

COGNITIVE VISUAL INSPECTION : BENEFICI APPLICATIVI NELL'AMBITO INDUSTRIALE



AGENDA

- COGNITIVE VISUAL INSPECTION : **USE CASES**
- COGNITIVE VISUAL INSPECTION : **ELEMENTI DI ANALISI**
- COGNITIVE VISUAL INSPECTION : **APPUNTI DI DEEP LEARNING**
- COGNITIVE VISUAL INSPECTION : **CLASSI DI IDENTIFICAZIONE**
- COGNITIVE VISUAL INSPECTION : **MVI (Maximo Visual Inspection) IN PILLOLE**
- COGNITIVE VISUAL INSPECTION : **MVI USER INTERFACE**
- COGNITIVE VISUAL INSPECTION : **MVI MOBILE INSPECTOR**
- COGNITIVE VISUAL INSPECTION : **MVI INFRASTRUTTURA**



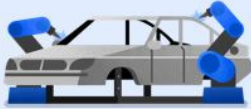
La tecnologia e le potenzialità della COGNITIVE VISUAL INSPECTION sono oggi al servizio delle tecniche di ispezione, a garanzia della qualità di un prodotto e del suo processo manifatturiero.

Diverse sono le opportunità, o “USE CASES”, che possono beneficiare di un suo utilizzo.

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CARROZZERIA



Componenti in ricevimento

Controllo saldature

Deposito sigillante

VERNICIATURA



Difetti verniciatura

ASSEMBLAGGIO



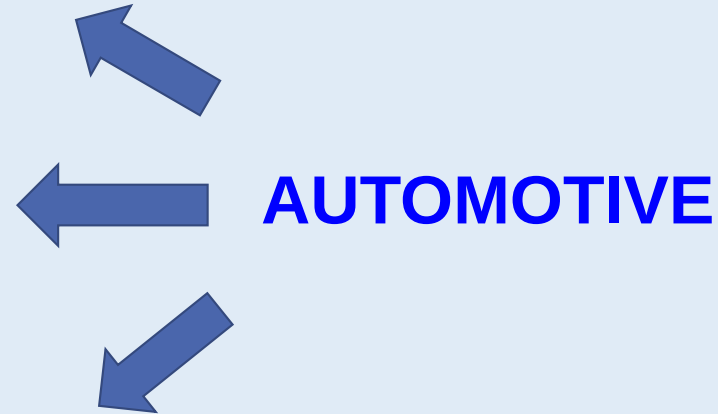
Corretta installazione

Controllo parti

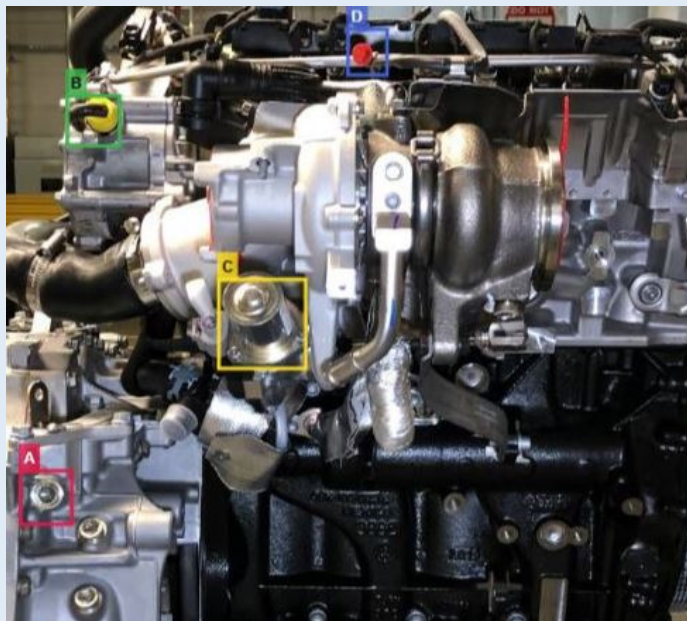
Conessioni elettriche

Ispezione finale

... il mondo dell'automotive si presta a una lunga lista di controlli (check list) per ogni step di processo ...

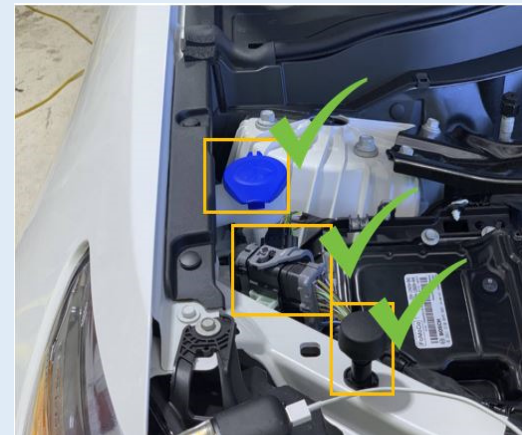


AUTOMOTIVE



BLOCCO MOTORE

VANO MOTORE

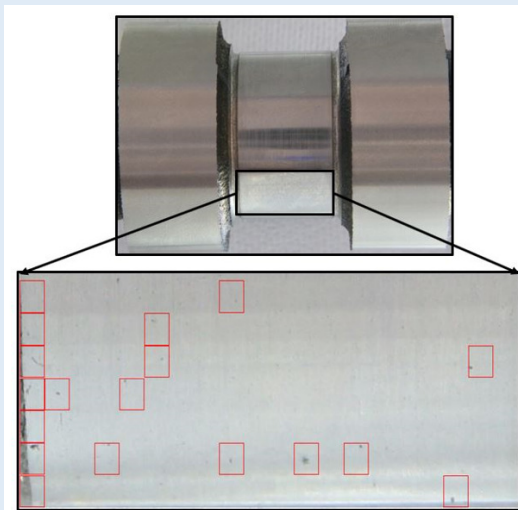




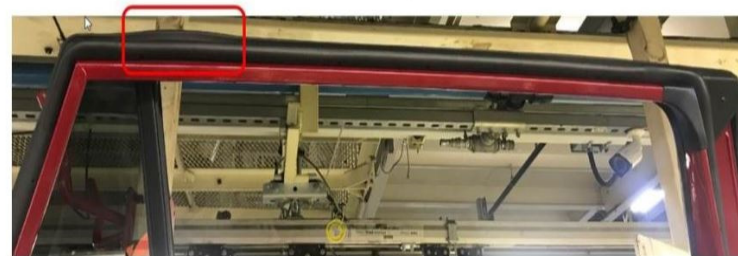
PORTIERA



ALBERO A
CAMME



DEFECT – Weather Strip Bubbled



GOOD CONDITION



GUARNIZIONI

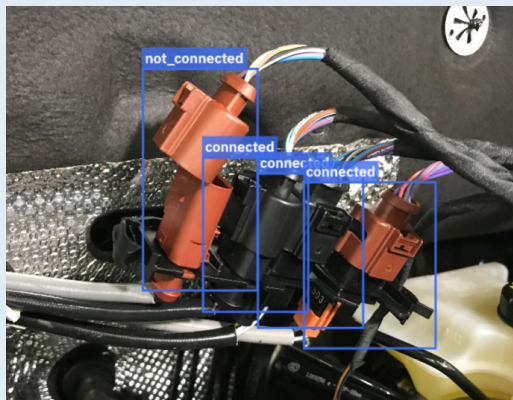
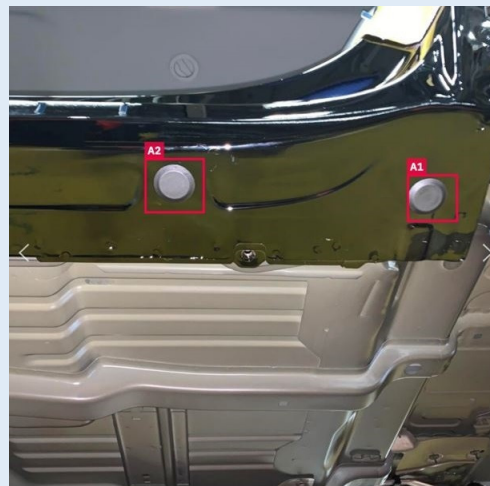
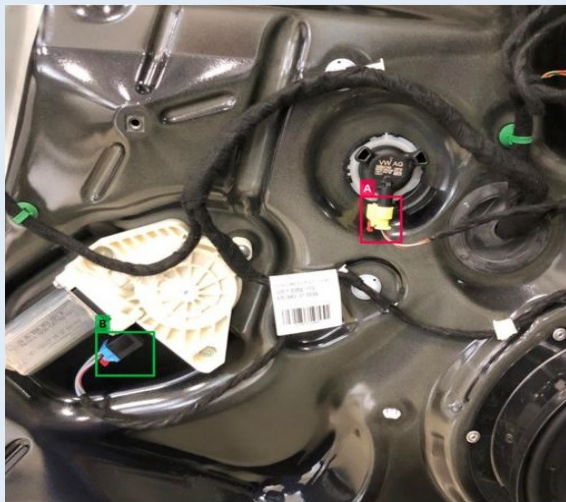
AUTOMOTIVE

FINITURE

RUOTE

CONNETTORI

IBM



SICUREZZA SUL LAVORO



IBM



PACKAGING FARMACEUTICO

Results



Confidence threshold

0.5 1 0.5

Objects	Result	Average
> A	good_vert 10 objects	0.999

Results



Confidence threshold

0.5 1 0.5

Objects	Result	Average
> A	good_vert 7 objects	0.999
> B	bad_vert 3 objects	0.999

Results



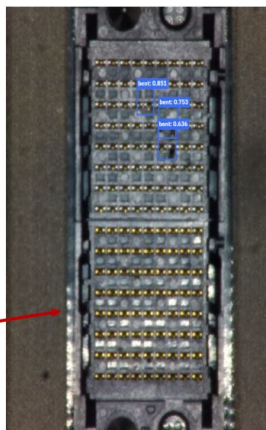
Confidence threshold

0.5 1

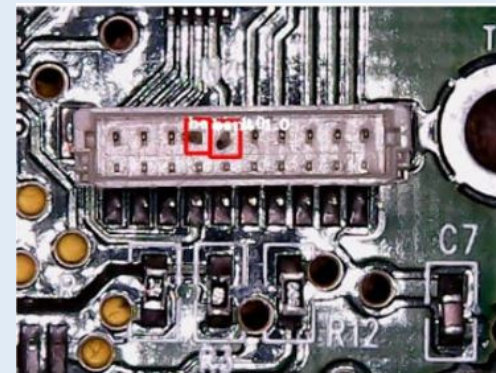
Objects	Result	Average
> A	d_oriz 2 objects	0.997

MANIFATTURA ELETTRONICA

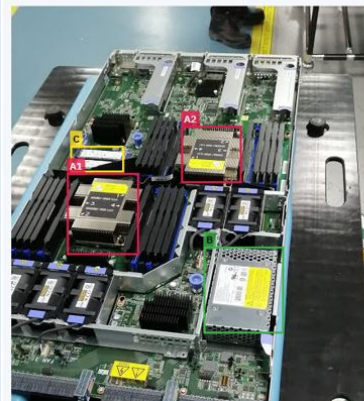
Ispezione pin piegati
connettore con telecamera
mobile su perno guida lineare.



PIN CONNETTORE
PIEGATI



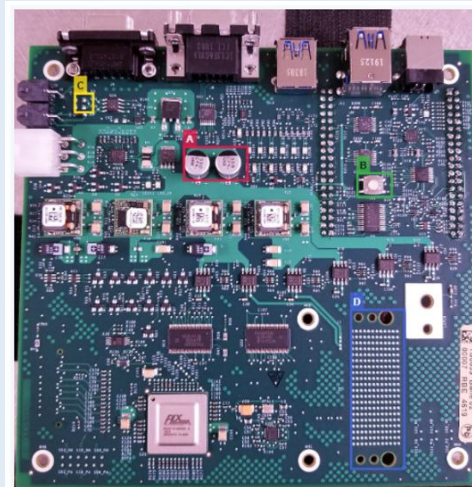
Results



Confidence threshold 0.5 1 0.5

	Objects	Result	Average
> A	with_heatsink 2 objects	-	0.999
B	with_bbu 1 objects	0.998	-
C	with_ssd 1 objects	0.998	-

PRESENZA
COMPONENTI



A	large_cap 1 objects	0.997
B	switch 1 objects	0.997
C	missing_small_cap 1 objects	0.993
D	missing_connector 1 objects	0.999

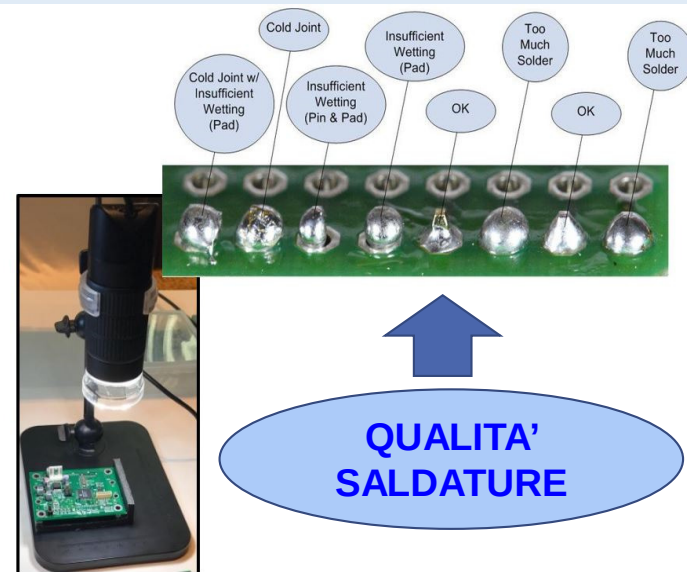


CONTAMINAZIONE
CONTATTI DORATI



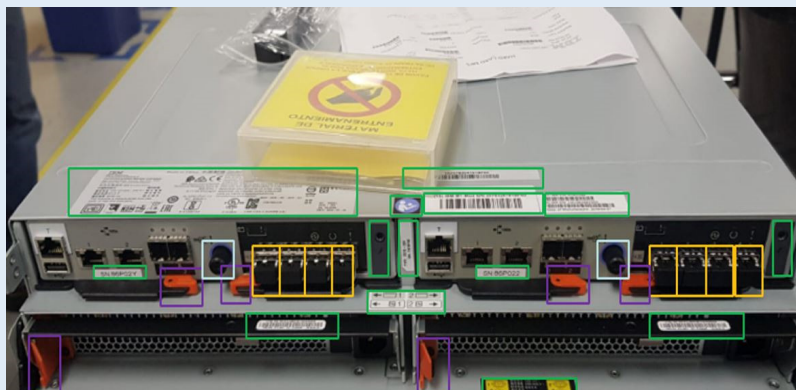
VERIFICA
ETICHETTE

MANIFATTURA ELETTRONICA

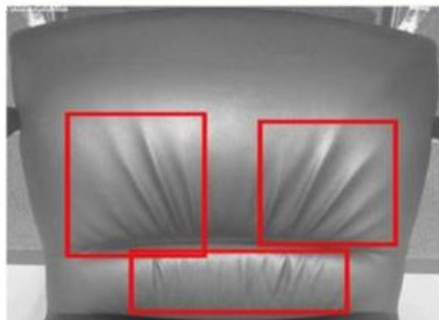


QUALITA'
SALDATURE

PARTI CHASSIS



ISPEZIONE SUPERFICI E RIVESTIMENTI



No	Screenshot	Detection	Confident Level	Timestamp
3		WRINKLES	95.98%	3:15:44 PM
2		WRINKLES	99.2%	3:15:44 PM
1		WRINKLES	99.56%	3:15:44 PM

PIEGHE RIVESTIMENTO



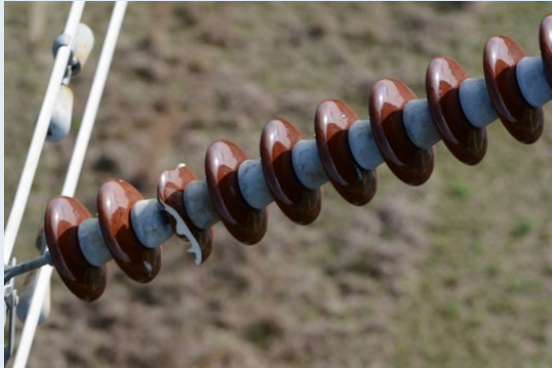
GRAFFI



ISPEZIONI PER MANUTENZIONI

PUNTI DI
CONTROLLO

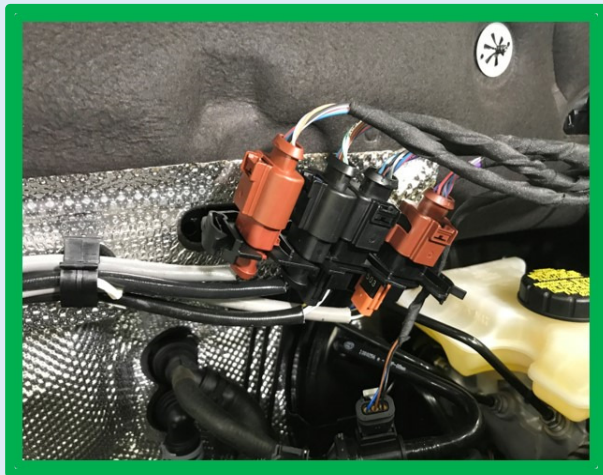
Ispezioni linee
elettriche con droni



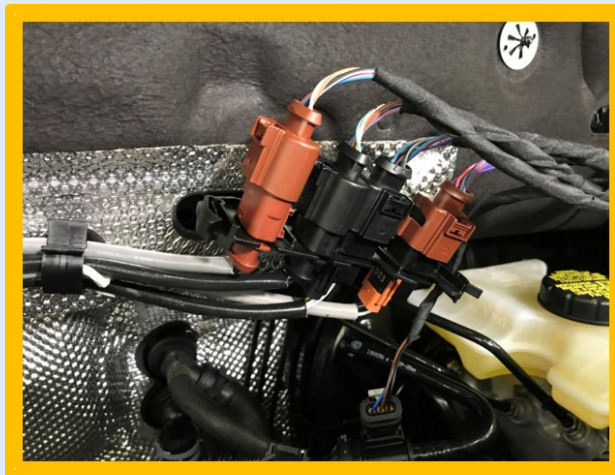
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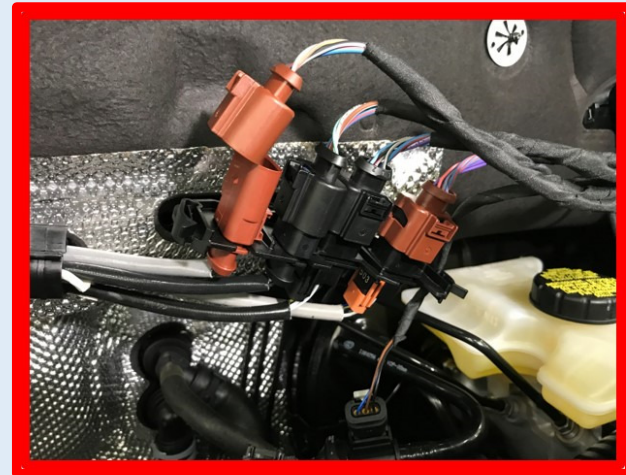
Una corretta soluzione nasce da una chiara COMPRESIONE del problema (use-case), delle tipologie di “anomalie” o “condizioni” da identificare, delle caratteristiche del processo produttivo, delle condizioni visive, delle variabili ambientali, della qualità e quantità delle immagini ...



completa



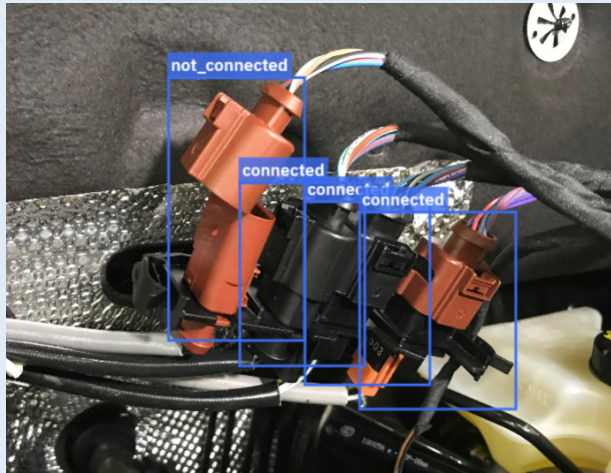
parziale



mancante



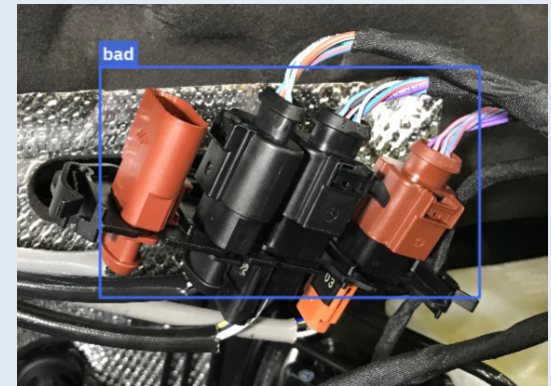
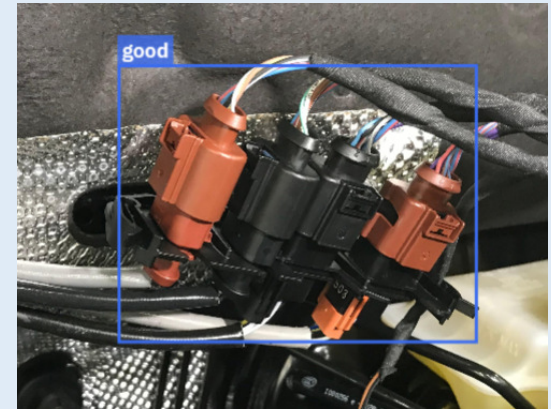
Esempi di **OUTPUT** richiesti al modello,
tramite il processo di “**labeling**”



Condizione **SINGOLA**
(valida anche per il conteggio parti)



Condizione di **INSIEME**
GO / NO GO



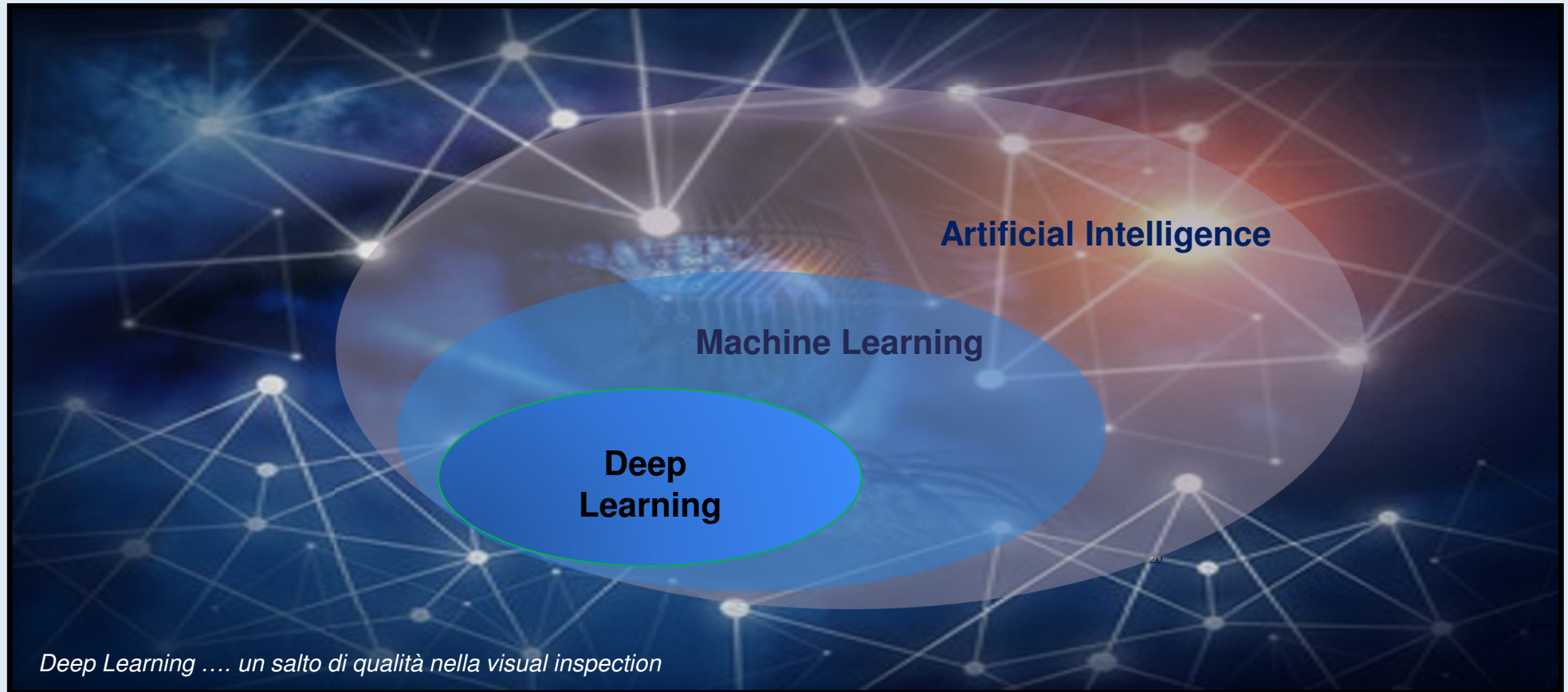
.... E ricorda che

What is GIGO?



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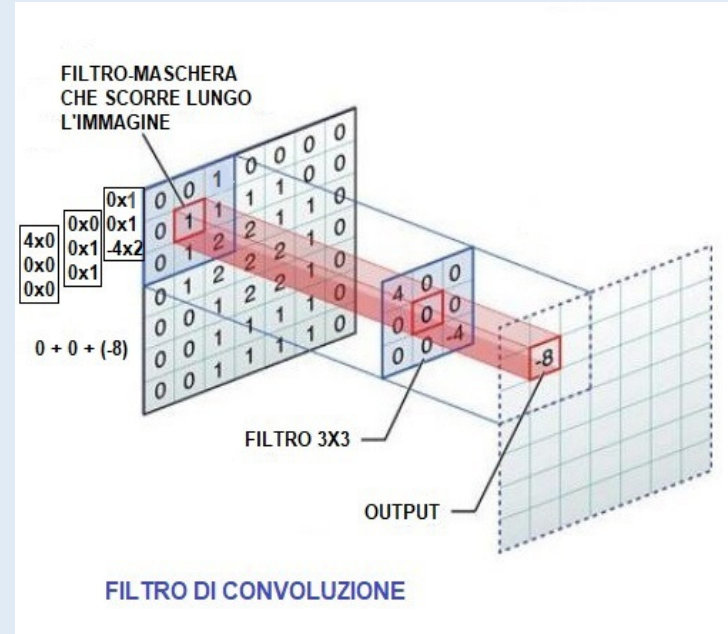
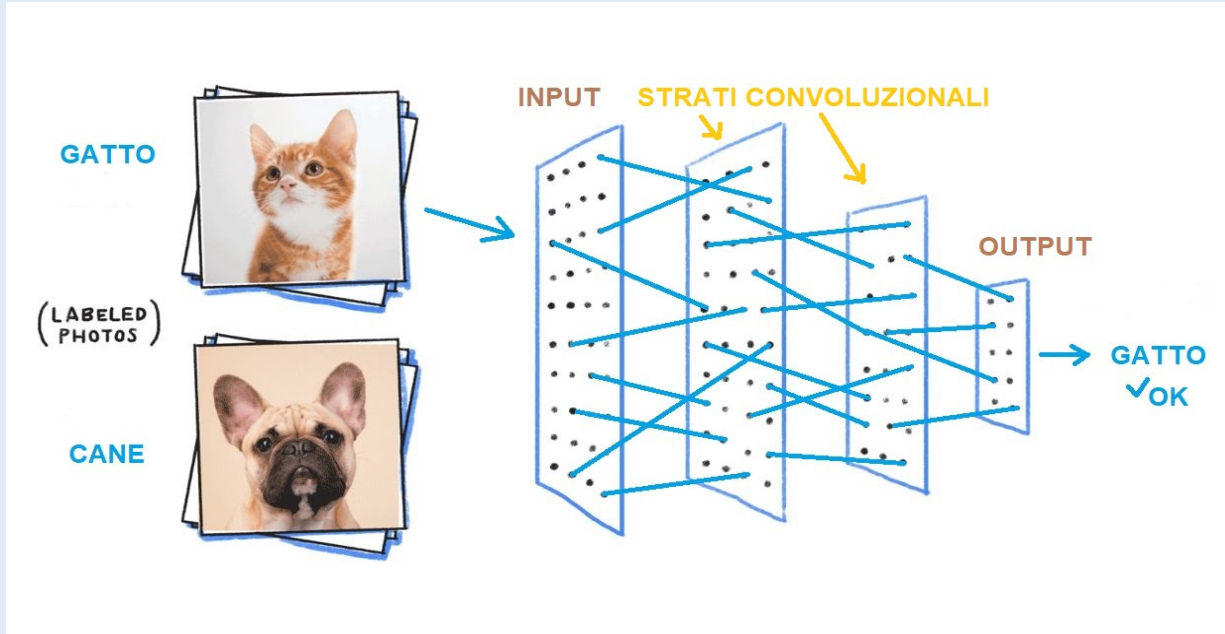


Vi è stato un tempo in cui un bimbo di 3 anni sapeva distinguere un oggetto meglio di un computer.

Oggi, con l'avvento del Deep Learning, la macchina può risultare determinante nel supportare le esigenze di riconoscimento visivo, anche nelle sue forme più complesse.



Utilizzo di Reti Neurali Convoluzionali per il riconoscimento delle immagini



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CLASSIFICATION + LOCALIZATION



CAT

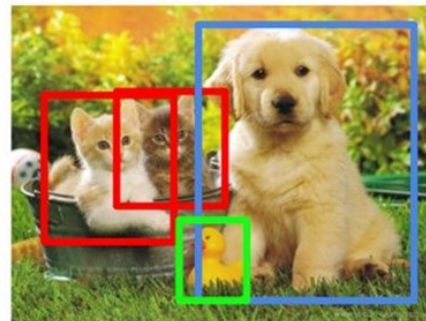


CAT

Single object

OBJECT DETECTION

box



CAT, DOG, DUCK

segmentation

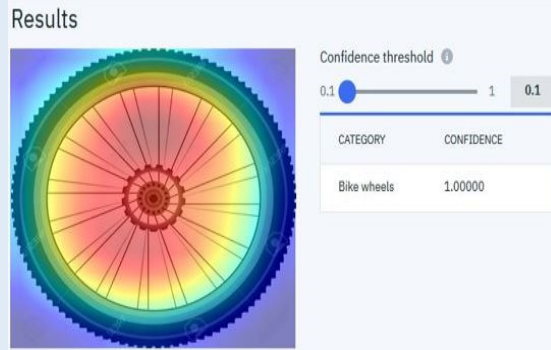


CAT, DOG, DUCK

Multiple objects

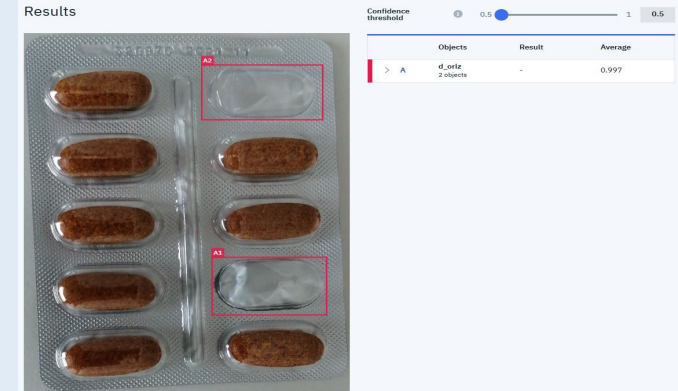


... CLASSIFICATION – OBJECT DETECTION ... e ... ANOMALY DETECTION
(introduzione del concetto di variazione)

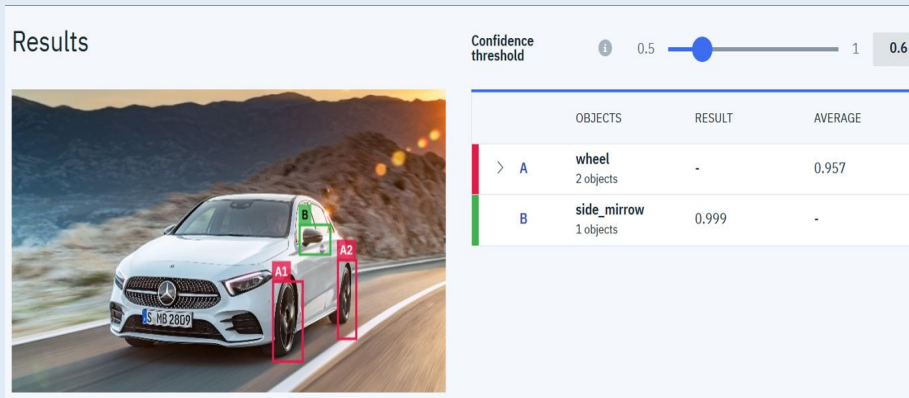


CLASSIFICATION

OBJECT DETECTION



ANOMALY DETECTION
(stato di variazione da identificare)





In un ambito produttivo l'anomalia è

una **VARIAZIONE** (di condizione – di prodotto)
che va tracciata e corretta



il **SINTOMO**
di un processo da migliorare

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La soluzione Maximo Visual Inspection (MVI) si avvale della tecnologia Deep Learning, è facilmente configurabile e adattabile a molteplici scenari di Industria 4.0.

MVI fornisce un ambiente di lavoro completo, adatto per generare modelli di classification e object detection, capace di gestirne l'intero ciclo di sviluppo (acquisizione immagini, labeling, training, fine-tuning e deployment).

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Welcome to IBM Visual Insights



Create Dataset

Start by adding images and video files to a data set.



Prepare Data

Label objects in images and video frames, then use auto labeling to finish adding labels to the whole data set; assign categories to images or videos, or label actions in videos.



Train Model

Select a few custom options to create your model.



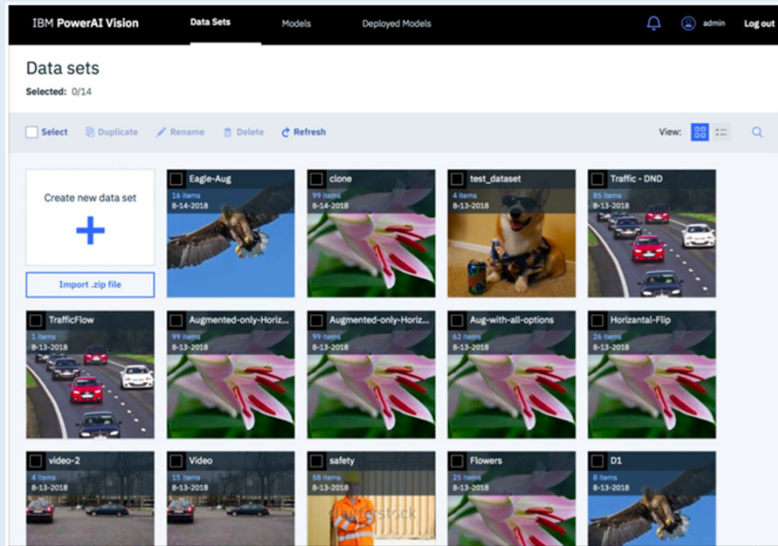
Deploy Model

Deploy the trained model and receive an API link for an inference device.

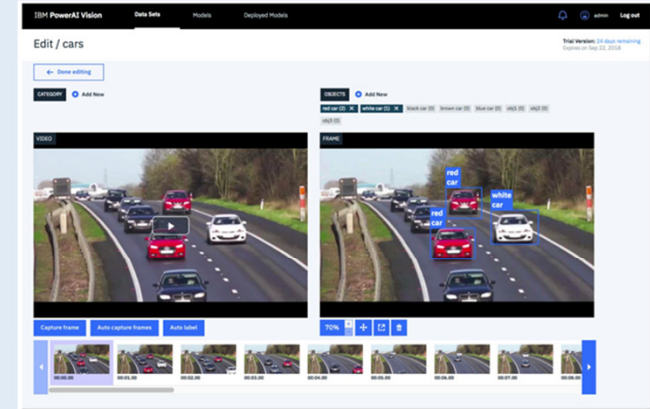
[Get started](#)

DATA SET + PREPARAZIONE DATI

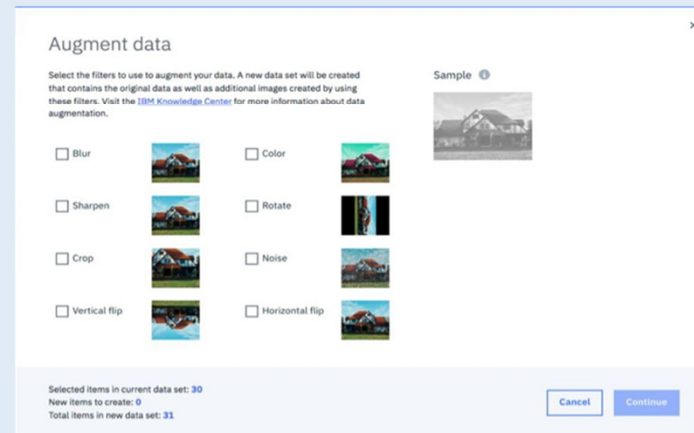
1 CREAZIONE DATA-SET



2 DEFINIZIONE OGGETTO (LABELING)



3 ELABORAZIONE IMMAGINE (AUGMENTATION)



SCELTA DEL MODELLO

Select type of training ①



Image classification

Classify an entire image according to its visual content based on the relationship of nearby pixels.



Object detection

Detect instances of particular classes within images or videos using rectangular or polygonal bounding boxes.



Action detection

Classify brief, temporal actions in video. Actions of interest will be located in both space and time.

CLASSIFICATION

Optimize model using ①

System Default (GoogLeNet)

A 22-layer deep convolutional neural network used in the context of image classification.

Training options ^

☐ Enable Core ML

Custom packaged model

Provide source code and weight files. Perform training and inference within Visual Insights. Learn more here.

Select type of training ①



Image classification

Classify an entire image according to its visual content based on the relationship of nearby pixels.



Object detection

Detect instances of particular classes within images or videos using rectangular or polygonal bounding boxes.



Action detection

Classify brief, temporal actions in video. Actions of interest will be located in both space and time.

OBJECT DETECTION

Optimize model using ①

Faster R-CNN

Highly accurate for locating object bounding boxes in both images and videos. Generates a TensorRT asset by default.

Tiny YOLO v2

Optimized for speed but can be less accurate. Generates smaller models that work well for FPGA and embedded devices.

Training options ^

☐ Enable Core ML

Detron

Best for object detection and segmentation of small objects. Generates accurate but large models.

☒ Enable segmentation

Single Shot Detector (SSD)

Suitable for real-time inference. Works well for embedded devices. Almost as fast as YOLO but not as accurate as Faster R-CNN. Generates a TensorRT asset by default.

Custom packaged model

Provide source code and weight files. Perform training and inference within Visual Insights. Learn more here.

DISPONIBILITA' DEL MODELLO

Deployed Model / Giorgio_truck_model

You can call the generated application programming interface (API) to run your deployed model. The API is unique to this model, and you cannot edit the API.

Object detection

Accuracy (faster R-CNN)

Model: [Giorgio_truck_model](#)

Created

10/1/2019, 5:29:45 PM
By: student

Model hyperparameters

Max iteration 4000

Momentum 0.9

Ratio 0.8

Learning rate 0.001

Weight decay 0.0005

100%

Accuracy

Deployed model API endpoint

[api/dlapis/f0991992-47b7-4360-bc87-5db7332d23fb](#)

Copy

API Reference

GET

Test Model

Drop image here



Confidence [0.1-1.0]

External URL

URL

Upload

Import

To test a video using the API endpoint, click [here](#).

Objects

TAP_1_BAD (29 objects)
TAP_2_BAD (30 objects)
TAP_3_BAD (28 objects)
TAP_1_GOOD (23 objects)
TAP_3_GOOD (33 objects)
TAP_2_GOOD (19 objects)

Results



Confidence threshold

0.5 1 0.5

	OBJECTS	RESULT	AVERAGE
A	tap_2_bad 1 objects	0.973	-
B	tap_3_bad 1 objects	0.999	-
C	tap_1_bad 1 objects	0.999	-

IMMAGINE DA
VALIDARE



IBM

IMMAGINE VALIDATA

CUSTOM MODELS

- I Data Scientists possono utilizzare, come base di ulteriore sviluppo, un loro modello e caricarlo in MVI (limitato a TensorFlow)

Custom models

Selected: 0/2

☐ Select Edit Delete Refresh

Drop a model .zip file

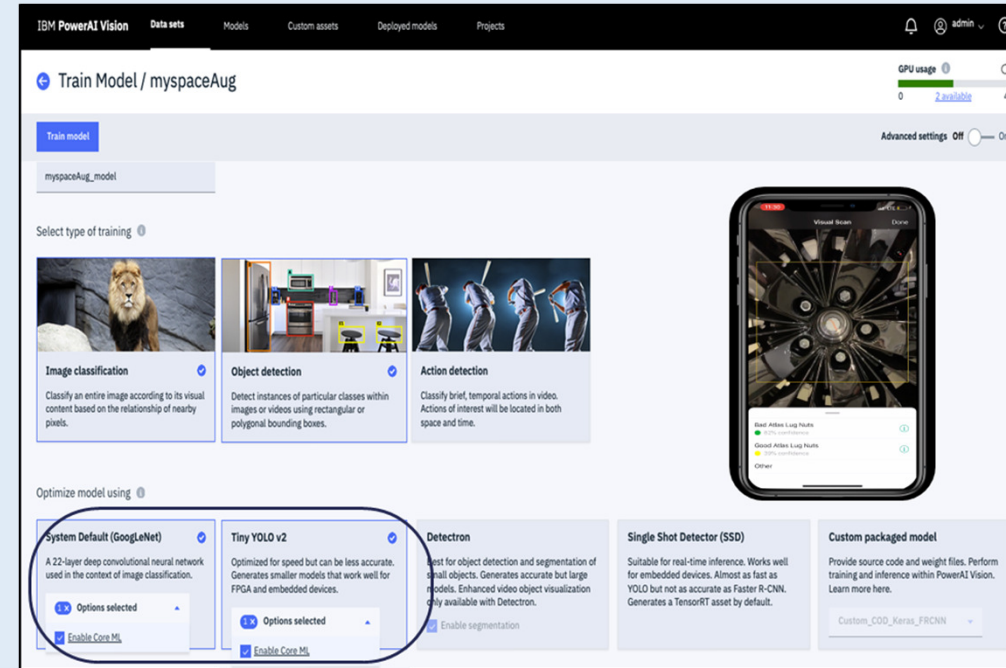
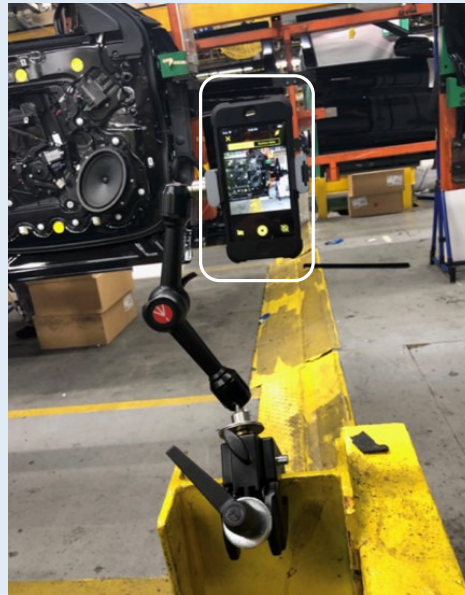
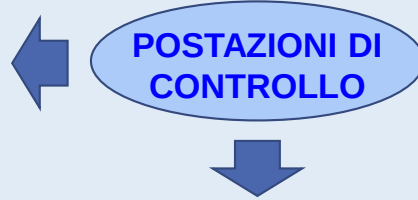
[Browse files](#)

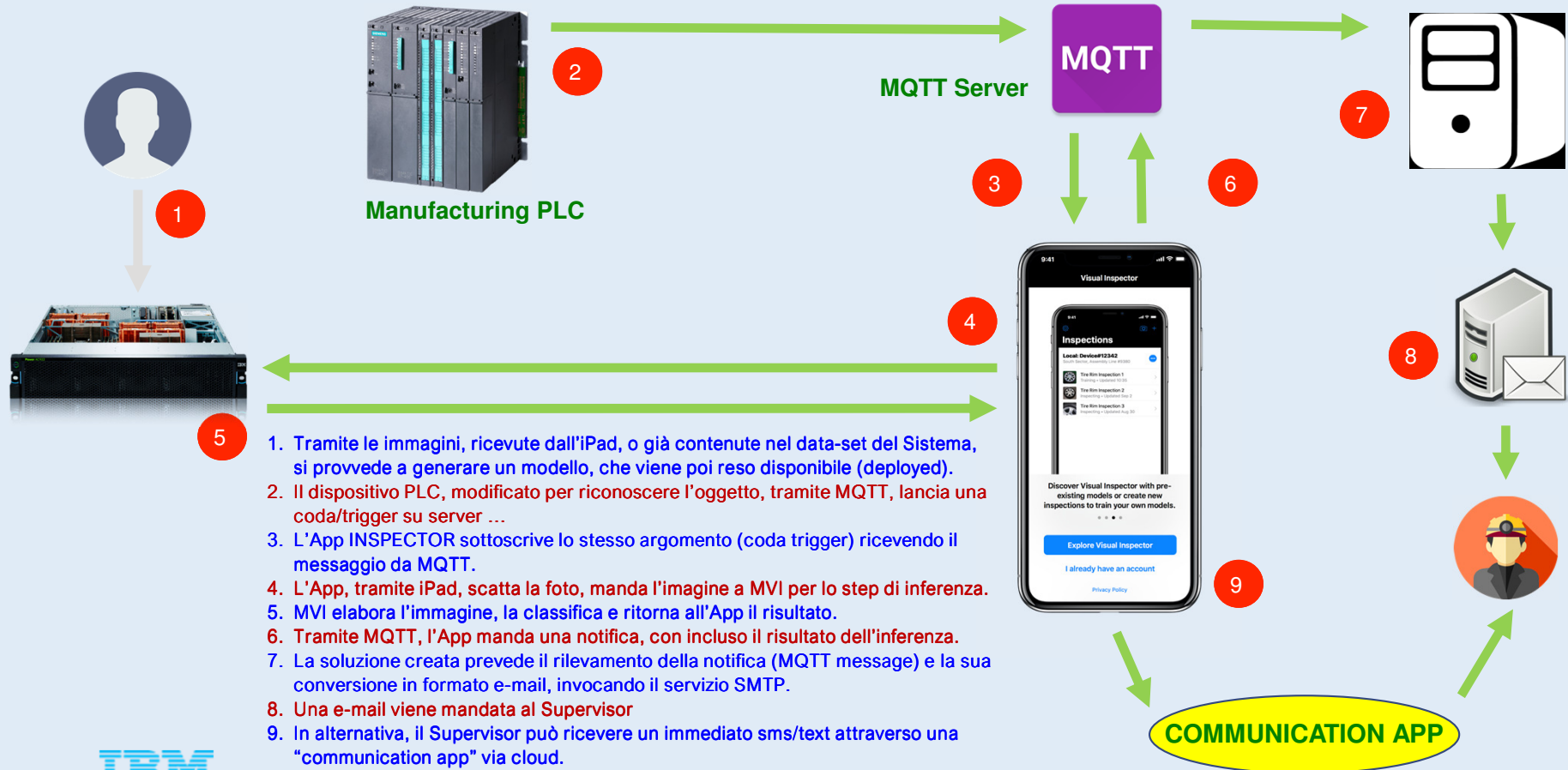
NAME	FRAMEWORK	DESCRIPTION	GENERAL TASK	UPLOADED AT	STATUS
☐ CICModel	Tensorflow	Custom model for Image classification	Image classification	11/1/2018, 5:06:58 PM	Uploaded
☐ FRCNN_CDD	Tensorflow	Custom model for Object Detection	Object detection	11/1/2018, 5:06:16 PM	Trained

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MVI MOBILE INSPECTOR : interfaccia mobile per la gestione del modello CoreML su iOS devices (iPhones e iPads)





1. Tramite le immagini, ricevute dall'iPad, o già contenute nel data-set del Sistema, si provvede a generare un modello, che viene poi reso disponibile (deployed).
2. Il dispositivo PLC, modificato per riconoscere l'oggetto, tramite MQTT, lancia una coda/trigger su server ...
3. L'App INSPECTOR sottoscrive lo stesso argomento (coda trigger) ricevendo il messaggio da MQTT.
4. L'App, tramite iPad, scatta la foto, manda l'immagine a MVI per lo step di inferenza.
5. MVI elabora l'immagine, la classifica e ritorna all'App il risultato.
6. Tramite MQTT, l'App manda una notifica, con incluso il risultato dell'inferenza.
7. La soluzione creata prevede il rilevamento della notifica (MQTT message) e la sua conversione in formato e-mail, invocando il servizio SMTP.
8. Una e-mail viene mandata al Supervisor
9. In alternativa, il Supervisor può ricevere un immediato sms/text attraverso una "communication app" via cloud.

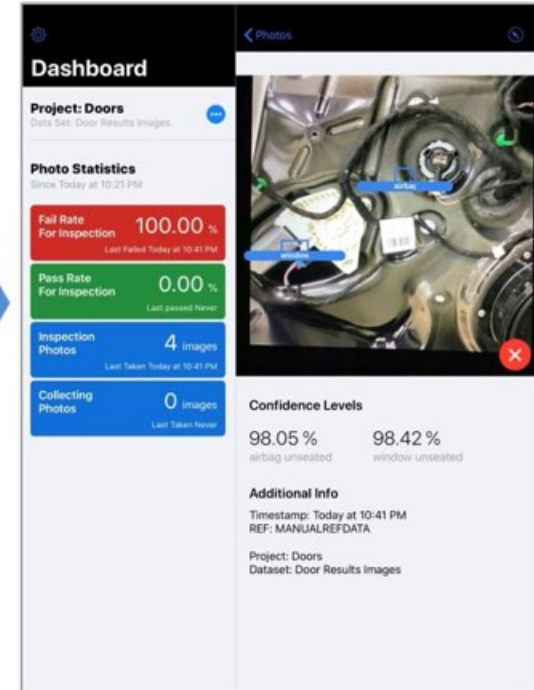
Door Inspection Station



iOS App: Inspection



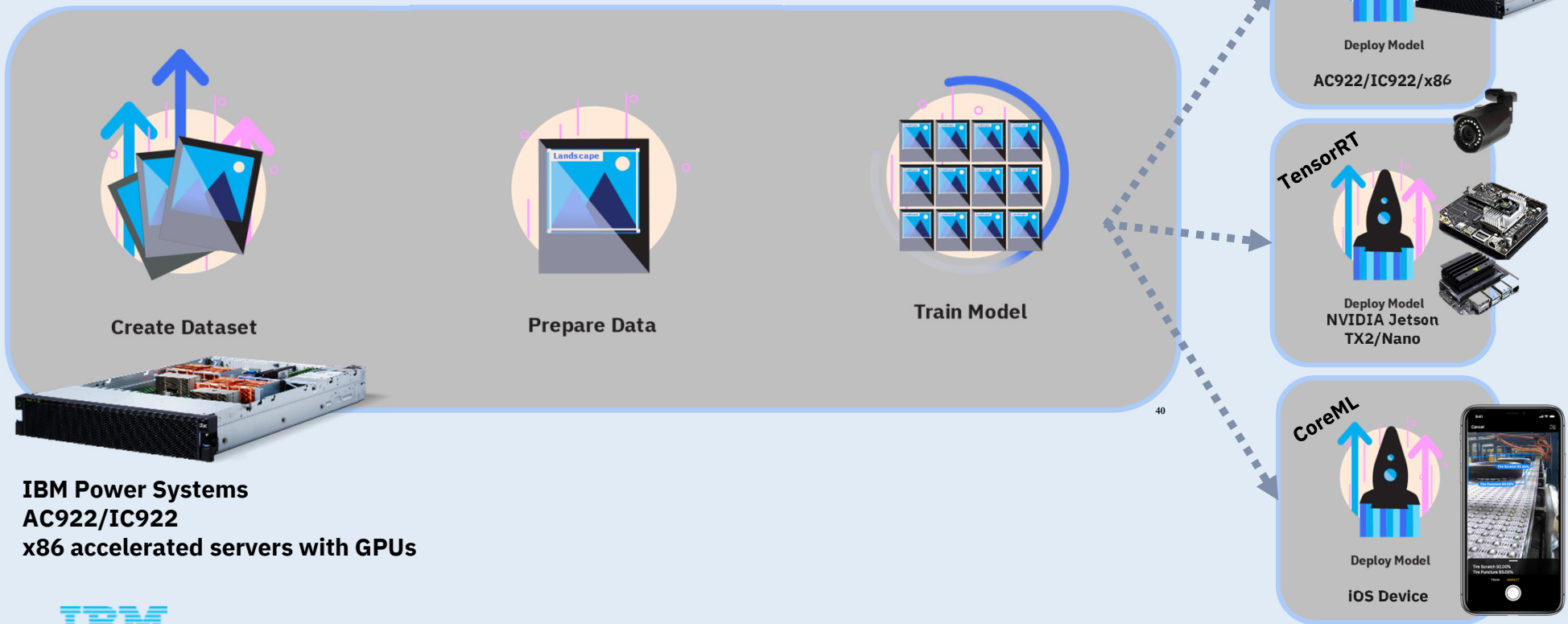
iOS App: Dashboard



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Flessibilità nel generare ed utilizzare un modello su edge devices



- **IBM Power Systems**
AC922/IC922
- **x86 accelerated servers with GPUs**

GRAZIE

