ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING APPLIED TO PUBLIC SAFETY

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MOTOROLA SOLUTIONS

EVERY MINUTE IN 2018 …

4,333,560
videos watched on YouTube

3,877,140
Google searches

97,222
hours of video streamed by Netflix users

159,362,760
emails sent

1,111
packages shipped from Amazon

15,000
aircrafts in flight

176,220
Skype users make calls

120
new professionals joined LinkedIn

6,876,510 €
abandoned in carts by online shoppers

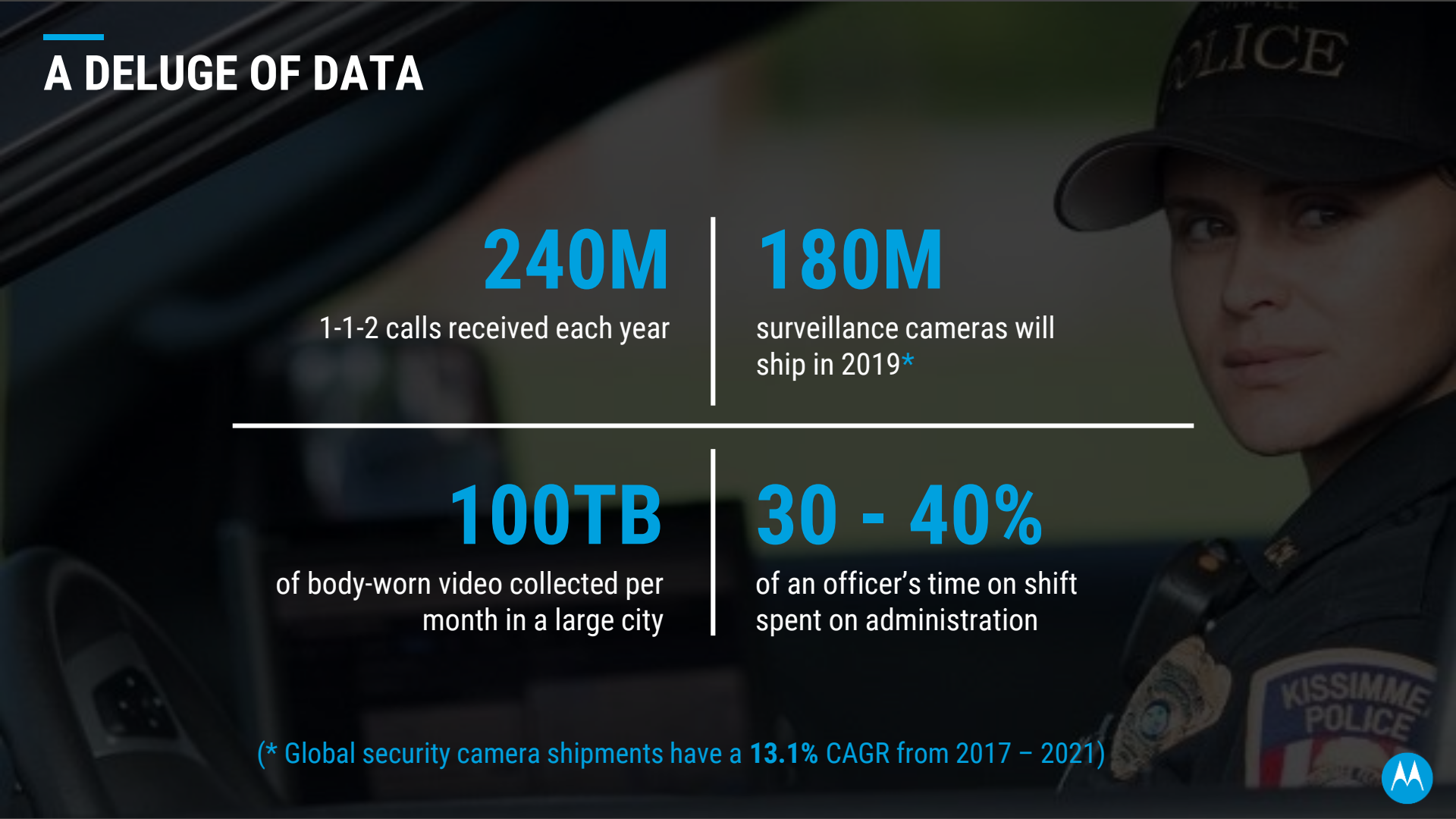
1,389
rides ordered on Uber

61,888 €
transactions on Venmo

70,796
bottls of wine drunk by overwhelmed consumers

Source: Domo's Data Never Sleeps 6.0 (2108)

A DELUGE OF DATA



240M

1-1-2 calls received each year

180M

surveillance cameras will ship in 2019*

100TB

of body-worn video collected per month in a large city

30 - 40%

of an officer's time on shift spent on administration

(* Global security camera shipments have a **13.1%** CAGR from 2017 – 2021)

THE CHALLENGE OF HUMAN ATTENTION

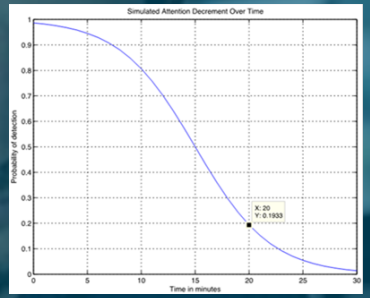
VOLUME

~45B+ cameras within the next 5 years
(LDV Capital, Aug-2017)

Security camera market will grow at **CAGR 13.1%**
(IHS Markit, 2018)

Internet video surveillance traffic increase by **7x**
(Cisco Visual Networking Index: Forecast and Trends, 2017–2022)

FOCUS



20% efficacy after 20 minutes

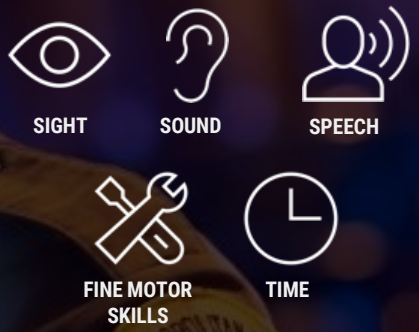
COMPLEXITY

1x: **85%** Detection Rate
4x: **74%** Detection Rate
6x: **58%** Detection Rate
9x: **53%** Detection Rate

HIGH VELOCITY HUMAN FACTORS

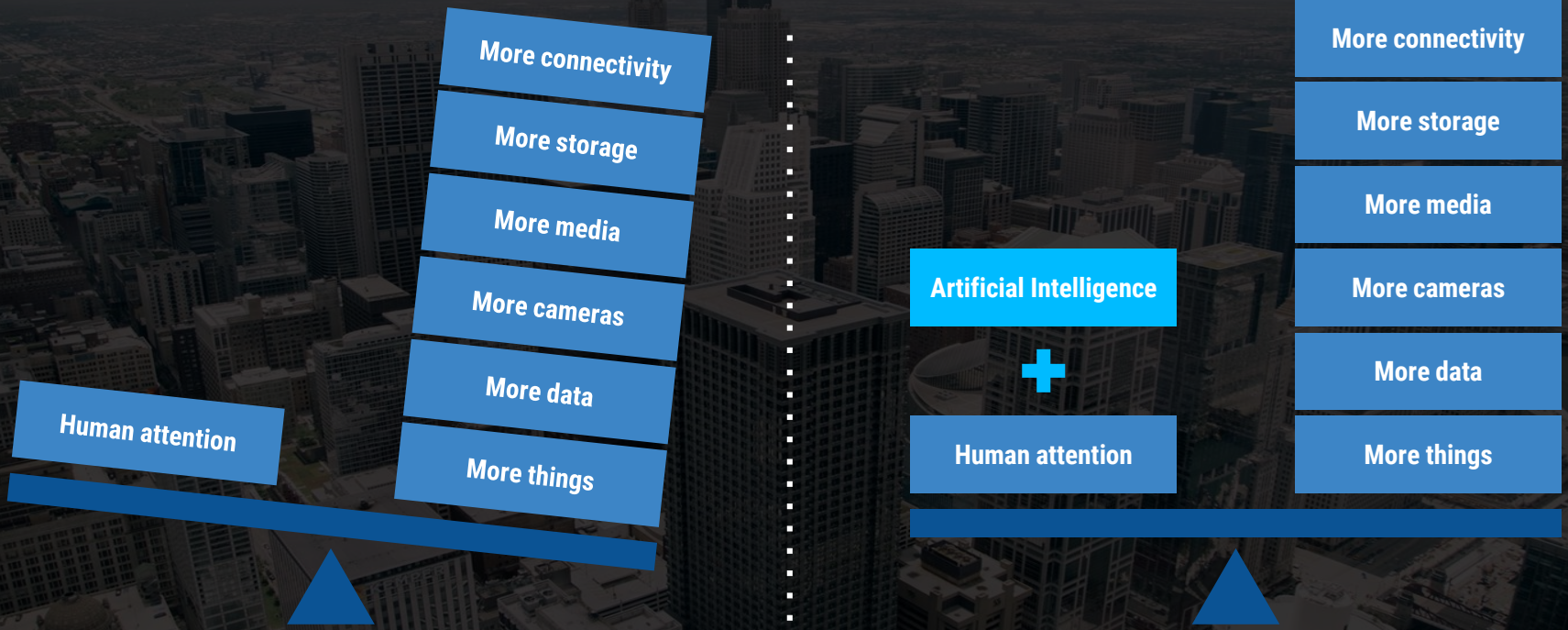
Stress and Intensity Levels

THE FIRST RESPONDER PARADOX:
When they need technology the most, their cognitive abilities are least capable of using technology




GO TO SPACE
GO HOME

RESTORING THE BALANCE



ARTIFICIAL INTELLIGENCE - TERMINOLOGY

ARTIFICIAL INTELLIGENCE (AI)
Human intelligence exhibited by machines

MACHINE LEARNING (ML):
An approach to achieve artificial intelligence through systems that can learn from experience to find patterns in a set of data

DEEP LEARNING (DL):
A specific technique for implementing machine learning leveraging Neural Networks

NEURAL NETWORKS (NNs):
A structure that is arranged in layers that loosely mimic the human brain, learning patterns of patterns. A Convolutional Neural Network (CNN) is a type of NN that is particularly well suited to image processing.

THE GREAT POWER OF AI

40-50%

of jobs could be automated within 10-20 years

20-35%

fewer employees needed in by 2030

Source: AI Superpowers China, Silicon Valley and the New World Order, Kai-Fu Lee (2018)

Fatal Uber Self-Driving Car Accident Could Have Been Prevented, Says Former Manager

Amazon scraps secret AI recruiting tool that showed bias against women

Facebook and YouTube should have learned from Microsoft's racist chatbot

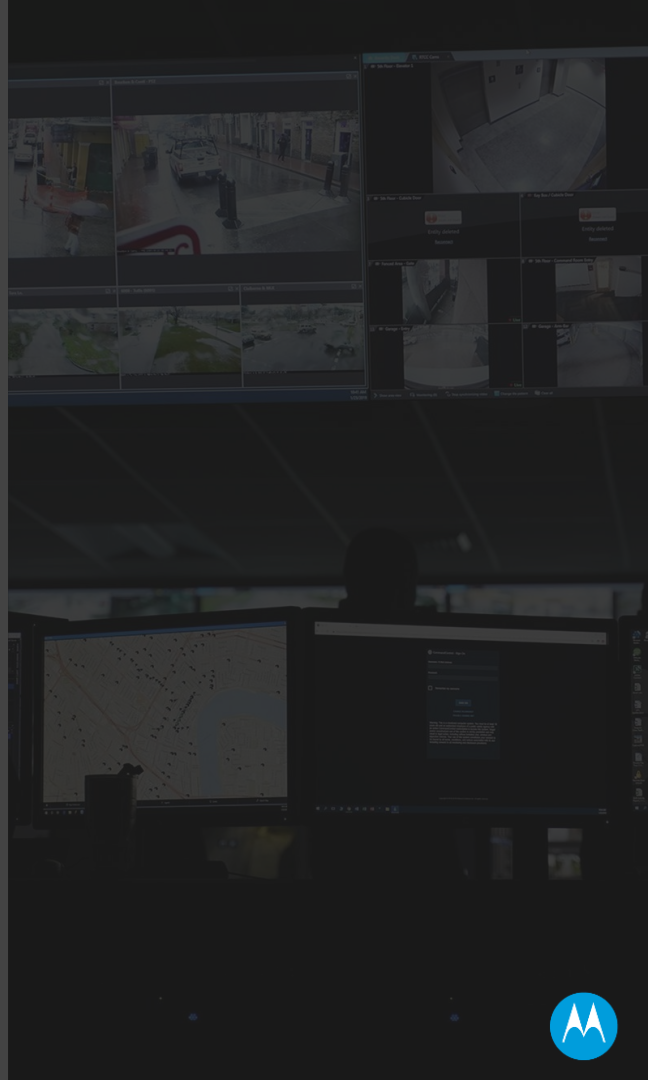
THE AI TEXT GENERATOR THAT'S TOO DANGEROUS TO MAKE PUBLIC

How IBM Watson Overpromised and Underdelivered on AI Health Care

PERCEPTIONS OF ARTIFICIAL INTELLIGENCE

AI = Facial Recognition = Surveillance & Tracking = Bad

AI = Bad



CORNERSTONES OF RESPONSIBLE AI DESIGN

FAIRNESS

The data used to train our AI algorithms is tested to eliminate bias, and re-tested repeatedly in field environments to verify integrity

PRIVACY

Our solutions always have been and will continue to be compliant with individual privacy laws that apply to the use of our technology

UNDERSTANDABILITY

We use only mature and tested AI components with known inputs and behavior, so we can interpret and trust the outputs

RELIABILITY

We introduce new solutions in controlled circumstances with feedback loops, and monitor to ensure new solutions operate as intended

ARTIFICIAL INTELLIGENCE FROM MOTOROLA SOLUTIONS

We extend the cornerstones of responsible AI with three fundamental concepts:

HUMAN IN THE LOOP

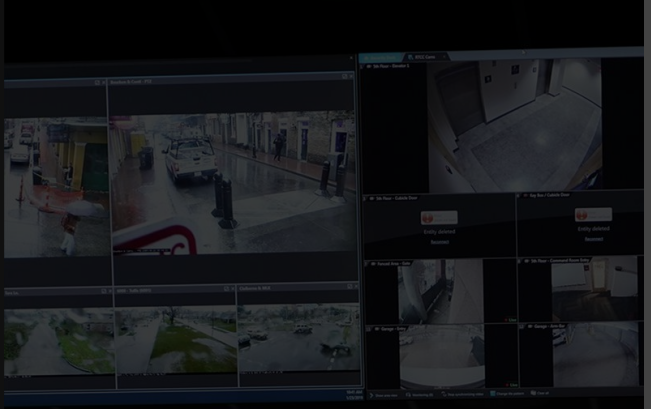
Our AI helps users make better decisions; it helps them with what they are already authorized and empowered to do; it never self-initiates consequential actions

FOCUSED APPLICATION

We identify specific, bounded sections of the workflow where AI can help users accomplish their goals, faster and better within a compliance framework

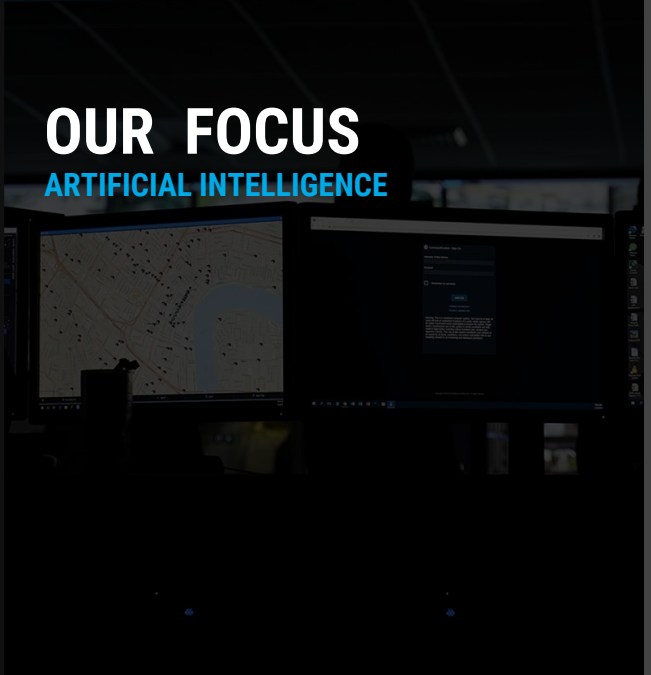
MATURE AI

This focus on a particular portion of the workflow allows us to use established, vetted AI components for more predictable and understandable results



OUR FOCUS

ARTIFICIAL INTELLIGENCE



DOMAIN CENTERED INNOVATION

We continually invest to understand our users

WORKFLOW BASED

We apply human centered design around E2E workflows

COMPLIANCE CONTROLS

Accountability and policy enforcement

PURPOSE-DRIVEN AI

Manage AI training and enhance with continuous feedback

DISCIPLINE

Comprehensive processes for compliance and policy

KEY APPLICATIONS FOR AI IN PUBLIC SAFETY

UNUSUAL MOTION DETECTION

AI learns typical activity in a scene, detects and flags unusual motion without any predefined rules or setup

VOICE ANALYTICS

Domain-specific automated speech recognition models, language understanding, speech-to-text transcription

VOICE CONTROL

Eyes up, hands free voice commands
guide interactions with the officer's personal area network

VIRTUAL PARTNER

Voice and text-based natural language query to CAD, Records and relevant Public Safety Big Data resources

APPEARANCE SEARCH

Deep learning AI locates specific persons or vehicles of interest, directed through simple physical descriptions

END-TO-END PUBLIC SAFETY SOFTWARE SUITE

COMMANDCENTRAL

Incident Awareness

Incident Management

Post-Incident Resolution

COMMUNITY ENGAGEMENT	EMERGENCY CALL MANAGEMENT	VOICE & COMPUTER AIDED DISPATCH	REAL-TIME INTELLIGENCE OPERATIONS	FIELD RESPONSE & REPORTING	RECORDS & EVIDENCE MANAGEMENT	ANALYSIS & INVESTIGATION	JAIL & INMATE MANAGEMENT
Citizen	112 Call Taker	Dispatcher	Intelligence Analyst	Frontline Responder	Records Specialist	Crime Analyst	Corrections Officer

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END-TO-END PUBLIC SAFETY SOFTWARE SUITE

COMMANDCENTRAL + ARTIFICIAL INTELLIGENCE

Incident Awareness | Incident Management | Post-Incident Resolution

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Artificial Intelligence

How AI Helps:

AI automatically transcribes and translates incoming speech to text - including recognizing key terms like “heart attack” - allowing the call taker to focus on the response

Results:

Streamlined 112 call center interactions

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END-TO-END PUBLIC SAFETY SOFTWARE SUITE

COMMANDCENTRAL + ARTIFICIAL INTELLIGENCE

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Artificial Intelligence

How AI Helps:

AI continuously monitors cameras for unusual situations, such as the appearance of smoke, or an individual entering an off-limits area

Results:

Video analysts verify potential items of interest instead of scanning endless feeds

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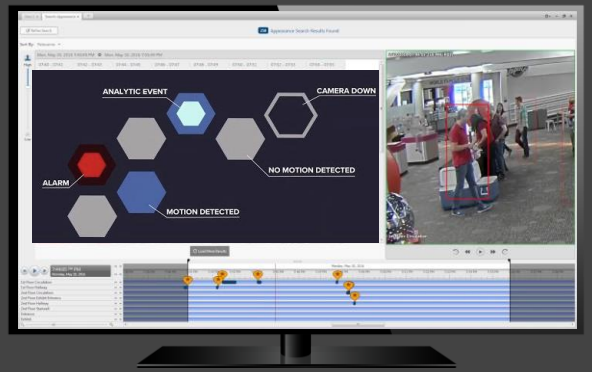
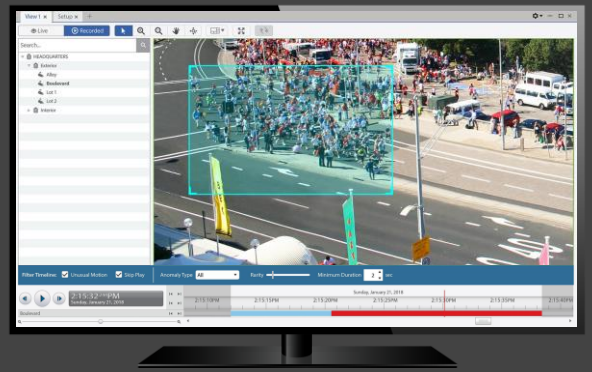
VIDEO INTELLIGENCE



EVENT IDENTIFICATION AND LOCALIZATION

AI locates specific items of interest (geofence crossing, left object, presence and brings focus of attention to user)



UNUSUAL MOTION DETECTION

Deep Learning AI learns typical activity in a scene, detects and flags unusual motion without any predefined rules or setup

VIDEO AUGMENTATION

Augmented video fuses computer vision, multi-sensor analytics and 3D overlays in a single layer of intelligence

END-TO-END PUBLIC SAFETY SOFTWARE SUITE

COMMANDCENTRAL + ARTIFICIAL INTELLIGENCE

Incident Awareness | Incident Management | Post-Incident Resolution

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Artificial Intelligence

How AI Helps:

Using natural language recognition to perform standard queries, dictate incident reports and take statements

Results:

Officers in the field are safer operating “eyes up and hands free”, and save time

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APX NEXT

with **ViQi** AI Virtual Assistant

ViQi VOICE CONTROL

Operate your radio with natural language commands, including:

- Change your channel
- Change your zone
- Change the volume
- Ask for your battery status

ViQi VIRTUAL PARTNER

Provides fast access to critical information while in the field

- Driver's License
- License Plate
- Vehicle Identification Number

INTERACTIVE VOICE CONTROLS

ViQi voice control

Operate your radio with natural language commands, including:

- Change your channel
- Change your zone
- Change the volume
- Ask for your battery status

ViQi Today can check a:

license plate

driver’s license

vehicle ID number (VIN)

END-TO-END PUBLIC SAFETY SOFTWARE SUITE

COMMANDCENTRAL + ARTIFICIAL INTELLIGENCE

Incident Awareness | Incident Management | Post-Incident Resolution

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Artificial Intelligence

How AI Helps:

AI speeds up the search for historical video and audio events or persons of interest

Results:

Faster case resolution for agencies, especially in major incident scenarios

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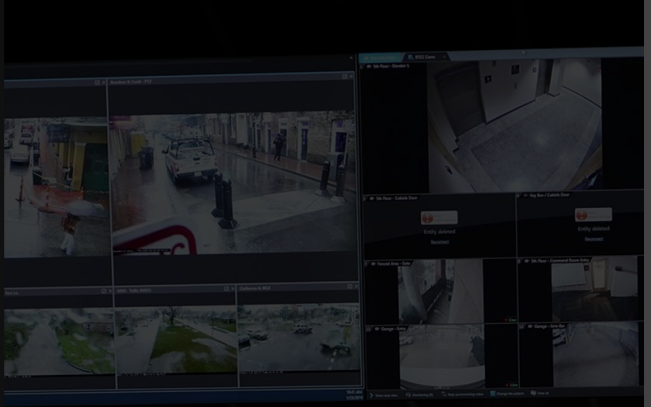
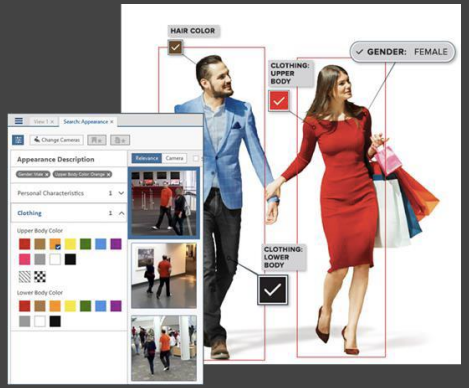


APPEARANCE SEARCH

AVIGILON

Initiate a search for a **Person** or **Vehicle**



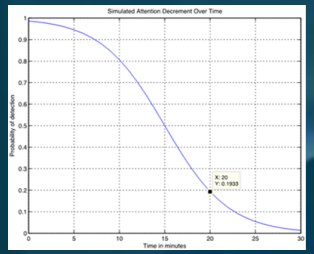
Initiate a search for a person by **Physical Description**

Descriptors available for people:

- **Gender**
- **Size**
- **Hair Color**
- **Upper / Lower Body Clothing Color**

RESTORING THE BALANCE WITH AI

FOCUS



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VOLUME

~45B+ cameras within the next 5 years

Security camera market will grow at **CAGR 13.1%**

Internet video surveillance traffic increase by **7x**

Artificial Intelligence

+

Human attention

- More connectivity
- More storage
- More media
- More cameras
- More data
- More things

PRINCIPLES AND PRACTICES FOR THE RESPONSIBLE APPLICATION OF ARTIFICIAL INTELLIGENCE AT MOTOROLA SOLUTIONS

WHITE PAPER

MOTOROLA SOLUTIONS

Artificial Intelligence (AI) will improve the efficiency, effectiveness and safety of the Motorola Solutions user community. However, as a powerful, multi-faceted emerging technology, AI can have far-reaching unintended consequences if applied inappropriately, or executed with insufficient rigor and discipline.

This paper summarize
responsibly applying
Our goal is to ensure
operation. We apply
by copious customer
foundational tenets o
and an emphasis on t
of AI for focused, pur

HOW ARTIFICIA PUBLIC SAFET

To a layperson, AI is
can broadly mimic a h
today's technology is
aspects of human int
the ability to recogniz
to text. In the context
workflow, these speci

Motorola Solutions h
hardware and softwa
our acquisitions, strat
and development pro
platform for public sa
we can bring AI-drive
exponentially increas
that characterizes co
this data, improving t
responders and comm

Our objective is to support humans throughout the public safety incident workflow by augmenting their decision-making with appropriate AI assistance. Some ways that we are applying AI in this regard include:

- Using AI to transcribe, translate, interpret and summarize speech and text during human interactions with a public safety

THE NEED FOR RESPONSIBLE AI

Artificial Intelligence is new, complex, powerful technology. Applied carelessly, it can generate surprising and unintended results. Applied improperly or maliciously, the technological scaling of AI can amplify or institutionalize undesirable outcomes - a risk of particular import for public safety, given its societal import.

Our policy for applying AI starts with three foundational tenets that are fundamentally focused on our users and fields of use:

- Human in the Loop
- Focused application resulting in purpose-built solutions
- Applying mature AI

Responsible AI simply
services, one must con
and constrain the outc
powered solutions mu
Solutions approaches
principles, supplanted
development, validatio
ensure our AI solutions

POLICY AND PR RESPONSIBLY

Over decades of design
has developed substant
research, iterative user
human factors engineer
of in-field and in-situ ot
apply this intimate und
design process that re
specifically optimized f
and verification framew
users to perfect the des
apply specific human fa
technology is well-tuned
their daily workflows.

We are applying the sa
application of "purpose
capabilities with specifi

FOCUSED APPLICATION AND MATURE AI

Our two remaining foundational tenets - focused application, and mature AI - are connected.

Many respected and capable companies across a variety of industries have applied substantial thought and effort into the considerations of how to best

UNDERSTANDABILITY AND TRANSPARENCY

Understandability simply means that the behavior and outputs of an AI system must be readily explainable by those who provide it. This 'why' component is an essential characteristic of a system in order for users to interpret and trust the and for society to trust th responders are applying

In traditional systems, ex is generally a straightfon reading the software pro what the programmer ins do. Trained AI systems d have programmed or cod operations are a function dataset used. Variations from the system's trainin manifestation of traditio the underlying implement

How Motorola Solut Understandability in

- Motorola Solution ability to explain th systems by adoptir AI components tha as possible for the For example, by kn commands needed that the system wi greatly constrain th and words (intents understood.

PRIVACY

In the context of AI applications, the issue of privacy primarily involves securing and managing the data associated with the system, including training data (input to the system) and any outputs that the system produces in operation.

stringent cybersecurity practices that we apply to all of our products[6]. We build in all of the necessary security controls, auditing, and practices necessary to enable our users to secure and manage sensitive data (e.g., Law Enforcement Records) and this same fabric applies to outputs generated by AI. Where possible

SUMMARY

Motorola Solutions is responsibly and incrementally employing AI to assist and augment our users to help them be more efficient, effective and safe. We are doing this by leveraging proven mission critical research and design principles guided by the fundamental tenets of human in the loop for consequential decisions and focused solutions that leverage mature AI.

We are developing AI aimed at customer outcomes that are familiar and consistent with outcomes we've previously enabled in a more manual fashion with other technologies. AI simply enables these outcomes in a way that is more efficient, more effective, and safer. We can easily measure the effectiveness and accuracy of AI-driven solutions relative to more traditional methods of achieving the same outcomes. In this way, our AI solutions are anchored in and measured against widely accepted, culturally and ethically appropriate methods that support fairness, understandability, privacy, and security.


WE HELP PEOPLE BE THEIR BEST
IN THE MOMENTS THAT MATTER