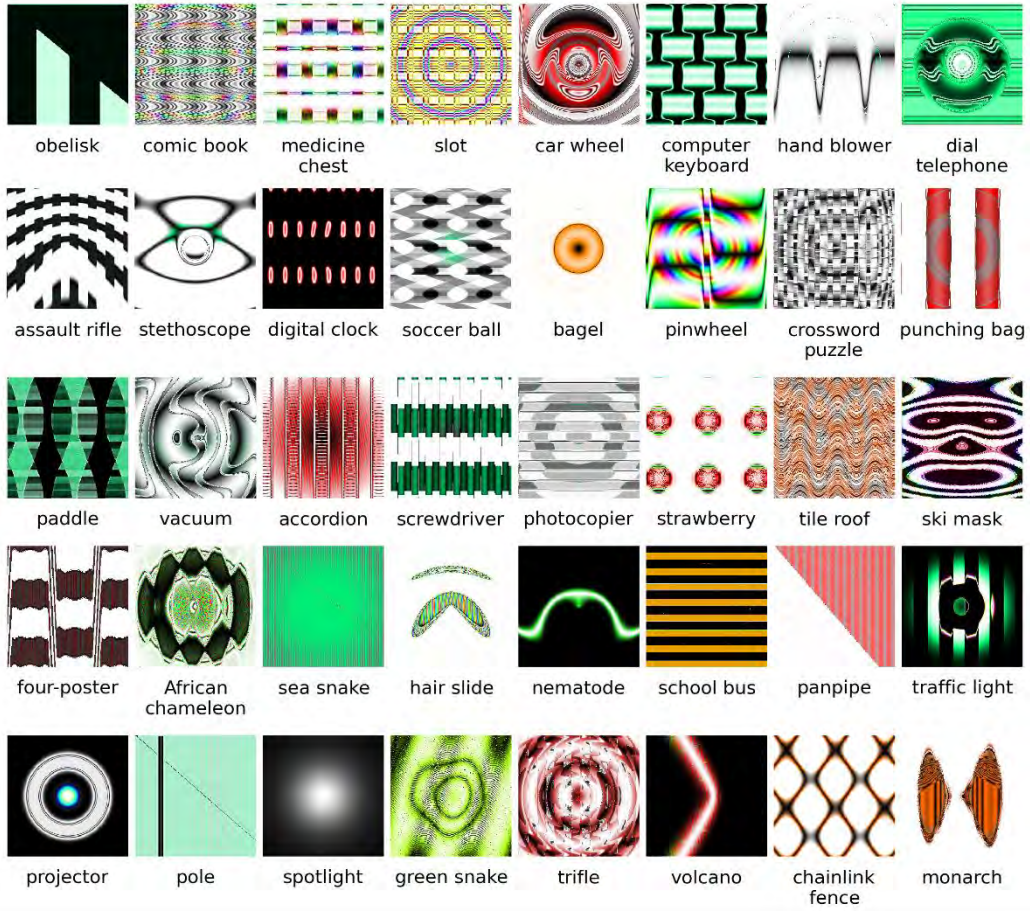


Computer Vision using deep learning algorithms achieves performance on par with tested experts, demonstrating a level of competence comparable to dermatologists.

nature
International journal of science

Attention! Things may go wrong – Adversarial Examples

- Noise and overfitting are problems of deep learning models



Above: Human overfit, too

Left: Adversarial examples to deep learning models

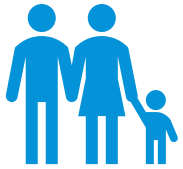
Deep Neural Networks are Easily Fooled: High Confidence Predictions for Unrecognizable Images Anh Nguyen, Jason Yosinski, Jeff Clune (2015)

Ethics of Data and Technology

Data

If we don't focus on deciding which data we need, who owns the data, and how we share the value from the data, we will see a shift from an oil-based economy with all its dysfunctionalities to a new data-based economy with a whole new set of dysfunctionalities.

People



IoT technologies raise ethical and social concerns.
Regulators, executives, and consumers should be wrestling with these material risks as they enjoy the benefits.

Technology

The ethics of algorithmic decision-making is also critical to building fair, resilient cities. As re/insurers, we are facing questions like: "Who is liable when a system fails?" e.g., when an autonomously driven car crashes due to algorithmic failure.

Source: Swiss Re Institute

Summary

- Computer Vision is a field in Artificial Intelligence that studies image and video processing, object recognition, scene segmentation, and the interpretation of images.
- More and more Computer Vision applications are developed in the insurance industry.
- These applications can help underwriters better understand risks, claim adjusters more accurately estimate damage, which can lead to improved customer experience, innovation, and the development of new insurance products.
- It is important for the actuaries community to understand the mechanisms behind these applications, and maintain the Actuarial Standards of Practices while applying these technologies for various use cases.

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